

EU-SPRI CONFERENCE LUND 2016

Book of abstracts

2016-06-03



Proceedings Content

Parallel session 1	1
1A. TRACK THEME 1: CONCEPTUALIZING SOCIAL INNOVATION THROUGH 'CLASSICAL' INNOVATION STUDIES AND APPROACHES (I)	1
Social Innovation and the Role of the State: Case Study of Norway and Latvia	1
'Classical' innovation studies and their relevance for analysing social innovation	3
Towards a theoretically sound concept of social innovation as part of a comprehensive innovation theory – Results of the first global mapping of social innovation initiatives.....	6
Bridging the gap between innovation studies and social innovation research: Conceptualising social innovations as service innovations with a social purpose	9
1B. PERFORMANCE OF INNOVATION SYSTEMS	11
Using Data Envelopment Analysis to assess the performance of national innovation systems in Europe	11
Innovation Output in Sweden and Finland, 1970-2013. Evidence from economic history	14
Science, the State and the City: Britain's struggle to imitate US success in Biotechnology and its lessons on the limits of innovation systems building	17
Policy and practice in performance-based research funding systems	19
1C. THE ROLE OF UNIVERSITIES.....	22
Why do firms, universities and knowledge institutes collaborate in multidisciplinary research programs? A mixed methods approach to evaluation.	22
Academic-policymaker engagement in the science and technology policy process: Capability and motivation factors.....	24
Different recipes for the same dish: comparing policies for scientific excellence across different countries	27
Long-term impact of R&I funders on Swedish HEIs collaboration with external actors.....	29
1D. TRACK THEME 2: INNOVATION PARADIGMS IN THE BIOECONOMY (I)	32
Sustainable Bioenergy Development: implications for innovation policy	32
Policy supported innovation network formation in the bioeconomy – the case of biorefinery technology innovation in Sweden.....	35
CAPABILITIES TOWARDS BIOECONOMY: ANALYSING REGIONAL CAPABILITIES AND THE ROLE OF REGIONAL INNOVATION POLICY IN THE THREE FINNISH CASE-REGIONS.....	38
THE BUSINESS OF BIOECONOMY: PATENT RACES IN LIGNOCELLULOSIC BIOFUELS.....	41
1E. TECHNOLOGY AND R&D.....	44
Does rivalry in R&D foster harmful innovations ?.....	44
The variety of related variety studies: technological relatedness in analysis of inter-firm R&D cooperative projects	47
The embedding of emerging technology fields in research and markets.....	50
1F. TRACK THEME 3: CAN WE STILL LEARN FROM EVALUATIONS? EXPLORING NEW AVENUES IN THE EVALUATION OF STI POLICIES (I)	53
Taking the Road Less Travelled: Evaluating and Monitoring the Socio-Economic Impact of Investment in Research Infrastructures.....	53
Towards a Typology of Innovation System Evaluation Practices - Evidence from EU Member States.....	55
Towards a novel method of research evaluation: tracking proximity change in translational research projects.....	58
Do vouchers make a difference? A study of vouchers for improving organizational capabilities in firms	61

Parallel session 2	63
2A. TRACK THEME 1: CONCEPTUALIZING SOCIAL INNOVATION THROUGH 'CLASSICAL' INNOVATION STUDIES AND APPROACHES (II)	63
Modelling Actors' Roles and Interactions in Social Innovation Processes.....	63
The role of societal engagement in social innovation.	66
Taking a Multi-Level Perspective on Social Innovations - from Grass Root Movement to Transformation"	69
Cooperating in Policy and Theory for Social Innovation: Linking Cooperative Enterprises, Social Innovation and Social Entrepreneurship.....	71
2B. ENERGY, INNOVATION AND ENVIRONMENT	74
Cross-pollination in bioenergy: Innovation networks between the bioenergy and biotechnology in Denmark.....	74
The Need for Governance by Experimentation: the Case of Biofuels	77
The characteristics and dynamics of the Danish energy innovation system in perspective: a patent-based analysis	80
The Entrepreneurial Chinese State. Innovation in China's wind turbine industry.....	82
2C. INNOVATION SYSTEMS AND SUSTAINABILITY TRANSITIONS (I)	83
Policy Approaches to Facilitating Innovation for Sustainability: A Comparative Analysis of Smart Cities in Japan and the United States.....	83
Structuring signals of transition towards the platform economy: combining horizon scanning and the multi-level perspective	87
Perceptions of problems and solutions in innovation systems: The influence of institutional logics in the empirical domain of renovating houses energy-efficiently	90
Cluster strategies for the North Sea the offshore wind service sector. A sectoral innovation system foresight.....	93
2D. TRACK TEAM 2: INNOVATION PARADIGMS IN THE BIOECONOMY (II)	96
Value chain structures that define second generation bio-refineries in Europ�.....	96
Governance in transitions: directionality and heterogeneity towards a bioeconomy	98
Absorptive Capacity and Industrial Symbiosis – Experiences from the Danish Green Industrial Symbiosis SME Program 2013-2015	101
Natural resource diversity and Knowledge idiosyncrasies. Implications for resource intensive development paths and sustainability transitions.....	104
2E. REGIONAL INNOVATION SYSTEMS AND INNOVATION POLICY	106
Innovation Policies for a Creative Economy: Challenging the dominance of STI and "Research".....	106
Formal and informal institutions as drivers of regional economic diversification	108
Towards a Dynamic Perspective on Leadership in Regional Innovation Systems	109
Cross-Industry Innovation Capability for Path Renewal	112
2F. TRACK THEME 3: CAN WE STILL LEARN FROM EVALUATIONS? EXPLORING NEW AVENUES IN THE EVALUATION OF STI POLICIES (II)	114
Evaluating large R&D&I support programmes using a systemic innovation perspective. The case of the EU Framework Programmes.....	114
What Bangs for your Bucks? Assessing the design and impact of transformative policy.....	117
Impact assessment and grand challenges.....	120
Towards an indicator framework and monitoring system for the evaluation of next-generation structural-oriented RTI programmes	122

Parallel session 3	125
3A. INTERNATIONALIZATION AND INNOVATION	125
The application of the “universal” excellence in “peripheral” countries	125
Bounded Collaboration and Changing Core-Periphery Relationship in Sino-Russian Scientific Co-Production.....	127
Internationalization support as the integrating axis of innovation policy – perspectives from European National Innovation Systems, Silicon Valley and technology startups.....	129
Globalising innovation systems: Southeast Asian pathways	131
3B. INNOVATION, ENTREPRENEURSHIP AND ECONOMIC GROWTH	134
A critical review of entrepreneurial ecosystems: towards a future research agenda	134
Why enhancing resources and capabilities of newly-established firms can lead to superior innovative performance? Implications for innovation and entrepreneurship policy.....	136
Entrepreneurial experimentation: A key function in Entrepreneurial Systems of Innovation	138
Innovation and firm growth: investigating the multilevel drivers and resulting implications for policy	141
3C. INNOVATION SYSTEMS AND SUSTAINABILITY TRANSITIONS (II)	144
How Policies Affect the Economics of Distributed Energy Storage: A Case Study in California ..	144
Innovation policy and network evolution: the case of the Dutch energy system	147
Competing actor interests and conflicts in sustainability transitions: Case of wind and solar PV energy in India.....	150
Regional innovation systems and transformative change: The case of the chemicals industry in West Sweden	152
3D. INNOVATION AND MEDICAL APPLICATION (I)	154
Divergent trajectories of sectoral evolution: The case of Traditional Chinese Medicine in China (1949-2015).....	154
Frugality and outreach: innovation in the Indian diagnostic devices market - The case of 3nethra	156
The future of Swedish IVD	159
3E. PUBLIC PROCUREMENT FOR INNOVATION (I)	162
Mandatory Procurement for Innovation & Inclusive Growth: Critical Appraisal of India’s Policy for Development of Small & Medium Enterprises (SME)	162
Early supplier involvement and public procurement for innovation: evidence from Finland.....	164
Opening the black box of innovation adoption in the public sector: Understanding institutional factors as a basis for intelligent organisational management and policy making	166
Heterogeneity of demand on innovation policy instruments: assessment and implications	169
3F. TRACK THEME 8: ADVANCING URBAN LIVING LABS	171
Experimentation and Institutionalization: The case of Urban Living Labs.....	171
A comparative analysis of the urban labs in Maastricht and Antwerp.....	173
Articulating roles of experiments and infrastructuring as long-term systemic learning in Urban Living Labs	175
From an archipelago of urban living labs to integrated urban sustainability transformations? .	178
Identifying Urban Living Labs opportunities in urban initiatives taken in Delhi, India	181
Parallel session 4	182
4A. TRACK THEME 4: NEW AVENUES FOR REGIONAL INNOVATION POLICIES (I)	182
Policies for regional economic change: combining actor-based and system-based strategies...	182
Smart Scientific Specialisation	183
Regional responses and RIS-building strategies.....	185

What's the policy logic all about? Contrasting institutional logics in innovation policy in Norway & Finland	188
4B. SMART SPECIALIZATION	191
Regional Characteristics and Smart Specialization Strategies: Comparative Analysis of European Regions.....	191
Energy in smart specialization strategies: an exploratory study	194
How outward looking is smart specialisation? Mechanisms, drivers and barriers to interregional collaboration in research and innovation policy.....	197
Current status and future prospects of evidence-based research & innovation policy: the case of smart specialisation	200
4C. TRACK THEME 9: FOSTERING INNOVATION AND INDUSTRIAL DEVELOPMENT IN GLOBALIZED INNOVATION SYSTEMS: POLICY CHALLENGES IN A MULTIPOLAR WORLD ECONOMY (I)	203
Capturing local value creation in the MENA region by integration into global solar value chains	203
Vertical and horizontal dimensions of upgrading in global value chains: insights from the establishment of local manufacturing of wind turbine components in South Africa.....	205
Strategic Innovation Policy-Notes from a System-Evolutionary Perspective	208
4D. TRACK THEME 5: INCLUSIVE INNOVATION POLICIES: RESEARCH AND POLICY INSIGHTS FROM THE GLOBAL NORTH AND SOUTH (I)	211
Democratizing innovation – stimulating consumer innovation in Sweden	211
Innovation and productivity in a S&T intensive sector: the case of Information industries in Spain	213
Inclusiveness in innovation – what does it take to make it happen?	214
European Integration and the attraction of skilled individuals to Sweden	216
4E. POLICY MIX FOR INNOVATION	217
Improving the innovation policy mix for SMEs in traditional industries.....	217
Characterizing the policy mix and its impact on eco-innovation in energy-efficient technologies	220
Addressing the challenges of innovation governance – what role for research and innovation policy councils?	222
Towards a Taxonomy of Science and Innovation Policy Instruments.....	225
Parallel Sessions 5.....	228
5A. TRACK THEME 4: NEW AVENUES FOR REGIONAL INNOVATION POLICIES (II)	228
Regional cooperation: evidence from European cooperative innovation networks.....	228
Location of Knowledge-Intensive Entrepreneurship in Developing Countries: The Case of the State of São Paulo, Brazil	230
Policy models and rationales of science, technology and innovation in Central America: an alternative look to the integration process.....	233
Unrelated knowledge and related diversification - knowledge base combinations and path development in a DUI based, globalised region	236
5B. THEORETICAL PERSPECTIVES ON INNOVATION POLICY	238
Separate innovation policy and research policy - to abandon linearity!	238
An innovation system framework for system innovation policy: the case of Strategic Innovation Programs (SIPs) in Sweden.....	240
Innovation policy at stake: Should we throw the baby with the bath waters or change the composition of the bath waters.....	242

New and Old Avenues for European Research, Technology and Innovation Policies: changing rationales for European RTDI	244
5C. TRACK THEME 9: FOSTERING INNOVATION AND INDUSTRIAL DEVELOPMENT IN GLOBALIZED INNOVATION SYSTEMS: POLICY CHALLENGES IN A MULTIPOLAR WORLD ECONOMY (II)	247
Niche development and upgrading in the PV value chain: The case of local assembly of PV panels in Senegal	247
A Policy Review on Instruments Fostering the Diffusion of Electric Vehicles in China.....	249
Global Innovation Systems – a conceptual framework for technological innovation in transnational contexts	252
Global development trajectories in the wind and solar photovoltaics sector: how technology-related differences shape the dynamics of international knowledge transfer	254
5D. TRACK THEME 5: INCLUSIVE INNOVATION POLICIES: RESEARCH AND POLICY INSIGHTS FROM THE GLOBAL NORTH AND SOUTH (II)	256
Distinguishing patterns of learning and inclusion through patterns of network formation in developing agricultural clusters	256
Inclusive innovation in sociotechnical systems: The cases of Russia and India.....	258
Global open innovation platforms facilitating inclusive innovation policy.....	260
5E. TRACK THEME 7: DESIGNING TRANSFORMATIVE CHANGE: ATTEMPTS TO BRIDGE MISSION-ORIENTED R&I AND THE DYNAMICS OF SOCIO-TECHNICAL CHANGE (I).....	263
Institutionalisation of markets for innovative health technologies: The case of personalised cancer medicine in the Netherlands.....	263
An analysis of the manufacture of futures for sustainable agro-food systems: competing visions of the agroecological transition	266
How governments should deal with incumbents when governing societal transition processes	268
Researching urban sustainability transitions in the city of Genk (Belgium): Investigating the nuclei for transformative change and the potential for acceleration	270
Parallel Sessions 6.....	273
6A. EVALUATIONS OF INNOVATION AND RESEARCH POLICY.....	273
Concentration on the Few? R&D and Innovation Participation in German Firms between 2001 and 2013	273
Assessing the impact of research in Social Science and Humanities: A Comparative Perspective on National Evaluation Systems in France and Germany	276
Innovation Assessment: Making Sense of Collingridge Dilemmas	279
6B. INNOVATION AND MEDICAL APPLICATION (II)	282
Diversity creation and selection mechanisms in health innovation: the role of public policies..	282
Constructing regulatory niches for medicines that address unmet needs.....	285
A lesson in Lost Innovation: Australia's quest for the bionic eye	287
6C. TRACK THEME 9: FOSTERING INNOVATION AND INDUSTRIAL DEVELOPMENT IN GLOBALIZED INNOVATION SYSTEMS: POLICY CHALLENGES IN A MULTIPOLAR WORLD ECONOMY (III)	289
The role of the home market in international technological innovation systems	289
Policy proposal for clean energy technology transfer: Classification of technologies and identification of transfer channels.....	292
Tailoring innovation policies to technology-specific learning patterns: An analysis of the locus of learning and knowledge feedbacks in three clean energy technology innovation systems	294
The Transatlantic Trade and Investment Partnership – A risk for the dynamic efficiency at both sides of the Atlantic?.....	297

6D. TRACK THEME 6: (RE)SEARCHING THE CRITICAL 'MESO' LEVEL: LEARNING INNOVATION AGENCIES AND ENTREPRENEURIAL ECOSYSTEMS.....	299
Towards next generation RDI programs – policy-makers insights from the past and reflections for the future	299
The policy relevance of measuring diversity of Entrepreneurial Ecosystems	300
Matching public and private funds to foster innovation: the case of EMBRAPPII in Brazil.....	303
From Cluster to Co-creation of Innovation and Entrepreneurial Competences- Learning innovation agencies and entrepreneurial ecosystems as observed in the Optoelectronics industry in Wales and Scotland in the UK	306
6E. TRACK THEME 7: DESIGNING TRANSFORMATIVE CHANGE: ATTEMPTS TO BRIDGE MISSION-ORIENTED R&I AND THE DYNAMICS OF SOCIO-TECHNICAL CHANGE (II).....	309
Demand-sided financial incentives for innovations – concept and challenges based on the example of the German feed-in tariffs for renewable energy.....	309
Revisiting the Role of University in Developing Countries: Transforming Power Relations towards an Interdisciplinary Institute	311
Moving beyond the innovation focus: from innovation system and multi-level perspective towards an integrated concept of transformative socio-technical change.....	314
From national challenges to emerging new innovation systems: role of Institutional entrepreneurs beyond formal policies; Case of Biopharmaceutical sector in Iran	316
Parallel Sessions 8.....	319
8A. POLICY FOR SUSTAINABILITY	319
Aiming high and failing spectacularly - Lessons from a recent crisis in regenerative medicine ..	319
Lock-in of mature Technological Innovation Systems, The transformation towards clean concrete in the Netherlands	321
Innovation policy in the age of transitions	323
8B. CREATIVITY, KNOWLEDGE AND INNOVATION	325
Skills Diversity and Firm Growth: The Complementary Role of Arts and Science Skills	325
Creativity, innovation and research in the Norwegian economy	328
Governance of knowledge base complexity: Implications for innovation policy in resource based countries	330
8C. KNOWLEDGE TRANSFER AND INNOVATION	333
INTERGENERATIONAL TRANSFER OF SCIENTIFIC KNOWLEDGE AND SUSTAINABLE DEVELOPMENT OF SCIENCE.....	333
Combining Centers of Excellence programs with the attraction of foreign research organizations: challenges and policy options in Complex International Science, Technology and Innovation Partnerships	335
Innovation intermediaries: building bridges for global health (subtitle: Exploring the role of innovation intermediaries as institutional entrepreneurs in Product Development Partnerships for poverty-related diseases)	338
8D. INNOVATION AND STRUCTURAL CHANGE.....	341
Small Firms' Access to Venture Capital: Innovation Policy and its Limits	341
Innovation, structural change and employment: a long run perspective and some policy implications.....	342
EU corporate R&D intensity gap: What has changed over the last decade?.....	344
8E. GOVERNANCE OF DISCONTINUATION	347
Exploring nuclear trajectories in Germany and the UK: understanding (dis)continuities and incumbency in socio-technical systems	347

How obsolescent innovation must give way: The Governance of the Discontinuation of Incandescent Light Bulbs in the EU	350
Multiple stories of DDT: an international comparison of a notorious villain's ban	351
Parallel Sessions 9.....	352
9A. ALTERNATIVE APPROACHES TO EXPERIMENTATION AND SUSTAINABILITY	352
Between seedbeds and battlegrounds: emerging governance arrangements in Bristol's path to a low carbon future.....	352
The Experimental City: new modes and prospects of urban transformation.....	355
The Sharing Economy: A Case of "Reverse" Technology Assessment	356
9B. SOCIAL INNOVATION.....	358
Challenges to Research and Innovation Policy for Social Problem Solving and their Policy	
Implications: The Case of South Korea	358
New avenues for inclusive innovation in EU's social innovation policies?	360
Exploring Social Innovation Policy – Empirical Evidence and Pending Questions	363
9C. RESEARCH AND INNOVATION	366
Serendipity in research and innovation: Towards a taxonomy and a theory	366
TRANSFORMATIVE FUTURES OF RESEARCH AND INNOVATION. A META-ANALYSIS OF TWO SCENARIO-BUILDING EXERCISE	369
Navigating towards responsible research and innovation: facilitating strategic reflection	372
9D. PUBLIC PROCUREMENT FOR INNOVATION (II).....	375
Can public procurement aid the implementation of regional innovation strategies?	375
Trading Scale and Complexity: The Innovation Potential of Different Modes of Collaborative Public Procurement.....	377
Public procurement for innovation: lessons from the procurement of a navigable storm surge barrier	380
9E. INSTITUTIONAL LOGICS AND UNIVERSITIES	383
Governing university employment: institutional logics and regional heterogeneity	383
Scientific diaspora: Challenges and opportunities for public policy	386
Converging institutional logics and blurring boundaries: how national policies influence roles and relationships between research institutes and universities	389

Parallel session 1

1A. TRACK THEME 1: CONCEPTUALIZING SOCIAL INNOVATION THROUGH 'CLASSICAL' INNOVATION STUDIES AND APPROACHES (I)

Social Innovation and the Role of the State: Case Study of Norway and Latvia

Anete Vitola
(University of Latvia)
anete_vitola@yahoo.com

KEYWORDS: Social innovation, Case study, Innovation studies

1. Relevance

Social innovation is gaining ever-increasing attention from society in general and media (The Economist, 2010), policy makers and researchers and is also an emerging theme in innovation studies (Benneworth et al, 2015). It can be important tool to address pressing problems faced by modern society (Pol and Ville, 2009) and defined by policy makers, for example, in the discourse of societal challenges led by the European Commission. Examples of social innovation range from addressing various inequality problems to access to services, aging society problems, youth unemployment and environmental issues to mention just few. Despite the popularity of the term, the academic community is not coherent in understanding and defining the concept and it is claimed to be ambiguous (Grimm et al, 2013). Policy development for social innovation can also be debated from several perspectives. To better understand the processes of social innovation and respective policy development it is relevant to analyze these processes empirically, which is what this paper does.

2. Research aims and questions

This research aims to characterize the role of state in particular social innovation cases to prepare a ground for further research and generalizations. The research question is: what role has the government institutions played in development and sustaining of social innovation cases in Norway and Latvia?

3. Definitions

A working definition of social innovation in this paper is based on definitions from Mulgan (2006) who defines social innovation as: “innovative activities and services that are motivated by the goal of meeting a social need” and the definition from OECD (2010): “social innovation implies conceptual, process or product change, organizational change and changes in financing, and can deal with new relationships with stakeholders and territories”. The definition of Mulgan emphasizes the addressing of a social need which is considered to be important when social innovations are considered and the definition of OECD provides a broad perspective on what forms social innovation can take (conceptual, process, product, organizational, financing) which is important for broad perception of the phenomena. Cases selected for analysis are based on these definitions and parameters.

Amanatidou (2015) has explored the concept of social innovation as: “a coherent innovation concept analyzing it through the lenses of a classic innovation studies”. Among others, innovation studies focus also on the role government institutions play in the innovation system, therefore it’s important to investigate this role also in the context of social innovations to improve understanding on what kind of policies and instruments are suited for social innovations.

The academic literatures about social innovation discusses whether the role of the state in promoting social innovation ends with providing a friendly environment for these innovations to happen or should the role of the state be more proactive and include stimulating mechanisms and funding. The concept of market failure is also used in the context of social innovation to justify action from government (Pol and Ville, 2009). World Economic Forum has listed six action lines that governments can pursue to support social innovation: support for social innovation networks, increasing the government capacity to support social innovation, development of necessary infrastructure, support for the growth of social entrepreneurs, supplementing of private capital and policy evaluation in the field of social innovation (World Economic Forum, 2013).

4. Description of the methodologies

Some (Grimm et al, 2013) have argued that the state has a role in encouraging and up-scaling social innovation. This paper will empirically explore whether this role has been activated in practice and what are the perspectives of social innovators themselves towards the role of the state. To research these issues, the study applies exploratory case study methodology. The choice of the research method is determined by limited empirical previous research on the role of the state in social innovation that prohibits from testing specific hypothesis at this stage of research on social innovation. Rather exploratory studies are necessary to better understand the phenomenon of social innovation.

Literature review performed in the scope of the study examined how the role of state is portrayed regarding social innovations. Empirically this study explores whether the overall policy environment in Norway and Latvia is friendly for social innovation to succeed and whether more proactive policy interventions would be necessary. The main categories used for the analysis of cases are:

- Interaction of respective case with government institutions (in different phases of development, support received and bottlenecks);
- Expectancies of social innovators towards the government;
- International collaboration of social innovators and the role of networks;
- Estimation of long-term impacts of analyzed social innovations.

The first part of the paper will summarize academic discussions about the role of state in promoting social innovation. Analysis of specific policy instruments will follow with examples for international practice. Third part will summarize the results of case studies of social innovations and provide conclusions on what role the state has played in these cases and whether there are any differences between the case of Norway and Latvia. Conclusions will offer brief comparison and discussion of the role government institutions play in “classical” and social innovation processes, based on the results of this research and from what is known from the field of innovation studies.

5. Empirical materials

The comparative empirical study focuses on several social innovation cases in Norway (e.g. social enterprise “Epleslang”, science teaching initiative “Forskerfabrikken”) and Latvia (e.g. environment initiative „Lielā talka“, education and innovation project „Demola Latvia“, education initiative “Iespējamā misija”). Selection of cases is based on conformity with the definition of social innovation and representation of different fields. In depth interviews with the promoters of these social innovations have been performed and the data is complemented with documentary analysis of policy planning documents in the field of social innovation. Case studies focus on the role local and national level government institutions have played in the generation, development and sustaining of the social innovation examples in Norway and Latvia. The selected countries are both democracies with market-based economies and social innovation is comparatively new topic for both countries. At the same time countries differ in terms of their economic development and social welfare system. This allows comparison of development of social innovations and respective support systems in countries in different stages of their development and social support traditions.

6. Expected outcomes

The expected outcomes include better and empirically based understanding of the role of state in development of social innovations and overall system of innovations and policy recommendations based on the results of empirical study.

References

- Amanatidou, E. 2015. Understanding social innovation: from innovation systems to innovation functions. In EU-SPRI Conference, Helsinki, 10-12 June 2015.
- Benneworth, P., Amanatidou, E., Edwards Schachter, M. & Gulbrandsen, M. 2015. Social innovation futures: beyond policy panacea and conceptual ambiguity. TIK Working Paper on Innovation Studies. Oslo: Senter for teknologi, innovasjon og kultur Universitetet i Oslo. Working Paper No. 20150127.
- Grimm, R., Fox, C., Baines, S., Albertson, K. 2013. Social innovation, an answer to contemporary societal challenges? Locating the concept in theory and practice. *Innovation: The European Journal of Social Science Research*. Vol. 26, No. 4. 436-455.
- Mulgan, G. 2006. The Process of Social Innovation. *Innovations: Technology, Governance, Globalization*, 1 (2). 145–162.
- Social Innovation Europe initiative. 2011. Financing Social Impact. Funding Social Innovation in Europe – mapping the way forward. Available here: http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=5582&lang=en&title=Financing-Social-Impact.-Funding-social-innovation-in-Europe---mapping-the-way-forward P.7.
- OECD. 2010. Social Entrepreneurship and Social Innovation. SMEs, Entrepreneurship and Innovation. OECD Publishing.
- Pol, E., and S. Ville. 2009. Social Innovation: Buzz Word or Enduring Term? *The Journal of Socio-Economics* 38 (6). Pp. 878–885.
- The Economist. 2010. Let's hear those ideas. Available here: <http://www.economist.com/node/16789766>
- World Economic Forum. 2013. Breaking the Binary: Policy Guide to Scaling Social Innovation. Available here: http://www.weforum.org/pdf/schwabfound/PolicyGuide_to_ScalingSocial%20Innovation.pdf

‘Classical’ innovation studies and their relevance for analysing social innovation

Attila Havas

(Institute of Economics, Research Centre for Economic and Regional Studies, Hungarian Academy of Sciences)
havasatt@econ.core.hu

KEYWORDS: Definitions of social and business innovation, Models of innovation, Innovation studies in mainstream and evolutionary economics, Innovation systems, STI policy rationales

1) Relevance for Track theme 1

The proposed paper is directly relevant for both aims of Track theme 1. Its underlying objective is to (a) identify those elements – notions, methods, approaches – and achievements of ‘classical’ innovation studies that can enrich the analysis of social innovation (SI), and (b) derive policy implications.

2) Research questions

The paper considers (i) if and how the various definitions of SI (Heiskala, 2007; Moulaert et al., 2013; Nicholls et al., 2015) can be made more operational and rigorous by applying some standard methods and basic definitions used in innovation analyses to clarify the unit of analysis and the degree of novelty, (ii) which of the various models of innovation can be used to inform SI analysis; (iii) what can be learnt from the analysis of (business) innovations offered by classical, neo-classical, mainstream and evolutionary economics for SI analysis. It also assesses (iv) the relevance of STI policy rationales derived from mainstream and evolutionary economics for promoting SI; and (v) identifies methodological and policy lessons from the innovation systems literature for SI.

3) Definitions and central concepts

The paper is based on a report prepared for the CrESSI project (Creating Economic Space for Social Innovation, EU FP7), and thus it departs from the definition of SI used there: “The development and delivery of new ideas (products, services, models, markets, processes) at different socio-structural levels that intentionally seek to improve human capabilities, social relations, and the processes in which these solutions are carried out.” This definition is contrasted with other ones proposed by Heiskala (2007); Moulaert et al. (2013); and Nicholls et al. (2015). As for business innovations, the Oslo Manual (OECD, 2005) is used, as well as the notions of technology systems and techno-economic paradigms (Freeman and Perez, 1998).

Four models of innovations are considered from the point of view of their relevance to analyse the actors involved and processes used in SI processes: the science-push, the market pull, the chain-linked, and the multi-channel interactive learning models of innovation (Bush, 1945; Balconi et al., 2010; Di Stefano et al., 2012; Kline and Rosenberg, 1986; Caraça et al., 2009).

Economics paradigms – neo-classical, mainstream, and evolutionary –, as well as the STI policy rationales derived from the latter two, namely market and systemic failures (Bach and Matt, 2005; Edquist, 2011; Foray (ed.), 2009; Smith, 2000) are the central concepts in section 3 of the proposed paper.

Section 4 considers the relevance of regional, sectoral, national, and technological innovations systems (actors, structures, interactions, institutions, functions, and their policy implications) for SI analysis. (Asheim and Isaksen, 2002; Bergek et al., 2010; Carlsson, 1994; Carlsson (ed.), 1995, 1997; Carlsson et al., 2002; Cooke, 1992, 2001; Edquist, 2005, 2011; Edquist (ed.) 1997; Freeman, 1987, 1995, 2002; Hekkert et al., 2007; Lundvall, 2004, 2007a, 2007b; Lundvall (ed.), 1992; Lundvall et al., 2002; Malerba, 2002; Nelson (ed.), 1993)

4) Theoretical framework

The paper draws on evolutionary economics of innovation, in particular its systems approach. (Dosi et al. (eds), 1988; Edquist (ed.), 1997; Fagerberg et al. (eds), 2005, 2013; Freeman, 1991, 1994; Hall and Rosenberg (eds), 2010; Martin, 2012; Metcalfe, 1998, 2010; Nelson, 1995; Pavitt, 1999; Smith, 2000)

5) Empirical material

The paper juxtaposes various notions, analytical tools and models, and thus it is not using any empirical material directly.

6) Methods applied

Five major strands/ components of the economics of innovation literature have been reviewed from the angle of their relevance for analysing SI: (i) the basic definitions used in ‘classical’ innovation analyses, (ii) various models of innovation; (iii) three economics paradigms; (iv) the policy rationales derived from the latter two paradigms; and (v) the innovation systems literature.

7) Outcomes: scientific advances and policy implications

The definition, and thus the analysis, of social innovation can be improved by adapting the achievements of the literature on business innovation. It is crucial to identify the subject (or level) of change, as well as the degree of novelty. In real-life cases, though, the borders are often blurred between incremental and radical change, e.g. the 'bottom-of-pyramid' markets seem to 'sit' on the border. Compared to technological innovations, it is likely to be even more difficult to establish the degree of novelty of a given social innovation: is it new to a certain community (at a local/ neighbourhood level), to a country or to the world? Actually, the degree of novelty seems to be of lesser importance in these cases: usually intellectual property rights are not an issue for social innovators.

In certain cases it might be relevant to identify whether a given social innovation is an 'isolated' new solution or – using the analogy of technology systems – a part of a new 'social system', that is, a set of interconnected social innovations, affecting several groups of people or an entire community at the same time, occasionally leading to the emergence of new social structures, institutions, behaviour, value systems and practices at a higher level of aggregation.

A major feature of the notion of techno-economic paradigms could guide SI analyses, namely the interconnectedness of technological, organisational and business model innovations, together with the emergence of a new, widely accepted 'common sense'. It could be a useful starting point to refine the notion of disruptive social innovations, introduced by Nicholls et al. (2015).

'Destructive creation', on the one hand, and the 'dark side' of social innovation, on the other, (unintended or unavoidable negative consequences of efforts to improve the situation of a certain group on the life of other groups) strongly indicate that – contrary to widely held 'unconscious' views – both business and social innovations could bring unfavourable changes, too.

Social innovations mobilise many different types of actors, who generate and exploit a wide variety of knowledge, and thus the multi-channel interactive learning model of innovation seems to be the most relevant to analyse SI.

The innovation models considered in the paper share a major feature: the market selects among business innovation attempts. As for social innovations, the selection process seems to be much more complex, with more actors playing a role, and thus bringing their own assessment (values) into play: the social innovators; the beneficiaries; the policy-makers; the politicians; other potential sponsors; and to some extent the media and other opinion-leaders.

Evolutionary economics is concerned with several key notions that could be relevant when analysing SI: the importance of dynamics; uncertainty; differences among contexts; learning; various types, forms and sources of knowledge; path dependence; processes of generating variety; selection among diverse solutions; networking and co-operation among actors; co-evolution of various types of changes.

Social innovations draw on different types (scientific and practical) and forms (codified and tacit) of knowledge, stemming from various sources (organised and systematic R&D activities, other types of search processes, e.g. those 'informed' by practitioners). Diversity is, therefore, a key notion from this angle, too. Analysts and decision-makers should be aware of the diversity of social innovations, in terms of their nature, drivers, objectives, actors, and process characteristics.

The market failure argument implies that a strong intellectual property rights (IPR) regime needs to be introduced. This policy approach is unlikely to be the most germane one to promote SI. Further, gaining the recognition of being a creative social innovator is likely to be a stronger driver than protecting IPR. Overall, policies should rather promote the dissemination and exploitation of knowledge to foster SI than constrain these processes.

The systemic failure concept can be extended to social innovation without any theoretical constraint. Yet, it is a demanding task to establish what elements of an innovation system are missing or fledgling, what institutions ('rules of the game') hamper social innovations, and thus what policy actions would be appropriate to induce the necessary changes.

The systems approach to innovation could provide useful guidance to organise and focus the analysis of social innovations, too, explain what and how has happened and offer a sound basis for drawing policy proposals, as well as recommendations for social innovators. The various levels of the systems approach – national, sectoral, technological, and regional – seem to be highly relevant for social innovators too. The functions of innovation systems (Bergek et al., 2005, 2008, 2010; Edquist, 2005, 2011) can be reinterpreted for analysing social innovations.

The notions of orgware and socware (Lundvall) – referring to how people relate to each other inside a given organisation and across organisational borders – could be useful when analysing SI involving innovators from both public bodies and NGOs, as well as when considering the relations between social innovators and those

who are affected by a given SI. In these cases it is certainly an important feature how people interact inside a given organisation, as well as when they work for different organisations and thus need to cross organisational borders to interact when designing and implementing a social innovation.

Distinguishing between two types of dynamics, that is, continuous adaptation of a given system vs. transition from a certain type of system to a different one, could lead to important results when analysing SI.

References (selected)

- Asheim, B., A. Isaksen, 2002, Regional Innovation Systems: The Integration of Local ‘Sticky’ and Global ‘Ubiquitous’ Knowledge, *Journal of Technology Transfer*, 27 (1), 77–86
- Benneworth, P., E. Amanatidou, M. Edwards Schachter, M. Gulbrandsen, 2015, Social innovation futures: beyond policy panacea and conceptual ambiguity, *TIK Working Papers on Innovation Studies*, No. 20150127
- Bergek, A., S. Jacobsson, M. Hekkert, K. Smith, 2010, Functionality of Innovation Systems as a Rationale for and Guide to Innovation Policy, in: Smits et al. (eds), pp. 115–144
- Caraça, J., B.-Å. Lundvall, S. Mendonça, 2009, The changing role of science in the innovation process: From Queen to Cinderella?, *Technological Forecasting and Social Change*, 76 (6), 861–867
- Carlsson, B., S. Jacobsson, M. Holmén, A. Rickne, 2002, Innovation systems: analytical and methodological issues, *Research Policy*, 31 (2), 233–245
- Cooke, P., 2001, Regional Innovation Systems, Clusters, and the Knowledge Economy, *Industrial and Corporate Change*, 10 (4), 945–974
- Dosi, G., C. Freeman, R.R. Nelson, G. Silverberg, L. Soete (eds), 1988, *Technical Change and Economic Theory*, London: Pinter
- Edquist, C., 2005, Systems of innovation – Perspectives and challenges, in: Fagerberg et al. (eds), pp. 181–208
- Edquist, C., 2011, Design of innovation policy through diagnostic analysis: identification of systemic problems or (failures), *Industrial and Corporate Change*, 20 (6), 1725–1753
- Edquist, C. (ed.), 1997, *Systems of Innovations: Technologies, institutions and organizations*, London: Pinter
- Fagerberg, J., D.C. Mowery, R.R. Nelson (eds), 2005, *The Oxford Handbook of Innovation*, Oxford: Oxford University Press
- Freeman, C., 1987, *Technology Policy and Economic Performance: Lessons from Japan*, London: Pinter
- Freeman, C., 1995, The “National System of Innovation” in historical perspective, *Cambridge Journal of Economics*, 19 (1), 5–24
- Heiskala, R., 2007, Social innovations: structural and power perspectives, in: T.J. Hämäläinen, R. Heiskala (eds), *Social innovations, institutional change and economic performance*, Edward Elgar, Cheltenham, pp. 52–79
- Lundvall, B.-Å. (ed.), 1992, *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, London: Pinter
- Lundvall, B.-Å., 2007a, National Innovation Systems – Analytical Concept and Development Tool, *Industry and Innovation*, 14 (1), 95–119
- Lundvall, B.-Å., 2007b, Innovation System Research and Policy: Where it came from and where it might go, *GLOBELICS Working Paper Series*, No. 2007-01
- Malerba, F. (ed.), 2002, *Sectoral systems of innovation: Concepts, issues and analyses of six major sectors in Europe*, Cambridge: Cambridge University Press
- Moulaert, F., D. MacCallum, J. Hillier, 2013, Social innovation: intuition, precept, concept, theory and practice, in: F. Moulaert, D. MacCallum, A. Mehmood, A. Hamdouch (eds), *The International Handbook on Social Innovation: Collective Action, Social Learning and Transdisciplinary Research*, Cheltenham: Edward Elgar, pp. 13–24
- Nelson, R.R., 1995, Recent evolutionary theorizing about economic change, *Journal of Economic Literature*, 33 (1), 48–90
- Nelson, R.R. (ed.), 1993, *National Innovation Systems: A comparative study*, New York: Oxford University Press
- Nicholls, A., J. Simon, M. Gabriel, 2015, Introduction: Dimensions of Social Innovation, in: A. Nicholls, J. Simon, M. Gabriel (eds), *New frontiers in social innovation research*, Basingstoke: Palgrave Macmillan, pp. 1–26
- Smith, K., 2000, Innovation as a Systemic Phenomenon: Rethinking the Role of Policy, *Enterprise & Innovation Management Studies*, 1 (1), 73–102

Towards a theoretically sound concept of social innovation as part of a comprehensive innovation theory – Results of the first global mapping of social innovation initiatives

Jürgen Howaldt* and Dmitri Domanski
(TU Dortmund University – sfs)
*howaldt@sfs-dortmund.de

KEYWORDS: Social Innovation, Social Practices, Global Mapping, Systemic Approach, Innovation Policy

The aim of this paper is to contribute to further development of the concept of social innovation through theoretical debate and empirical research. Against the background of important achievements as well as weaknesses of innovation research, the paper advocates for a theoretically grounded concept of social innovation. It elaborates on distinct properties of social innovation and stresses the necessity of developing a concept that is suitable for empirical research. Such a concept is also a precondition for a comprehensive (social) innovation policy.

The theory of innovation has a long history dating back to the pioneering work of Schumpeter (2006) in the early 20th century. While much of the early theoretical work emphasised the socio-cultural dimensions of innovation (Kallen, 1932; and other relevant predecessors like Tarde, 1903 and Ogburn, 1966), this was gradually displaced in favour of more economic and technological perspectives. Recently, however, there has been a revival. The concept of social innovation is becoming increasingly evident in policy, scientific and public debates. There is a growing consensus among practitioners, policy makers and the research community that widespread social innovation is required to cope with the significant challenges that societies are facing now and in the future.

Yet social innovation is still an uncoded field without a common set of theoretical underpinnings, datasets, or proven causal relationships (Howaldt & Schwarz, 2010; Franz et al., 2012). What is needed is a theoretically sound concept of social innovation beyond the different policy areas, research fields and regional perspectives. Such a concept is a precondition for the development of an integrated theory of socio-technological innovation in which social innovation is more than a mere requirement, side effect and result of technological innovation. Only by taking into account the unique properties and specifics of social innovation in different contexts, it is possible to comprehend the systemic connection, interdependence and characteristics of social and technological innovation as driving forces in the overall processes of social change.

With social innovations, the new does not manifest itself in the medium of technological artefacts, but at the level of social practices. If it is accepted that the invention and diffusion of the steam engine, the computer or the smartphone should be regarded differently from the invention and social spread of a national system of healthcare provision, the concept of corporate social responsibility (CSR) or a system of micro financing, then it stands to reason that there is an intrinsic difference between technological and social innovations.

Under this perspective, a social innovation is a new combination and/or new configuration of social practices in certain areas of action or social contexts prompted by certain actors or constellations of actors in an intentional targeted manner with the goal of better satisfying or answering needs and problems than is possible on the basis of established practices. An innovation is therefore social to the extent that it, conveyed by the market or 'non/without profit', is socially accepted and diffused widely throughout society or in certain societal sub-areas, transformed depending on circumstances and ultimately institutionalised as new social practice or made routine. As with every other innovation, 'new' does not necessarily mean 'good' but in this case is 'socially desirable' in an extensive and normative sense. According to the actors' practical rationale, social attributions for social innovations are generally uncertain (Howaldt & Schwarz, 2010).

Against this background, the project SI-DRIVE: Social Innovation – Driving Force of Social Change places considerable emphasis on developing a theoretically sound concept of social innovation as a precondition for the development of an integrated theory of innovation which considers social, business, public sector and technological innovation. This is also a precondition for a comprehensive social innovation policy. Such a policy focuses on social innovations and enabling actors in addition to supporting new technologies and is only in its

infancy. It requires above all a deeper understanding of the principles and modes of action of social innovations.

The SI-DRIVE approach aims at a systemic analysis of social innovations within their broad social context, which considers cultural, religious and historical conditions as well as governance models. Hence, SI-DRIVE overcomes the shortcomings of exiting concepts which focus on collecting best cases in order to develop methodologies for developing social innovations. Our approach is built around the five key dimensions of social innovation which on the one hand affect the potential of social innovation, their scope, and their impact and on the other hand structure and guide empirical research. The five key dimensions are: concepts and understanding; addressed societal needs and challenges; actors, networks and governance; process dynamics; resources, capabilities and constraints.

While the Critical Literature Review (CLR) of SI research (Howaldt et al., 2014) provided a general depiction of how social innovation resonates within the wider frameworks of existing innovation theory and research, the concepts and perceptions of social change, and of societal and policy development the purpose of the global mapping was to check the theoretical framework against an empirical dataset. The results of the global mapping of more than 1.000 social innovation initiatives in seven policy fields reveal the importance of social innovation successfully addressing social, economic, political and environmental challenges of the 21st century on a global scale. The survey shows that all societal sectors are represented across all the policy fields. It indicates that cross-sectoral collaborations and networks are of great importance, and no particular dominance of any sector can be detected.

The need for better understanding the complexity and systemic character of social innovation can also be stressed by taking a closer look at the field of innovation studies. In this regard, the central elements of a sociologically enlightened understanding of innovation could be summarized as follows: the systematic and social character of innovation that cannot be reduced to technological and organizational innovation; aspects of complexity, risk and reflexion; incompatibility with planning and limited manageability; an increasing variety and heterogeneity of involved agents; non-linear trajectories as well as a high degree of context and interaction contingency.

While social innovation research has been strongly characterised by focusing on the third sector as the main societal sector and driver of social innovation or on the social entrepreneur as its protagonist in order to explain how social innovations emerge in societies, concepts such as innovation systems or the triple-helix are based upon different components, among them almost always a conceptual operationalisation of drivers, barriers and governance (even if these might be labelled in different terms). The concepts both recognize appropriate constellations of key actors (i.e. in particular universities, industry and government) and complex interactions among them as being important for development of technological innovations.

Thus, a systemic approach to social innovation focuses on the interfaces of the so far differentiated and largely separate self-referential societal sectors of state, business, civil society and academia, of their corresponding rationalities of action and regulation mechanisms and at the associated problems and problem-solving capacities (Howaldt et al., 2015). Collaborations between different sectors are picked up by at least two different heuristic models, the quadruple helix (Wallin, 2010) on the one hand, where government, industry, academia and civil society work together to co-create the future and drive specific structural changes, and the social innovation ecosystem (Sgaragli, 2014) on the other hand, which also asks for interactions between the helix actors, adds the notion of systemic complexity and looks at both the serendipity and absorptive capacity of a system as a whole. By focusing on the roles and functions of different societal sectors as well as relations and interactions among them, SI-DRIVE helps to better understand social innovation ecosystems and to develop policy recommendations.

SI-DRIVE's policy field reports confirm that the societal and governance systems, in which the social innovations are embedded, are complex and the problems that are addressed are deeply rooted in complex societal and structural issues. At the same time, we have to admit that many initiatives are small in scale. Therefore – as we emphasized in the CLR – to better understand this relationship between social innovation and social change we have to analyse the social embeddedness of any innovation in a dense network of innovation streams. In SI-DRIVE we have developed the concept of the practice field as a general type of different projects with one thematic area. While an initiative is single and concrete implementation of a solution to respond to

social demands, societal challenges or systemic change (e.g. Muhammed Yunus's Grameen Bank which lends micro-credits to poor farmers for improving their economic condition), a practice field expresses general characteristics common to different projects (e.g. micro-credit systems). Only by taking the broader perspective of a practice field we will be able to get deeper insights into upcoming trends and emerging areas for social innovation and their impact on social change.

References

- Franz, H.-W.; Hochgerner, J.; Howaldt, J. (Eds.) (2012). *Challenge social innovation. Potentials for business, social entrepreneurship, welfare and civil society*. Berlin, New York: Springer.
- Howaldt, J.; Butzin, A.; Domanski, D.; Kaletka, C. (Eds.) (2014). *Theoretical approaches to social innovation. A critical literature review*. Retrieved March 07, 2016, from http://www.si-drive.eu/wp-content/uploads/2014/11/D1_1-Critical-Literature-Review_final.pdf.
- Howaldt, J.; Domanski, D.; Schwarz, M. (2015). Rethinking Social Entrepreneurship: The Concept of Social Entrepreneurship under the Perspective of Socio-scientific Innovation Research. *Journal of Creativity and Business Innovation*, 1, 88–89. Retrieved March 07, 2016, from <http://www.journalcbi.com/social-entrepreneurship.html>.
- Howaldt, J.; Schwarz, M. (2010). *Social innovation: Concepts, research fields and international trends*. IMO international monitoring. Aachen: IMA/ZLW & IfU – RWTH Aachen University.
- Kallen, H. (1932). Innovation. In E. R. Seligman, & A. Saunders Johnson (Eds.): *Encyclopaedia of the Social Sciences* (pp. 58–61). New York, London: Macmillan Publishers.
- Ogburn, W. (1966). *Social Change with Respect to Culture and Original Nature*. Oxford (UK): Delta Books [1st edition 1922].
- Schumpeter, J. A. (2006). *Theorie der wirtschaftlichen Entwicklung*. Reprinted 1st ed. 1912. Berlin: Duncker & Humblot.
- Sgaragli, F. (Ed.) (2014). *Enabling Social Innovation Ecosystems for Community-led Territorial Development*. Rom: Fondazione Giacomo Brodolini.
- Tarde, G. (1903). *The Laws of Imitation*. New York: Henry Holt and Company.
- Wallin, S. (2010). The co-evolution in local development – From the triple to the quadruple helix model. Conference Paper at Triple Helix VIII, Madrid, October 2010. Retrieved March 07, 2016, from http://www.leydesdorff.net/th8/TRIPLE%20HELIX%20-%20VIII%20CONFERENCE/PROCEEDINGS/0110_Wallin_Sirkku_O-104/triple%20helix%20Wallin%20final.pdf.

Bridging the gap between innovation studies and social innovation research: Conceptualising social innovations as service innovations with a social purpose

Doris Schartinger and **Matthias Weber***

(AIT Austrian Institute of Technology)

*matthias.weber@ait.ac.at

KEYWORDS: Social Innovation, Innovation studies, Service Innovation, Social purpose of innovation

Relevance

Research on technological innovation has a long tradition in both economics and sociology (“innovation studies”). Over the years, sophisticated concepts and theories have been developed, starting with linear to interactive and systemic to complex interpretations of how innovations come about.

Recent research has demonstrated that many of the insights from innovation research have not yet been perceived and absorbed by the community of social innovation scholars (Butzin et al. 2015). This is not particularly surprising, given the practice-driven nature of much research on social innovation, which implied a relative neglect of academic rigour in defining concepts and embedding them in existing lines of scientific research.

At the same time, innovation studies have increasingly embraced the social dimension of innovation. This is particularly visible in research on innovation in services, but also in the debates about the directionality dilemma of traditional innovation perspectives, i.e. the blindness with regard to the desirability of innovations. Innovation was regarded for a long time as desirable per se, mainly for economic reasons, in spite of growing awareness of the manifold negative impacts that innovations can have.

From this angle, social innovation research provides interesting complements to innovation studies, because it explicitly addresses the dual nature of innovation, i.e. both its normative (social innovations must have a social purpose) and its analytical character (social innovation must lead to a change in social practice).

Seen from a normative viewpoint, the purpose of innovation is either to provide responses to existing and emerging challenges, or to open up novel opportunities to improve well-being in society (which in a narrow interpretation of the past translates into economic growth). In other words, it does not matter whether an innovation is social, organizational, political or technological in nature, as long as it contributes to meeting these purposes and thus serves as a driver of social change, independently of the specific nature of the innovation in questions.

Research aims and questions

Against this background, we aim at bridging the gap between the long-standing tradition of innovation studies and the more recent rise in interest in social innovation. What is needed is a comprehensive understanding of innovation with all its normative and analytical facets. Our starting point for addressing this issue is research on innovation in services, which – we argue - provides many features to bridge the gap between the communities of innovation studies and social innovation research.

Theoretical framework: Social innovation from an economic perspective

In economics, a discussion about social innovation (using exactly this label!) has first arisen in the literature on service innovation, as most social innovations are, in essence, service innovations with a social purpose. The line of argument that relates the literature on service innovation to social change is based on three argumentative steps: First, the service innovation literature develops the special properties of services and – as a consequence - of service innovations, thus providing a general analytical foundation for this discussion. Secondly, in this stream of literature, innovation scholars are mainly concerned with the challenge of grasping the differences between service innovation and social innovation as a particular form of services. And thirdly, this has implications for the discussion on social change, which is actually not part of the service innovation literature because it is not concerned with social change as such. In this regard, the literature is usually restricted to matters of the diffusion of service innovations.

Service innovations differ from innovations in manufacturing in three important regards. First of all, service innovations are immaterial in nature. Secondly, services and service innovations are not provided in clearly cut separable and countable units, but are often difficult to delimit. Thirdly, service innovation require user involvement and co-production of the service innovation.

Although social innovations are basically new services showing these three basic characteristics, and services

incorporate person-to-person interaction in development and/or delivery (note: services may also integrate the interface of technology-to-person interaction), the term social innovation is rather reserved to services that have additional qualities. The OECD LEED Forum on Social Innovation (2000) and the European Commission (2011) emphasized the connection between services and social innovation. Social innovators seek to develop new services that improve the quality of life of individuals and communities in labour market integration, social inclusion, health and wellbeing, education, and environmental challenges. In other words, social innovations are a sub-type of service innovation with a specific purpose. Still, service innovation and social innovation remain rather separate subfields (see Harrison et al., 2010; Djellal and Gallouj, 2012; and Reinstaller 2013.) It makes sense to elaborate on the special features of social innovation, instead of arguing all service innovation equals social innovation because it is interactive in some form.

Windrum et al. (2016) identify three areas where the conceptual understanding of social innovations goes beyond that of service innovations:

1. Incentives. In the service innovation literature social innovation is a special type of service that does not conform to business rationality in that it is not driven by profit motives, but by principles of inclusion and well-being. This does not imply that commercial service innovations do not induce well-being, but they are incentivized by expected profits whereas social innovation is incentivized by value created to society as a whole rather than to private individuals (i.e. externalities) (see also definition by Phills, Deiglmeier, & Miller, 2008).
2. Empowerment. Social innovations differ from commercial service innovations in that they seek to empower citizens. Where the consumption of commercial services is driven by demand based on prices, income and preferences, the use of social innovations is more based on needs (which are different from demand, see Hodgson (2008)). Social innovations attempt to assign new roles and relationships (e.g. between the citizens and the state) to individuals or groups in need, they develop assets and capabilities and/or the more efficient and environmentally sustainable use of existing assets and resources (Science Communication Unit, 2014; Chiappero-Martinetti and Von Jacobi, 2015).
3. Imitation. In innovation economics it is seen as given that fast imitation undermines economic returns of innovators. Hence, low appropriability regimes provide disincentives for innovators to engage in innovative activities, which results in less innovation and therefore loss to society. In contrast to that, social innovators often seem to encourage imitation and the rapid dissemination of their problem solutions. The key to this problem is probably that weak competition and the scarcity of solutions in the areas of social innovation needs to be compensated for: When needs of a group or parts of society are overwhelming, and solutions to solve the needs are scarce, ideas to solve the needs are rather promoted (once they finally exist) by the actors, instead of being withheld for better commercial exploitation.

Expected outcomes: Implications for the discussion on social innovation and social change

It seems that especially these three additional qualities of social innovations compared to service innovations in general, also yield special conclusions for the connection between social innovation and social change.

First, considering the direction of social change it is worthwhile thinking of innovation projects that are explicitly set up to solve social problems (e.g. of marginalization, of social determination etc) encounter barriers in a systematic way instead of viewing them as the product of singular achievements and pure luck.

Intentionality is important considering that many innovation projects have some social impact as a wider effect.

Second, the very active roles of empowered citizens strengthened by social innovations may impact on new social practices guiding social change.

Third, imitation is a key aspect in the rapid dissemination of new service ideas and practices which may accelerate social change. In practice, the dissemination of new ideas and practices is challenging. This is due to two characteristics of social innovations. First, they tend to be very local in nature. Second, there is often a lack of codification (Harrison et al., 2010; Windrum, 2014).

1B. PERFORMANCE OF INNOVATION SYSTEMS

Using Data Envelopment Analysis to assess the performance of national innovation systems in Europe

Jon Mikel Zabala-Iturriagagoitia*(Deusto Business School) and Charles Edquist(CIRCLE, Lund University)

* jmzabala@deusto.es

KEYWORDS: Data envelopment analysis, Efficiency, National innovation systems, Innovation union scoreboard

1.- Introduction

The European Commission has introduced the Innovation Union Scoreboard (IUS) as a tool to monitor the implementation and to examine the innovation performance of European member states. A Summary Innovation Index (SII) is provided by the IUS to assess the innovation performance of the member states. The SII includes 25 indicators, which are equally weighted. These indicators are divided into three main categories (i.e. enablers, firm activities and outputs) and eight dimensions (i.e. human resources, excellent research systems, finance and support, firm investments, linkages and entrepreneurship, intellectual assets, innovators, economic effects). The IUS measures the innovation performance for each country by summarizing all 25 indicators into a single SII, irrespective of whether the indicators are presenting innovation outputs or innovation inputs. Following Edquist and Zabala-Iturriagagoitia (2015), we argue that synthetic or composite innovation measures such as the one provided by the IUS are highly misleading. In this paper we use Data Envelopment Analysis (DEA) to measure innovation performance, by comparing the input and output indicators of the IUS. The goal of this paper is thus to investigate whether the use of a mathematical approach such as DEA provides additional insights to those achieved with a common-sense methodology, as done by Edquist and Zabala-Iturriagagoitia (2015).

2.- Efficiency consideration

To measure performance/productivity/efficiency of innovation systems, the indicators need to, in some way, be split up into innovation inputs and clear innovation outputs. Neither input nor output indicators themselves can measure the innovation performance of a country. It is rather the relation and balance between them which measures how a country is performing in its innovative actions. A high level of the input indicators means that large efforts and resources are devoted to stimulate innovation. Similarly, a high score for the output shows that a country has a high production of innovations. However, if the input side is, relatively speaking, much larger than the output side, the efficiency of the system as a whole is low.

In this paper, the performance of EU28 national innovation systems are analyzed from this efficiency perspective by using exactly the same data as those provided by the IUS in a DEA model. We start by gathering all the data from the IUS reports between 2010 and 2015.

3.- Methodology

In order to group the IUS indicators into inputs and outputs, we follow Edquist and Zabala-Iturriagagoitia (2015), where they justify the relevance of some of the IUS in order to benchmark innovation performance. DEA takes account of the relationship between all inputs and outputs simultaneously in a multi-dimensional production function (i.e. production possibility set). DEA does not impose any preconceived functional form on the data when determining efficient units, so the production function of efficient units is estimated using piecewise linear programming on the sample data rather than making restrictive assumptions about the underlying production technology. The importance of this feature is that a unit's efficiency can be assessed based on the performance observed by others (i.e. or any linear combination derived thereof). By the same logic, DEA identifies the inefficiency of a particular unit by comparing it to similar units (or any linear combination derived thereof) regarded as being efficient (i.e. measuring distance to the frontier). Figure 1 depicts the general idea of the frontier concept used in DEA.

Figure 1.- Frontier concept and efficiency calculation

Figure 1a depicts a production frontier (isoquant) by means of an XY-coordinate system (input-output) where points A, ..., E define the scope and shape of the frontier, St refers to the production possibility set in time t, and CRS, NRS, and VRS are frontiers with Constant Returns to Scale [RtS], Non-increasing RtS, and Variable RtS, respectively. Points F and G lie below the frontier and illustrate inefficient input/output combinations. The technical efficiency [TE] of point G can be obtained by calculating $(XG')/(XG)$.

The calculation of this measure can be illustrated even better in a two-dimensional X_1X_2 -frame (i.e. two of the inputs are applied to produce one unit of a certain output) as in Figure 1b. Points A, ..., E all refer, once again, to (technically) efficient combinations of X_1 and X_2 in order to produce one unit of output and they therefore define the frontier. Point G corresponds to an inefficient observation since X_1 and X_2 can be reduced without any drop in output. The TE of point G can be obtained by calculating $\frac{OG}{OH}$. Hence, TE has a range $0 \leq TE \leq 1$, whereas 1.0 refers to a best practise, fully efficient example. Concerning point G, however, one has to reduce both inputs, e.g. in the proportion $1-TE$, in order to be efficient (reach the frontier).

4.- Results

The overall mean of the calculated TE for the EU28 countries studied was 0.702 in year 2013 (std. 0.265 and typical error 0.05). Our results reveal that a number of countries (France, Cyprus, Luxembourg, Spain, Greece, Romania, Malta and Bulgaria) had highly efficient innovation systems (see Table 1). These results are aligned with the previous findings by Edquist and Zabala-Iturriagagoitia (2015). As the table below shows, there is wide variance in innovation performance in Europe.

Table 1.- Technical efficiency of European countries (EU28)

CRS VRS Scale efficiency SII 2013

Sweden 0,372 0,743 0,501 0,750

Finland 0,540 1,000 0,540 0,684

United Kingdom 0,502 0,503 0,998 0,613

Slovenia 0,534 0,580 0,921 0,513

Denmark 0,585 1,000 0,585 0,728

Germany 0,589 1,000 0,589 0,709

Estonia 0,459 0,757 0,605 0,502

Netherlands 0,441 0,772 0,571 0,629

Belgium 0,713 0,989 0,720 0,627

Lithuania 0,160 0,181 0,887 0,289

France 1,000 1,000 1,000 0,571

Austria 0,613 1,000 0,613 0,599

Ireland 0,853 0,902 0,946 0,606

Cyprus 1,000 1,000 1,000 0,501

Luxembourg 1,000 1,000 1,000 0,646

Czech Republic 0,505 0,706 0,716 0,422

Poland 0,383 0,466 0,821 0,279

Slovakia 0,960 1,000 0,960 0,328

Croatia 0,699 0,761 0,918 0,306

Latvia 0,229 0,300 0,763 0,221

Portugal 0,751 0,999 0,752 0,410

Hungary 0,814 0,873 0,933 0,351

Spain 1,000 1,000 1,000 0,414

Italy 0,947 1,000 0,947 0,443

Greece 1,000 1,000 1,000 0,384

Romania 1,000 1,000 1,000 0,237

Malta 1,000 1,000 1,000 0,319

Bulgaria 1,000 1,000 1,000 0,188

Source: own elaboration.

With regard to the position of each country in relation to the frontier (level, near, far away) and its related efficiency score, all observations can be ordered by their achieved innovation efficiency. This ranking is then compared with that provided by the SII, which according to the IUS, measures EU Member States' Innovation Performance (Figure 2).

Figure 2.- The relationship between SII and Technical efficiency

If the two performance indicators coincided, one would expect the majority of points to be along a 45° line. However, the trend line indicates a negative relationship. To some extent, the rankings are reversed (see also Edquist and Zabala-Iturriagagoitia, 2015). The negative relation of these indices must result from their different conceptual logics, since the measures employed in both cases are the same.

Thus, although a country that is at the top of the efficiency ranking, but which employs very few resources might be efficient in terms of resource use, in terms of enhancing regional development, closing the gap in growth

rates, social welfare, etc. this same country might be contributing very little and be classed as lagging. On the other hand, a country that invests huge amounts of resources to improve its innovation system, but whose use of resources is identified as inefficient compared to the peer group of best practice regions, cannot be seen as an example of best practice. Hence, in order to assess the performance and institutional quality of an innovation system, both aspects must be considered.

5.- Discussion

We have shown that many countries which devote less resources than the innovation leaders, achieve outstanding levels of efficiency and, contrary to what the IUS predicts, countries with consolidated innovation systems, do not show efficiency levels commensurate with their expected competitiveness. The paper shows that the results achieved with the application of DEA to the analysis of the IUS, provides results which are totally aligned with the application of a common-sense based methodology, as done by Edquist and Zabala-Iturriagoitia (2015). The approach followed by the IUS seems thus to offer a partial view of the actual state of innovation systems. We have shown that the use of these indicators within different methodological frameworks yields differing, but not necessarily contradictory results. Therefore, policy makers will need to consider the results of different and complementary analyses to obtain a comprehensive picture of their respective innovation systems.

References

Edquist, C., Zabala-Iturriagoitia (2015) The Innovation Union Scoreboard is flawed: The Case of Sweden—not the innovation leader of the EU—updated version. Papers in Innovation Studies, Paper No. 2015/27. CIRCLE, Lund University, Lund, Sweden. (This paper won the VII UAM-Accenture Chair Award in Economics and Innovation Management of the Universidad Autónoma de Madrid in February 2016: https://www.uam.es/docencia/degin/catedra/premio2015_en.html)

Innovation Output in Sweden and Finland, 1970-2013. Evidence from economic history

Astrid Kander*(Lund University), Matthias Deschryvere(VTT), Robert Van Der Have(VTT), Nina Rilla(VTT),
Karolin Sjöö(Lund University) and Josef Taalbi(Lund University)

*astrid.kander@ekh.lu.se

KEYWORDS: Finland, Sweden, R&D and growth paradox, LBIOLiterature Based Innovation Output

1. Relevance of the paper

Innovation is widely considered the panacea for economic growth, employment, and societal challenges. Stimulating innovation is therefore seen as a top priority among policy makers around the world. In relation to the Innovation Union initiative, the European Commission recently suggested that the European Union is facing a situation of ‘innovation emergency’ as both the U.S. and Japan are spending a higher percentage of GDP on R&D. Innovation performance vary considerably within the union, with newer member states typically ranking poorly compared to EU 15. Among the better performing countries, Sweden and Finland have long been found in the very top; with Sweden leading the pack and Finland not far behind.

This paper is the first report on a comparative Finnish-Swedish innovation output project, funded by TEKES and VINNOVA in the period 2015 and 2016. The bilateral project is ambitious and aims at fine-tuning, comparing and analysing innovation data from Swedish and Finnish trade journals for the period 1970 to 2013. The relevance of our research in relation to the overall theme of the conference, is that evidence based policy needs high quality innovation output data in order to monitor and formulate appropriate measures.

The research project started with the notion that innovation trends seem to diverge in Finland and Sweden in the period from 1970 to 2007 on the basis of non-adjusted innovation data collected by VTT and Lund University respectively. However, after thorough examination of the consistency and comparability of the two datasets and correction of the data used in the analysis, a somewhat different picture of the trend lines in innovation in the neighbouring countries emerges. In the Finnish data year-to-year volatility in the number of innovations is less pronounced, while the Swedish data, which was updated to cover the years 2008 - 2013 shows new momentum. The corrected datasets suggest that rather than growing differences in innovation output, convergence can be detected between the innovation trends in Finland and Sweden particularly since the early 1990s.

Methodologically, the results underline the importance to review carefully the comparability of datasets compiled using the LBIOL method (Literature Based Innovation Output). We have improved upon two data bases created by Finnish and Swedish researchers (Saarinen, 2005; Palmberg, 2003; Sjöö, et al, 2014; Sjöö, 2014; Taalbi, 2014). A methodological contribution of the study is the experience of ascertaining consistent data collection and achieving a standard, which can be exploited by other researchers using the LBIOL.

2. Research questions

The overall aim of this paper is to find out how well Finland and Sweden perform in innovation output in relation to their R&D expenditures. This is related to the larger question that is of interest to policy makers: Does R&D pay off? Therefore we need to tackle the following research question: does renewal and structural change in the two countries’ manufacturing sector look different or similar? To find out if the catch-up of Finnish innovation performance on the aggregate level was due to stronger renewal and mainly related to a few strategic sectors, or instead spread all across the manufacturing sector, it is necessary to analyse the innovation database along sectors...

3. Definitions of main concepts

Innovation output, or actual commercialized innovations by Finnish or Swedish firms, are at the unit of analysis. These innovations are identified by reading trade journals, and taking down information about the innovations in a database. This so-called LBIOL approach is a ground-breaking method already used in highly influential research at the SPRU institute back in the seventies, together with expert surveys (see for example Rothwell et al. 1974).

We have sharpened the definition of what material from the trade journals that should go into the database in the UDIT (Understanding Diverging Innovation Trends in Finland and Sweden) project. In our view, only innovations found in articles that have an innovation focus should be included, which editors have found worthwhile to include in their trade journals. Product announcement sections, are merely to be regarded as firm

marketing devices and should not be included.

The combination of reliable LBIO based innovation data with innovation proxies from other reputable sources such as R&D- and Innovation surveys or patent data not only allows for assessing strengths and weakness of various methodologies, but also the extent of their validity (i.e. the question if findings truly represent the complex phenomenon of innovation).

4. Theoretical framework

We will contribute to the vast R&D and growth paradox literature, which states there is insufficient outcome in terms of innovation and economic growth on the national level from R&D expenditures. On purely theoretical grounds it can be argued that the idea of a paradox is based on misconceptions and a too linear view of R&D creating proportional numbers of innovation, which will result in proportional growth. The real innovation system is more complex, and relies on feed-back between national innovations and the world pool of ideas, as well as on some innovations becoming obsolete in the process of industrial renewal. There seems to be ground to think that R&D expenditures face declining marginal returns, like many other investments. More precisely we will further examine the hypothesis that the empirical result for the Swedish economy, showing that the R&D paradox only takes place in the fast-growing sectors of the economy, and thus is not a sign of poor performance, because the slow growing sectors show no gap at all between R&D and value added (Ejermo et al 2011). Our interpretation was that it simply took increasing R&D to get innovation output in these sectors. Based on real innovation output data, we do not know yet if this picture will be confirmed or not.

5. Empirical material

The primary data consists of SFINNO and SWINNO datasets which are collections of innovations observed systematically in a selection of trade journals in Finland and Sweden. While the same methodological approach and data collection methods have largely been in use in the both countries, closer analysis revealed some reliability and integrity issues - variations and gaps, respectively, in information content of the data sets - which need to be rectified before the innovation trends in manufacturing can be meaningfully compared. Data quality improvements have resulted in following three types of changes in the databases.

1) Additions refer to changes in the time series resulting from efforts to assure that there are no gaps in the coverage of the datasets for the period 1970-2013, thus improving data integrity. For Swedish data this has meant updating of SWINNO innovations for the years 2008-2013. For Finnish data in turn, an extensive recheck of journals for 1985-2009 was implemented after an initial analysis of innovations per each trade journal implied some irregularity. The aim of the recheck was to ensure that the coverage of innovations originating from the source journals is as completely as possible. Altogether 102 volumes of 15 journals published in 1985-2009 were rechecked by the VTT research team and a team of four students. As a result of the exercise, 936 unique innovations were identified and added into the original SFINNO database. For both countries we have scanned articles for the listed innovations to enable the third step, below: adjustments, and to facilitate the accessibility and use of the data in the future.

2) Deletions concern certain types of innovations that were not available in both countries, and thus affected the reliability of aggregate annual innovation rates across national contexts. The deletions include a) innovations originating from other source types than trade journals, such as experts opinions or company annual reports of the largest R&D spenders in the Finnish data; b) pure service innovations (without also a product/good dimension) again in the Finnish data; c) process innovations for internal use (in both countries for all years)); d) double marked innovations in both countries that had not been detected before, and lastly e) innovations developed by the public research organisations or universities that are not available on market or were not in use at the time source article was published. The number of deleted innovations is higher in SFINNO data as there has been some variation over time both what comes to sources from which innovations are identified and type of innovations observed, given that Finnish data contains data not only on products or processes but also services.

3) Adjustments refer to sharpened criteria of the LBIO method to further improve cross-national reliability and comparability. Data should only contain innovations found from articles that have an innovation focus, and editors have found worth-while to include in their trade journals. We re-classified the articles into three types in the following manner: Type 1 articles focus on an innovation or aspect thereof; Type 2 articles have an overview focus or, trade fair focus, or they fall into other overview category; and final type (type3) is product announcements. Type 3 and type 2 fair and other articles are excluded from the analysis, whereas type 1 and type 2 overview are included in our final dataset.

6. Description of the methodologies

Was Finland's innovation catch-up with Sweden due to improved innovation performance across all sectors or did it mainly take place in a few sectors? We will use a modified version of the advanced shift-share analysis proposed by Ang (2000) to answer this and make a complete decomposition into technical and structural change, driving the changes in the two countries. This will illuminate whether Finland had a more successful renewal of its manufacturing sector in the period 1970-2013 than Sweden. A renewal and accompanying structural change that spurred innovations better than in Sweden.

7. Expected outcomes

We aim with this paper for a thought provoking comparison of Finnish and Swedish innovation performance in the manufacturing sector, which we expect to stimulate policy makers and discussions in both countries, but also more generally in Europe. Indeed, the renewal of the manufacturing sector is high on national agenda's and a better understanding of innovation trends over longer periods of time in relation to the inputs and outputs is certainly welcome. In addition this contribution will offer an up to date assessment of the usefulness of trade journal innovation data for policy relevant innovation research. Policy makers are in search of useful complementary innovation data as existing survey data such as the Community Innovation Survey (CIS), patent data and publication data have proven to be limited in the information they can produce. As such, it is expected that the LBIO approach can offer a welcome complementary addition for the evidence based innovation policy toolbox.

Science, the State and the City: Britain's struggle to imitate US success in Biotechnology and its lessons on the limits of innovation systems building

Michael Hopkins*(SPRU, University of Sussex) and Geoffrey Owen(London School of Economics)
*m.m.hopkins@sussex.ac.uk

KEYWORDS: Biotech, Innovation systems, Finance, Industrial policy, Industrial dynamics

Motivation and research question: This paper presents the summary argument of a forthcoming book by the authors, exploring potential answers to the following questions: (i) Why it has been so difficult for the UK to produce large therapeutic biotech firms similar to those seen in the USA and (ii) why have UK firms not been able to commercialise therapeutic drugs to rival those that US firms have brought to market. Of course the therapeutic biotech sector (which aims to develop novel drugs) is not the only sector in which countries have struggled to emulate US success and so answers to these questions have implications for other, particularly knowledge-intensive, sectors.

Many prior studies trace such difficulties through comparative studies drawing on National Systems of Innovation (NSI) or similar approaches (e.g. Porter 1990; Murmann 2003; Lacasa et al 2004; Patel et al. 2008). These often identify sources of weaknesses or strengths as nations attempt to build national industries, particularly around emerging technologies, that can compete internationally. Similarly this paper draws on the NSI approach to explore the UK government's and investment community's efforts to mimic the US innovation ecosystem and the outcomes of these efforts and the lessons from this for policy.

In contrast to many prior studies that focus on gap analysis (e.g. identifying missing institutions or factors in innovation systems) the account provided here stresses the importance of, and interactions between, a national sector's starting conditions, system dynamics including the role of virtuous cycles (Hekkert et al. 2007), international competition and crucially the role of scale – not just in the focal sector (therapeutic biotech) but also the role of scale supporting sectors, such as venture capital, that may influence the performance of biotech firms (Hopkins et al. 2013).

Methods: The research provides a historical account of the development of therapeutic biotech sectors across multiple countries and key factors that explain the difficulties these had in following the US. It builds on prior work by the authors (e.g. Hopkins et al. 2013), focused on the UK biotech sector, providing a detailed review of secondary sources such as scholarly accounts (e.g. Orsenigo 1989; Gittelman 2006; Pisano 2006; Powell and Sandholtz 2012) as well as contemporary business/ financial/ trade press sources (such as Nature Biotechnology, the Financial Times etc.). Additionally over 80 semi-structured interviews with scientists, policy makers, company executives, investors, and commentators have been undertaken to gain original and first-hand accounts of the dynamics of individual national contexts. These sources allow us to chart the growth, struggles and major achievements of the US and UK therapeutic biotech sectors, together with accounts of the emergence of similar sectors in France, Germany, Japan and Switzerland (selected on the basis of US Office of Technology Assessment's analysis in the 1980s that these countries posed the most major threat to US dominance of the emerging industry). Comparative analysis tracks the firms and therapeutic drugs in each country along with government policy efforts (sector-specific and otherwise) that have been important in shaping the progress of national sectors.

Outcomes: Longitudinal datasets allow the generation of comparative statistics to show how the waves of therapeutics firms founded after the biotech breakthroughs of the 1970s fared in their respective national systems. A number of factors that interact dynamically are explored.

Firstly, the role of technological capabilities is crucial. In the US, the science base was able to support a wave of firms based on recombinant DNA technology to be founded and staffed. These firms brought products to market faster than those in the UK, where monoclonal antibody (MAbs) technology originated and was the focus of more efforts, but where the pool of labour was more limited. Even well-funded US firms were slower to bring MAbs to market, and UK firms came too late to exploit therapeutic recombinant DNA opportunities.

This highlights the importance of a second factor: cycles of investment and outcomes play a role in establishing expectations locally. The successful firms from the first wave of US biotech firms remain the largest and most successful in the sector to date, and started a virtuous cycle, in terms of investor support, that other US firms have exploited. Where capabilities in novel biotechnologies were not available, investors put money into firms using established technologies to develop small molecule drugs – these still were seen as ‘biotech’ firms. These often failed to generate successful products and this coloured investor attitudes towards the biotech sector, particularly in the UK where a cycle of investor disinterest was established after the late 1990s.

Thirdly, a supportive institutional framework was rapidly established in the USA but more slowly established in other countries. Key institutions (for technology transfer laws and regulatory incentives) together with prior existing institutions (availability of venture capital and technology friendly stock markets) allowed US firms to further extend their lead while other countries took more than a decade (at the least) to emulate the US (these were not assembled as a co-ordinated effort to build a biotech sector per se in the US).

Fourthly the scale of US investment, from government into the science base and into firms through the financial markets, allowed a specialisation and division of labour to develop which has further supported the generation of technological opportunities and development of specialist investors which provide investor support that is deeper, more liquid and more reliable than that found in other countries – creating a draw to the US capital markets, even for European firms. Even accounting for the lead time of early US firms and relatively late establishment of key UK institutions (such as stock market access for loss-making biotech firms), it can be demonstrated that US market entrants can be grown to sizes larger than their UK counterparts.

Conclusions: The research provides an account of industrial emergence that illustrates how a wide range of factors shape industrial success and how the order of historical events is as important as whether the parts of the ecosystem are in place and functioning. There are also clear implications for government policy as some of these factors are less amenable to policy influence than others. In other words, there is a limit to what government can do even with an active industrial policy. Crucially, advantages enjoyed by the US firms in biotechnology (such as its first-mover advantage in the technology, the prior establishment of key institutions, and the scale of its capital markets) are simply not available to other countries. For the UK it is apparent that some advantages can only be enjoyed at the supra-national level for European countries (such as common regulatory structures, and pan-European capital markets) and these could help to replicate the US scale advantages. Some policy options for action remain – such as increasing investment in public R&D although other features of the US economy that have stimulated the therapeutic biotech sector, such as fewer price controls on drugs and a healthcare system that accounts for ~18% of GDP are less acceptable in other countries.

References:

- Gittelman, Michelle (2006) ‘National institutions, public-private knowledge flows and innovation performance: a comparative study of the biotechnology industry in the US and France’, *Research Policy* 35 pp. 1052–68
- Hekkert, M. P., Suurs, R. A. A., Negro, S. O., Kuhlmann, S., Smits, R. E H M (2007) Functions of innovation systems: A new approach for analysing technological change *Technology Forecasting and Social Change* 74(4) pp.413-432
- Hopkins, Michael M, Crane, Philippa A, Nightingale, Paul and Baden-Fuller, Charles (2013) ‘Buying big into biotech: scale, financing, and the industrial dynamics of UK biotech, 1980–2009’ *Industrial and Corporate Change*, 22 (4). pp. 903-952.
- Lacasa, Dominguez., T. Reiss and J Senker (2004) ‘Trends and gaps in biotechnology policies in European Member States since 1994’, *Science and Public Policy*, 31(5), pp. 385-395
- Murmann, Johann Peter (2003) *Knowledge and competitive advantage, the co-evolution of firms, technology and national institutions*, Cambridge University Press.
- Orsenigo, Luigi. (1989). *The Emergence of Biotechnology*. Pinter Publishers, London.
- Patel, P. Arundel, A. and Hopkins. M. (2008) *Sectoral Innovation Systems in Europe: Monitoring, Analysing Trends and Identifying Challenges in Biotechnology*. A report prepared for the European Commission. Brighton: SPRU.
- Porter, M.E. (1990) *The Competitive Advantage of Nations*. London:Macmillan.
- Powell, Walter W. and Kurt Sandholtz (2012) ‘Chance, Necessité et Naïveté, ingredients to create a new organisational form’, in *The Emergence of Organisations and Markets*, edited by John F. Padgett and Walter W. Powell (Princeton: Princeton University Press).

Policy and practice in performance-based research funding systems

Bea Mahieu* and Erik Arnold
(Technopolis Ltd)

* bea.mahieu@technopolis-group.com

KEYWORDS: Performance-based research funding systems, Institutional research funding, Research funding, Governance of research and innovation, Research assessment

Relevance

Performance-based research funding systems (PRFS) have spread across many countries, especially since 2000 (Sörlin, 2007) (Hicks, 2012) (Mahieu & Arnold, 2015). While they are generally justified as providing incentives for increased quality and productivity in national research systems (universities, and in some cases also research institutes), there is little discourse about their wider policy purposes or therefore their role as components of research and innovation systems. This paper contributes to the policy debate by exploring characteristics of PRFS so far implemented in practice in ten countries, selected for the availability of published information, and relating these to their wider policy purposes (such as concentration of resources or sustaining regionally-based university systems, increasing accountability, steering behaviour towards objectives such as internationalisation, providing strategic intelligence for research policy in addition to their obvious attention to quality and productivity).

PRFS may be seen as manifestations of the changed social contract (Guston, 2000) between science and society, the New Public Management, in Europe policy pressure from the European Commission (which recommends all Member States to operate such systems) or simply as a new fashion in research funding. There is a growing literature about their effects upon research and researchers, eg (Martin & Whitley, 2010), (Martin, 2011) (Good, Vermeulen, Tiefenthaler, & Arnold, 2015), which we do not address here but tackle in another paper. However, we are fully cognisant of the fact that opinions (and, indeed, evidence) are divided about whether PRFS are good things per se.

The choice of the method to assess academic outputs, ie peer review or bibliometrics, typically is at the core of the debates on PRFS (Bence & Oppenheim, 2005) (Bucchi & Papponetti, 2007) (Mahieu & Arnold, 2015; Abramo, Cicero, & D'Angelo, 2011). Internationally, the trend is away from UK-style peer-review based exercises and towards greater use of bibliometrics or mixed systems. But this is happening in the context of systems that (re)allocate a lower proportion of institutional funding based on research quality, so that they can afford to be a little cavalier with their judgements. If (as in the UK and formerly in the Czech Republic) a large proportion of the institutional funding is at stake, then it will clearly be more heavily contested and the academic community itself drives up the costs (including to itself) and methodological sophistication associated with precision.

Historically, PRFS were concerned only with measuring and rewarding research performance. In recent years, knowledge exchange and innovation dimensions have been added to many systems. PRFS are therefore relevant not only to research policy but also to innovation policy. Impacts are predominantly assessed indirectly by using proxy indicators related to research quality and/or relevance.

Most countries use the universities' capacity to win external funding as a proxy for research quality and/or relevance. Competitive project funding is considered an indication of the university's competitiveness and thus for research quality; contract research funding stands (also) as an indication of the university's research alignment with the needs of society (as expressed by industry or the public sector) and/or national research priorities and acts as a proxy indicator for impact on innovation.

Several countries also use a series of systemic indicators assessing the universities' broader research activities, as proxy indicators for quality or relevance for the national research or innovation system. Most of these countries look into the number of PhDs awarded as an indicator for the university's contribution to the strength of the national research system, apart of the size. Indicators looking into the 'pathways to impact' (research esteem, collaborations, etc) relate to the dynamics and interactions between the various elements of a research system (actors, context, infrastructures and so on). These are focus points especially for those systems where a major intent is to steer research behaviour - in order to overcome specific systemic failures (eg in Norway an enhanced institute-HEI collaboration), enhance internationalisation (eg in Finland) or foster the socio-economic relevance of research (eg enhancing science-industry collaboration in Italy) (Mahieu, Arnold, & Kolarz, 2013).

Research aims and questions

The paper aims to

- Decompose PRFS into their component assessment and funding parts, considering each separately as well as their interplay, in order to understand the policy appropriateness of individual PRFS designs
- Understand what parameters are available in designing PRFS
- Explore how the design of individual PRFS relates to policy purposes
- Position different PRFS with respect to their intended systemic roles (such as interplay with external, project-based funding or university teaching)
- Explore how different aspects of PRFS design relate to policy purposes in practice
- Identify evidence about the systemic effectiveness of individual PRFS and explore lessons for design and policy emerging from it

Definitions and concepts

Western European university systems have tended to see a history where lump sum funding (what the OECD used to call the General University Fund) has given way first to a distinction between the components of institutional funding intended for research and education and then the introduction of various types of formulae that governing the amount of each type of institutional funding the universities receive. Institutional funding for research is therefore the part of the funding allocated as a block to the individual university with the intention that it be allocated internally for enabling and performing research. Modern funding systems are (in the UK terminology) ‘dual support’ systems, in that they provide one flow of state money for research to the universities in the form of institutional funding and a second flow via funding agencies such as research councils that allocate funding based on competitively judged project proposals. PRFS allocate some of the institutional funding for research based on past performance. They are complex systems combining research evaluation criteria and processes with a formula for allocating institutional funding for research.

Theoretical framework

This paper relates to the development of practice in the design and implementation of a policy instrument to satisfy a range of policy objectives. It tackles that development in the context of policy practice. It is not clear that the superposition of a theoretical framework would add value to the research questions identified above. Rather, we attempt to use an abductive approach to derive general principles from the practices we observe and their consequences.

Empirical materials

We rely primarily on reviewing documents in both the ‘grey’ and the ‘white’ literatures, including descriptions of PRFS published by their operators or relevant policymakers, studies and evaluations of PRFS and interviews with policymakers and agencies designing and implementing PRFS, in effect complementing the published materials. A separate set of sources relate to the overall structure of funding systems. These are to be found in a combination of national descriptions of systems and international statistics, notably those collected by the OECD in its Main Science Indicators series but also in recent pilots aiming to generate better information about research funding structures. Only a minority of the information needed has so far entered the white literature. One of our contributions in this paper is to make a transition from materials that are primarily descriptive to an analytic approach that couples together design and policy purposes.

Methodologies used

Our first step is to document policy objectives across nine countries, selected pragmatically as those for which the best published information is available while at the same time offering a diversity of types of system and policy objectives. These do not need to ‘representative’ in a statistical sense, since we do not aim to count what characteristics are the most frequent. Rather, we aim to explore the ‘design space’ available to funding policymakers by examining a diversity of approaches. We develop standardised descriptions of the nine PRFS system so that we can systematically relate them to their policy purposes. We relate each PRFS design to its context in the national research and innovation funding system. We collect available evidence about the effects of the PRFS on the funding system and research and innovation performance. Finally, we draw out the implications and lessons for practice that emerge – aiming to address our research questions (above).

Expected outcomes

Our intention is to identify policy and design options for policymakers working with, or wanting to work with,

PRFS as instruments of research and innovation policy. In that sense our objectives are wholly instrumental: we aim to help policymakers make better use of PRFS as policy instruments. We have ourselves already used some of the emerging ideas about what practices make sense in what context in redesigning the Czech PRFS, running national research assessment exercises in Latvia and Lithuania and in supporting a potential redesign of the UK RAE/REF PRFS system by UK government. We hope through this paper to make the relevant principles more available to policymakers, supporting the conference theme of exploring new avenues for research and innovation policies.

Select bibliography

- Abramo, G., Cicero, T., & D'Angelo, C. D. (2011). The dangers of performance-based funding in non-competitive higher education systems. *Scientometrics* (87), 641-654.
- Barker, K. E. (2007). The UK Research Assessment Exercise: the evolution of a national research evaluation system. *Research Evaluation* 2007, 16 (1), pp. 3-12.
- Bence, V., & Oppenheim, C. (2005). The Evaluation of the UK's Research Assessment Exercise: Publications, Performance and Perceptions. *Journal of Education Administration and History*, 37 (2), 137-155.
- Bucchi, M., & Papponetti, V. (2007). Research evaluation as a policy design tool: mapping approaches across a set of case studies. Fondazione Eni Enrico Mattei, Italy.
- Good, B., Vermeulen, N., Tiefenthaler, B., & Arnold, E. (2015). Counting quality? The Czech performance-based research funding system. *Research Evaluation*, 24 (2), 91-105.
- Guston, D. (2000). *Between Politics and Science: Assuring the Integrity and Productivity of Research*. Cambridge: Cambridge University Press.
- Hicks, D. (2012). Performance-based university research funding systems. (Elsevier, Ed.) *Research Policy*, 41, 251-261.
- Mahieu, B., & Arnold, E. (2015). R&D Evaluation methodology & Funding principles - The R&D Evaluation Methodology (Final Report 1). Technopolis Group. Prague: Ministry of Education, Youth & Sports.
- Mahieu, B., Arnold, E., & Kolarz, P. (2013). Measuring scientific performance for improved policy making - Literature review. Technopolis Group. Brussels and Strasbourg: STOA, European Parliament.
- Martin, B. (2011). The Research Excellence Framework and the 'impact agenda': are we creating a Frankenstein monster? *Research Evaluation*, 20 (3), 247-254.
- Martin, B., & Whitley, R. (2010). The UK Research Assessment Exercise: a Case of Regulatory Capture? In R. Whitley, J. Gläser, & L. Engwall, *Reconfiguring knowledge production: changing authority relationships in the sciences and their consequences for intellectual innovation* (pp. 51-80). Oxford: Oxford University Press.
- Sörlin, S. (2007). Funding Diversity: Performance-based Funding Regimes as Drivers of Differentiation in Higher Education Systems. *Higher Education Policy*, 20, 413-440.

1C. THE ROLE OF UNIVERSITIES

Why do firms, universities and knowledge institutes collaborate in multidisciplinary research programs? A mixed methods approach to evaluation.

Kevin Broecks* and Frank van Rijnsoever
(Copernicus Institute of Sustainable Development, Utrecht University)
* k.p.f.broecks@uu.nl

KEYWORDS: Research evaluation, Multidisciplinary research, University-industry collaboration, Motives for collaboration, Social network analysis

Relevance

The complex challenges facing society today (e.g. climate change) call for research that is multidisciplinary, includes a variety of stakeholders (e.g. universities, knowledge institutes, firms and governmental bodies) and prioritizes solving these challenges (Belcher, Rasmussen, Kemshaw, & Zornes, 2016). Stakeholder's motives for participating in such research and the benefits they accrue from collaboration vary widely (Ankrah, Burgess, Grimshaw, & Shaw, 2013). Some of these benefits, such legitimacy or access to a body of (tacit) knowledge, are difficult to quantify. Evaluating multidisciplinary and inclusive research therefore requires approaches that go beyond quantitative output indicators, such as publications or patents, and account for a diversity of motives for collaboration (Perkmann, Neely, & Walsh, 2011).

Research aim & definitions

We developed a mixed methods approach to evaluate this type of research. The approach was applied to the Dutch, national research program for Carbon Capture and Storage (CATO-2). The program involves a wide variety of stakeholders (e.g. energy companies, universities, local governments, NGOs, subsurface operators) and disciplines (e.g. chemical engineering, geology, law, psychology, economics).

We evaluate the effectiveness of research programs from two perspectives. First, we assess the motives for participation of each stakeholder in the program. We conceptualized the motives as sets of resources (van Rijnsoever, Hessels, & Vandeberg, 2008) (e.g. laboratories, funding, knowledge, legitimacy, access to a network) that these organizations gain when doing research collaboratively in the program, rather than by themselves. The research program should attempt to meet or exceed stakeholder's expectations about their gain in resources in order to stimulate future collaboration. The motives for collaboration differ between disciplines and types of organizations, which can lead to barriers in knowledge production if motives are not properly aligned. The research program management plays a role in aligning stakeholders' motives, as well as assuring relevance, credibility and legitimacy of the program. A focus on motives and the research program's effectiveness in aligning motives allows clear learning opportunities to be identified for future research programs.

Second, we assess the societal value of the research program by determining its contribution to the development of the technology in question. The assessment focuses on the development of knowledge (publications, patents), human capital (education activities, training), social capital (network development) and physical infrastructure (demonstration projects, test facilities).

Methodology

The evaluation method primarily consisted of a social network analysis for deliverables and publications and semi-structured interviews with 25 organizations involved in the research program and 3 organizations that were not involved in the program, but do have a large stake in the development of CCS. In addition, we regularly attended meetings and events of the research program and organized feedback sessions with the program director, program office and program council.

We used the social network analysis to establish the structure of the program (to what degree do different disciplines and organizations collaborate), to identify interviewees and to serve as a discussion tool in the interviews. The interviews were used to answer 5 main questions:

1. Why did the organization participate in the program?
2. What type of research results were most important to the organization (were their expectations met)?
3. How did the organization collaborate with other organizations?
4. What are future barriers and opportunities for CCS research?
5. How should a future CCS research program be designed?

We developed a set of vignettes to explore motivations for participating in the research program. Interviewees were asked to rank these vignettes based on the importance to their organization. Another set of vignettes was developed to delve further into the type of knowledge (commercial vs. academic vs. societal relevance and content) and type of network contacts (government, NGOs, scientists, industry) that were most important. All questions using these materials were initially asked in an open format to make sure the range of motivations was covered by the vignettes.

Discussions on the manner of collaboration in the research program were used to further interpret the social network analysis. First, we discussed (informal) collaborations that did not lead to tangible deliverables to assess whether the network analysis covers the degree of collaboration sufficiently. Second, we qualitatively assessed the value of the network by determining the role the research program plays in establishing the network. For example, by translating research that is shared between disciplines or by appointing knowledgeable individuals as go-to persons for questions on a topic.

Outcomes

Apart from acquiring funding and/or specific knowledge, four motives were important for participation decisions; access to a network of researchers and organizations, creating legitimacy for particular research activities, creating an overview of the current knowledge base and specifying a future research strategy and vision for CCS. The particular set of motives differed for each type of organization.

The social network analysis, supplemented by the interviews, revealed that the research program adds value to the network in three ways. First, the program coordinates research between disciplines and organizations that normally rarely interact, which is vital for topics that require multidisciplinary insights, such as systems analysis or regulatory frameworks. Second, they facilitate knowledge sharing by setting up events with the explicit focus of translating research findings to a wider audience. Third, they set up a structure to pin-point knowledgeable individuals for each topic in the program.

Particular challenges in this program were developing a shared language (between disciplines), knowledge dissemination (primarily to governmental bodies), deciding between research topics effectively without demonstration projects to steer choices, connecting different organizational perspectives on research goals (short vs. long term projects, extent of public engagement, etc.), and adapting to changes in the social context.

References

- Ankrah, S. N., Burgess, T. F., Grimshaw, P., & Shaw, N. E. (2013). Asking both university and industry actors about their engagement in knowledge transfer: What single-group studies of motives omit. *Technovation*, 33(2-3), 50–65. doi:10.1016/j.technovation.2012.11.001
- Belcher, B. M., Rasmussen, K. E., Kemshaw, M. R., & Zornes, D. a. (2016). Defining and assessing research quality in a transdisciplinary context. *Research Evaluation*, 25(1), 1–17. doi:10.1093/reseval/rvv025
- Perkmann, M., Neely, A., & Walsh, K. (2011). How should firms evaluate success in university-industry alliances? A performance measurement system. *R&D Management*, 41(2), 202–216. doi:10.1111/j.1467-9310.2011.00637.x
- Van Rijnsoever, F. J., Hessels, L. K., & Vandeberg, R. L. J. (2008). A resource-based view on the interactions of university researchers. *Research Policy*, 37(8), 1255–1266. doi:10.1016/j.respol.2008.04.020

Academic-policymaker engagement in the science and technology policy process: Capability and motivation factors

Andrew James* and Duncan Thomas
(University of Manchester)

* andrew.james@manchester.ac.uk

TO REVIEWERS: Please find a PDF-version of the abstract (including figure) at
<https://www.delegia.com/app/Data/ProjectImages/6857/131.pdf>

1. Relevance

The interaction between academic researchers and policymakers is an important theme for research in our field and one of the key stated objectives of the 2016 Eu-SPRI conference. Accordingly, our proposed paper is highly relevant to the Conference. We focus on the development of a model to help to explain the conditions under which academics might – or might not – engage in the science and technology policy making process. With austerity-related budget reductions in the UK and other countries, there are challenges to ‘research policies to solve societal problems’. Academics are increasingly being expected to engage with challenge-oriented policy, science and research. This is due to the ‘impact agenda’, in the UK, and other factors. Our model highlights that engagement may not necessarily increase to meet these challenges, due to the prerequisite capability and motivation factors we describe.

2. Research aims & Questions

We develop an analytical model to explore the interaction of capability and motivation as factors that underpin the extent of academic engagement in the science and technology (S&T) policy process. We address motivational and capability factors of academics, academic organizations, policymakers and government bodies. We also explore several policy and practice pressures, in the UK case, that may cause a dynamically changing balance of motivation and capability factors over time.

3. & 4. Definitions & Theoretical frameworks

Academics have always engaged with the government policy process in numerous ways: e.g. as ad hoc advisors; as expert secondees to government departments and agencies (including service in longer term roles like Chief Scientific Advisor in UK central government); and as members of committees at various levels. They also conduct commissioned research funded directly by or in some form of partnership with government actors.

The history of academic engagement in the policy process is a long one. Edgerton (2006) discusses the roles of scientists in the UK from 1920–1970 as advisors to what he calls ‘the warfare State’, the complex of activities associated with the design and development of weapons and their underpinning scientific and technological knowledge base. Today, in the UK, there are growing pressures on both policymakers and academics to increase engagement (for academics, the impact agenda; for policymakers, austerity-related budget policies). We believe this warrants revisiting this matter, above and beyond what has already been developed in previous research on university-industry and university-academic-industry links (e.g. the ‘triple helix’, see Etzkowitz and Leydesdorff, 2000; Kenney, 2013).

A recent UK Government Office for Science report on Engaging with academics (2013) describes some current engagement pressures on policymakers. Beyond the general trends long identified in discussion of the demands of ‘post-normal science’ (e.g. see Funtowicz and Ravetz, 1993) and the generally more applied/user-oriented nature of Mode II knowledge production (Gibbons, 1994) UK academics are now under pressure to demonstrate explicitly the ‘impact’ of their research insights on various user groups (e.g. on policymakers, industrialists, charities, foundations). This new ‘impact agenda’ is formally measured in the university performance metrics of the UK’s 2014 Research Excellence Framework (REF) to determine part of the periodic allocation of research block grant funding to universities. The 2013 Witty Review of ‘universities and growth’ has also proposed that the weighting of this ‘impact’ component be increased in future REFs, and the 2015 Nurse Review of the UK’s Research Councils has also stressed ‘societal impact’ from publicly-funded research, so this aspect is likely become an even stronger pressure.

On the policymaker side globally there are increasing pressures for ‘open’ policy-making (GO Science, 2013) and post-recession budgetary austerity in the UK is leading to an apparent desire (visible in our case studies of DEFRA and MOD) to satisfy a greater proportion of scientific advice needs via external sources. In general then both policymakers and academics in the UK are seeking more engagement.

To explore the various possible modes and spaces for this increased engagement we can turn to research on academic engagement with industry: mechanisms; motivations; and challenges (e.g. Etzkowitz and Leydesdorff, 2000; Perkmann and Walsh, 2008; D'este and Perkmann, 2011; Lam, 2011; Perkmann et al, 2013; Kenney, 2013). These suggest some characteristics are transferable to academic engagement in routine policy situations (there is also a substantial literature on academic engagement with more specific scientific/policy controversy situations, e.g. exploring scientific uncertainty and authority/expertise [Shackley and Wynne, 1996], how scientific uncertainty translates into actionable politics [Walker and Walsh, 2012], moving across organizational boundaries [Guston, 2001] and changing objects of discussion [Sundberg, 2007] via 'worlds of relevance' typically specific to certain stakeholders [Limoges, 1993]).

5. & 6. Empirical materials & Methodology

We start from the existing academic literature on academic engagement with the policy process beginning, addressing the themes set out in the previous section of this abstract. We use our analysis of that literature to develop our analytical model. We provide an exploratory test of that model through 15 face-to-face interviews with policymakers in two UK central government departments (the Ministry of Defence, MOD, and the Department of Environment Food and Rural Affairs, DEFRA) and with academics engaging with these departments in various ways.

7. Expected outcomes

We develop and test a model to explain the interaction between the motivations and capabilities of academics and policymakers to explain prerequisite conditions for engagement. Our model differs from some previous literature considerations of academic engagement with policy – in particular to Pielke's (2007) four idealized roles of the pure scientist, science arbiter, issue advocate, and honest broker. We recognize both capability and motivational factors at work. This is an important contribution, in considering engagement as the interplay between these motivation and capability factors, and addressing both individual and organizational aspects.

We identify seven 'engagement relationships' between academics and policymakers (these are not binary yes/no relationships in many cases, but rather a matter of degree):

<< FIGURE NOT ACCEPTED BY SUBMISSION SYSTEM >>

Figure 1: Prerequisites for academic-policymaker engagement (A) and the six possible states of near-engagement (B, C, D, E, F and G).

- A – Engagement: Policymakers are motivated and capable to seek academic advice; academics are motivated and capable to engage;
- B – Systemic incapability: Academics and policymakers are both motivated to engage but lack the capabilities to do so;
- C – Systemic demotivation: Neither academics nor policymakers are motivated to engage even though they have the capabilities to do so;
- D – Policymaker incapability: Academics are motivated and capable to engage; policymakers are motivated to engage but lack the necessary capabilities;
- E – Academic incapability: Policymakers are motivated and capable to engage with academics; academics are motivated to engage but lack the appropriate capabilities;
- F – Policymaker demotivation: Academics are motivated and capable to engage; policymakers have the necessary capabilities to engage but are not motivated to do so; and
- G – Academic demotivation: Policymakers are motivated to seek academic advice and have the necessary capabilities to engage; academics have the necessary capabilities to engage but are not motivated to do so.

Outside of the labeled A to G is non-engagement, i.e. where a relationship does not exist at that moment in time, even if there is some mix of motivation and capability factors for either the academic and/or the policymaker.

Our interview data from DEFRA and MOD provides examples to illustrate these seven engagement and near-engagement relationship types. Constructing this model also leads us to emphasize, from the academic possible 'supply' of science/research insights side, that those academics who are motivated and capable to engage with policymaker demands most likely represent a surprisingly small subset of the larger academic community who could potentially engage with the S&T policy process.

8. Discussion & Conclusion

Our engagement model can also be used to draw attention to the changing dynamics at play in the relationship between academic and policy maker communities. One example would be the idea of ‘policy levers’ to alter the level and/or nature of academic engagement in the policy process. For instance, one might expect to see more attempts at relationship ‘G’ (academic demotivation, near-engagement) moving to ‘A’ (engagement) in the UK as the increasing REF impact agenda (and declining research council funding) motivates and incentivizes academics, and their host organizations, to engage more with users like policymakers. Similarly a shift from relationship ‘F’ (policymaker demotivation, near engagement) to ‘A’ (engagement) seems to be occurring as policymakers demand grows for external expertise, in the UK, due to ‘openness’ and ‘austerity’ pressures (GO Science, 2013).

We can also suggest limits to the amenability of the whole engagement system presented here. In particular the individual ‘academic capabilities’ aspect – even with amenable organizational facilities, public web-based databases of academic experts to disseminate the identity and knowledge/skills of individual academics, and facilitation of more agreeable contractual/administrative and academic promotion incentives to engage – are probably challenging to affect. They rely on interpersonal communication and networking capabilities and deep character traits difficult to improve by simply say, universities providing academics with training programmes on ‘generating impact’ or ‘engaging with users’.

What our model cannot currently illustrate is the effectiveness of engagement, i.e. the issue of what it means for academics and policymakers’ scientific and/or organizational careers to be in an engagement relationship (our state ‘A’).

Lastly we may also wish to examine empirically in future whether certain academics have a specific propensity for engagement. We might develop some measure of ‘engagedness’ and examine whether highly-engaging academics engage only with government or with industry and other users as well.

9. References

<< AVAILABLE IN EXTENDED ABSTRACT >>

Different recipes for the same dish: comparing policies for scientific excellence across different countries

Edwin Horlings (Rathenau Instituut), **Leon Cremonini***(University of Twente) and Laurens Hessels (Rathenau Instituut)

*l.cremonini@utwente.nl

KEYWORDS: Science policy, Research funding, Excellence, Differentiation, Coordination

1. Relevance

Many research systems witness the rise of excellence initiatives, policies offering selective support for highly performing research groups or research organizations (OECD 2014). These policies build on the assumption that a small number of excellent performers will have positive spill-over effects on the vitality, attractiveness and productivity of the whole research system outweighing possible negative effects on the rest of the research community receiving relatively fewer resources. Although these instruments share a common rationale, their policy design and implementation vary widely. Evaluations of individual instruments are available but the general understanding of these instruments' costs and benefits is limited. A more systematic understanding of these instruments and their effects is desirable to facilitate policy learning.

2. Research aim(s) and question(s)

The aim of this paper is to improve the understanding of the effects of excellence policies by comparing selected policy instruments across different countries. The paper contributes to emerging debates exploring how science systems work as systemically converting inputs into desirable outputs. The research question of this paper is what policy instruments have the strongest potential to achieve differentiation in terms of resources and performance across individuals and organizations.

3. Definitions

This paper defines excellence policies as policies aiming to increase differentiation in the science system, by providing selective support to a limited number of researchers, groups or organisations who perform very well or show the potential to perform very well. An excellent scientist (or group or organization) is defined as a scientist whose performance is assessed by scientific peers as of extraordinary quality, as measured by publications, citations, prizes, grants or reputation.

4. Theoretical frameworks

Excellence policies are designed to create system-wide additionality. Governments intend to produce outcomes that would not have happened without the intervention. In the science system, five types of additionality can be distinguished (Bloch et al. 2014):

- a) input additionality (facilitate research activities that would not otherwise have been possible)
- b) output additionality (publications, patents, new products or services)
- c) behavioural additionality (e.g. choice of research topic/area, size of research projects, publishing strategy, risk-level in research, international collaboration)
- d) Career additionality (e.g. changes in research position, mobility and workplace)
- e) Institutional additionality (the degree to which grants have impacted host institutions and other connected research environments)

Although output additionality will probably be the most visible, we expect excellence policies to produce all five types of additionality.

The policy logic of excellence policies can be conceived in terms of coordination modes (Hessels 2013; Lepori 2011). Excellence policies often come as competitive funding relying on market coordination. However, many policies also rely on network coordination: the state allocates a large sum to a consortium of several research performers, which enjoy a significant degree of autonomy to allocate the funding within their network. In other cases, excellence policies function more like 'private hierarchies' because funding is allocated in the form of a bonus to the block-grant support for universities or research institutes, based on performance indicators. In these cases the funding is allocated within the research performing organization based on hierarchical decisions, possibly including competitive elements.

The implications for the activities of scientists can be conceptualized in terms of the credibility cycle, a quasi-economic model to explain the behaviour of individual scientists (Hessels et al. 2009; Latour and Woolgar 1986). Excellence policies interfere in the way scientists convert recognition into money. One could argue that they change the transaction rate in the sense that a given difference in recognition will lead to a larger difference

in money received. In this way they strengthen the Matthew effect, leading to a more uneven distribution in the resources for scientists within a national science system.

5. Empirical materials

In our paper we will compare excellence policies of the U.K., Germany, Denmark and Switzerland. These four countries differ in the general characteristics of their science systems and the types of policy instruments implemented. The paper will analyse the following policy instruments:

- a) Research Excellence Framework in the UK, as part of a longer tradition of selective research funding under the heading Research Assessment Exercise. The assessment scores of expert panels evaluating the performance of research units produces a direct input for the allocation of institutional funding.
- b) The German Excellence Initiative, aiming to increase differentiation in the system, improve research performance and improve international attractiveness of German research. To this end the federal governments provides funds for Graduate Schools, Clusters of Excellence and institutional strategies.
- c) Centres of Excellence, funded by the Danish national research foundation. These are collaborative research units led by outstanding researchers that are oriented towards producing ground-breaking results.
- d) Swiss Performance Mandates, substantial funds injected into the science system to increase the focus on fundamental research and to support a clear differentiation policy.

The analysis will be mainly based on secondary sources, such as evaluation reports, international comparative reports (Bennetot and Estermann 2014; OECD 2014) and academic literature (Langfeldt et al. 2015). In addition, we will conduct interviews with about three policy experts in each country.

6. Description of the methodologies

Our analysis will address differentiation on two levels of aggregation: among individual researchers and among research organizations. For each case we will analyse the current degree of differentiation in terms of performance and resources; the logic, design and implementation of excellence policies; and their effects on differentiation in the science system. Obviously, the effects of the instruments cannot be understood without taking into account a number of general characteristics of the national science system, such as size, traditional degree of differentiation, intensity of reputational competition and level of intellectual pluralism and flexibility (Whitley 2003).

7. Expected outcomes

The expected yield of this comparative analysis is first a typology of excellence policies according to the coordination modes they employ, as a contribution to the theoretical understanding of excellence policies in science. Second, we report empirical insights into the relationship between excellence policies and differentiation in the science system. Thanks to our careful sampling of cases, the comparison of our cases will enable us to explore the influence of different policy instruments on differentiation in the science system and the moderating effect of general system characteristics.

REFERENCES

- Bennetot, Enora and Estermann, Thomas (2014), *DEFINE Thematic Report: Funding for Excellence*; Brussels: European University Association.
- Bloch, Carter, et al. (2014), 'Developing a methodology to assess the impact of research grant funding: A mixed methods approach', *Evaluation and program planning*, 43: 105-17.
- Hessels, Laurens K. (2013), 'Coordination in the science system: theoretical framework and a case study of an intermediary organisation', *Minerva*, 51/3: 317-39.
- Hessels, Laurens K., van Lente, Harro, and Smits, Ruud E.H.M. (2009), 'In search of relevance: the changing contract between science and society', *Science and Public Policy*, 36/5: 387-401.
- Langfeldt, Liv, et al. (2015), 'Excellence and growth dynamics: A comparative study of the Matthew effect', *Science and Public Policy*, 42: 661-75.
- Latour, Bruno and Woolgar, Steve (1986), *Laboratory Life: The Construction of Scientific Facts* Second edition edn.; London: Sage.
- Lepori, Benedetto (2011), 'Coordination modes in public funding systems', *Research Policy*, 40/3: 355-67.
- OECD (2014), *Promoting Research Excellence: New Approaches to Funding*; Paris: OECD.
- Whitley, Richard (2003), 'Competition and pluralism in the public sciences: the impact of institutional frameworks on the organisation of academic science', *Research Policy*, 32: 1015-29.

Long-term impact of R&I funders on Swedish HEIs collaboration with external actors

Tobias Fridholm
(Technopolis Group)
tobias.fridholm@technopolis-group.com

KEYWORDS: Third mission, Impact assessment, University-industry collaboration

1.1 Relevance

Few themes are more central in innovation policy than the emphasis on promoting collaboration between HEIs and other societal actors. The importance of such collaboration has been particularly emphasised and supported in Sweden, where policy makers in the 1970s established that higher education institutions (HEI), and not research institutes, would perform the lion's share of the publicly funded applied research (SOU 1980:46). In this study we present a comprehensive analysis of the impact that Swedish external funders of research and innovation have had on the collaboration between six Swedish HEIs and other societal actors. To our knowledge, no such study has previously been undertaken.

[The study was carried out 2014-2015 on commission by Vinnova. The study is published as "Långsiktig utveckling av svenska lärosätens samverkan med det omgivande samhället: Effekter av forsknings- och innovationsfinansiärers insatser. Vinnova Analys VA 2015:03 " and has the following authors: Tomas Åström, Göran Melin, Tobias Fridholm, Miriam Terrell, Sebastian Stålfors, Emma Ärenman, Karolina Henningsson, Malin Jondell Assbring, Rickard Danell och Erik Arnold. Rickard Danell represents Umeå University and independently carried out the bibliometric analysis. All other authors represent Technopolis Group. All authors are acknowledged for their contributions to the study on which this abstract is developed.]

1.2 Research aim and questions

The study aims at investigating how external funders of R&I activities at Swedish HEIs have impacted on these institutions' R&I collaboration with external actors. The period of study is 1985 to 2014, and the study is built around case studies of six HEIs: Lund University, Uppsala University, Chalmers University of Technology, Royal Institute of Technology, Linneaus University and Mälardalen University.

The investigation focuses on two main questions: i) How have the six HEIs' interests and activities in R&I collaboration with external actors evolved? ii) What impact has external funders had on the six HEIs' R&I collaboration with external actors?

1.3 Definitions

External collaboration refers to "an interactive process that creates mutual benefit, both for universities and collaboration partners" (Perez-Vico et. al. 2014).

1.4 Theoretical framework

The study is based on an institutional and relational approach. We consequently emphasise the systemic nature of research and innovation activities (Freeman 1991), as well as the power structures between individuals in different positions in the organisations, different units in the organisations, and between the organisations as such (Bathelt and Glückler 2003).

1.5 Empirical materials

We used qualitative data from academic literature, relevant policy reports, and an extensive set of documents that we acquired from the six HEIs. In addition, we conducted 62 interviews with representative for current and previous HEI managements, deans, leaders for R&D centres and projects, companies, research institutes, and collaboration partners in the public sector. The interviews typically lasted between 45 and 120 minutes. We also carried out focus groups at five of the six HEIs, attended by prominent research leaders and by staff responsible for external collaborations, and a final seminar attended by around ten leading researchers and HEI managers as well as a handful of staff members at Vinnova. We also analysed quantitative data on streams of funding for collaboration, conducted a bibliometric study and sent a web survey to 999 researchers (response rate 37 percent) that had received funding from Vinnova or the Knowledge Foundation.

1.6 Description of the methodologies

The overall methodological approach has been to address the aims and research questions from different perspectives and by using different types of data. The main reason behind the approach is that examining an issue from different perspectives by using different types of data, is a recognised method for improving empirical quality (Yeung 1997).

We also opted for a broad approach to maximise the chances of acquiring all the information we needed. In particular for the earlier parts of the period, documents and quantitative data were either of poor standard, practically inaccessible or entirely missing. Although we recognise the importance of written material in longitudinal analyses of this kind, significant parts of the material therefore had to be sourced through interviews.

1.7 Expected outcomes

The HEIs differ quite considerably in the extent to which their top management has engaged in external collaboration. Chalmers and Mälardalen University had throughout the period clear visions and goals for external collaboration. At the other HEIs, management was at the end of the 1990s hesitant to formulate an overall HEI strategy for collaboration, but only a few years later this step seems to have been taken in full. Today, collaboration has become an integral part of the HEI's missions. At all HEIs, researchers argue that the attitude towards collaboration has become more positive with time, all the way from the top managements to the researchers themselves.

The number of publications that researchers at the investigated HEIs have co-authored with external parties has increased substantially from 1990 and onwards. The increase is the greatest for co-authorships with research institutes and similar organisations (RTO), followed by companies. [The bibliometric study was undertaken by Richard Danell, Umeå University]

Our investigation clearly indicates that collaboration initiatives companies has increased over time. Several HEIs have since around 2010 entered into strategic partnerships with key parties. The partnerships typically include several scientific disciplines, as well as staff exchange and cooperation in education, research and recruitment. In large companies, strong relationships with internationally competitive R&I environments at nearby HEIs and RTOs has over time become a competitive advantage in the internal competition for R&I resources. Such companies engage in collaborative R&I to get access to knowledge and results, and to indicate which R&I topics that are important, which they expect will enhance the quality of education and improve their long-term recruitment.

A few of the HEIs have taken on a significant regional responsibilities. When it comes to concrete collaboration, organisations from the public sector are especially prominent for HEIs providing education and research in medical and health sciences, and teacher training.

At HEI top management level, anticipated impact of external funding and relationships with external parties are typically considered in major strategic decisions, although they can rarely be traced in the strategies as such.

However, Our main examples where funders have had a clear impact on the HEIs include

i) HEI managements and central administrations have gradually developed their working practices and organisations to effectively deal with funding agencies' increased demand for centralised decision-making. HEIs with large base grants and well-established research environments are however very reluctant to explicit prioritisation of specific research areas.

ii) Professional support functions for proposals, contract negotiations, intellectual property advice etc., which the HEIs usually initially built to facilitate participation in the EU framework programme, but they have gradually also been used for other purposes

iii) TTO-like units established by the HEIs during the 1990s to try to meet both governmental and societal expectations on academia becoming more accessible and to have more contact interfaces. The effects on HEIs are likely to be e.g. a higher degree of professionalism in consortia formation and proposal production, more efficient implementation of R&D results, enhanced competence among staff on management of collaboration and commercialisation

iv) Better project management: Vinnova and its predecessors have for decades required training in project management. The European Framework Programmes and later Vinnova and some other Swedish funders have sets high standards for professionalism and process thinking for proposals. Such structured working practices have also been adopted in other contexts, meaning that funding agencies' influence on HEI working practices must be considered as profound

v) A substantial increase in the number of PhDs outside academia has in many ways simplified collaboration

vi) Behavioural additionality among collaboration partners, not least in industry. Large centre programmes have

lasted for long periods of time and enabled the partners to engage in more fundamental issues and technological developments. The impact of the agencies funding R&I is in this respect however difficult to estimate, since many companies simultaneously have become less inclined to invest in long-term research.

The most powerful motivator for change in HEIs has without doubt been money. In the early 1990s, several funding opportunities requiring external collaboration arose almost simultaneously: the EU Framework Programme, the sectoral research programmes for the automotive and aerospace industries, the co-production programmes of the Knowledge Foundation and the Competence Centre programme. These programmes provided collaboration-oriented researchers with opportunities to pursue a career, and to establish R&D groups that could not otherwise have been funded.

At the same time, collaboration has as well been pushed by factors for which the R&I funders have not been responsible (Benner and Sörlin 2014):

- i) Increasingly explicit demands from the government through changes in the Higher Education Act, in appropriation letters etc.
- ii) Needs and expectations on universities formulated by organisations in wider society, to begin with mainly companies, but increasingly municipalities, counties, regions, etc.
- iii) A genuine desire from both university managements and individual researchers to contribute to the development of society
- iv) Escalating international competition between universities

Overall, there have been significant shifts in the knowledge producing environments during the investigated period, which has lead organisations and many individuals working with R&I to become more interested in collaboration. This has lead individuals interested in external collaboration to come in positions where they have been able to shape organisational strategies and resources allocations.

1.8 References

- Bathelt, H. and J. Glückler (2003). Toward a relational economic geography. *Journal of Economic Geography* 3 (2), pp. 117-144.
- Benner, M. and S. Sörlin (2014). Samverkansuppgiften i ett historiskt och institutionellt perspektiv. *Vinnova Analys*
- Freeman, C. (1991). Networks of innovators: a synthesis of research issues. *Research Policy* 20, pp. 499-514
- Perez-Vico, E. T. Hellström, N. Fernqvist, H. Hellsmark och S. Molnar (2014). Universitets och högskolors samverkansmönster och dess effekter", VINNOVA, VA 2014:09
- SOU 1980:46.
- Yeung, H. W.-C. (1997). Critical realism and realist research in human geography: a method or a philosophy in search of a method? *Progress in Human Geography* 21 (1) pp. 51-74

1D. TRACK THEME 2: INNOVATION PARADIGMS IN THE BIOECONOMY (I)

Sustainable Bioenergy Development: implications for innovation policy

Bianca Cavicchi
(Norwegian Institute of Bioeconomy Research)
bianca.cavicchi@nibio.no

KEYWORDS: Sustainable bioenergy development, Bioeconomy, Systems thinking, Causal mapping, Innovation policy

This abstract proposal responds to the track theme 2, 'Innovation Paradigms in the Bioeconomy'. It presents two case studies of bioenergy development and sustainable outcomes in a Norwegian county and an Italian region and discusses a very preliminary comparison based on the empirical findings of both cases. The study explores the extent to which bioenergy development is delivering its expected sustainable outcomes. Bioenergy policy is expected to foster rural development and agriculture/forestry growth, and mitigate climate change effects; however available evidence shows that, in some cases, its alleged benefits are not perceived, and the negative effects trigger local tensions and conflicts (OECD, 2012; Batel et al. 2013; Buchholz et al. 2009; Carrosio, 2013; Cavicchi et al, 2014; Domac et al. 2005; Geels and Raven, 2006; Mangoyama 2011; Thornley et al. 2009; Upreti, 2004; Wüstenhagen et al. 2007). Therefore, the questions are: 'What feedback processes underlie bioenergy development in the case studies? How do these affect sustainable outcomes?'

The novelty of this study is in its use of an integrated and holistic approach to sustainable bioenergy development and policy evaluation that applies the Triple Bottom Line approach and systems thinking theory. It thus seeks to go beyond the conventional techno-economic innovation approach and contribute the advancement of an innovation paradigm that includes the social dimension. The Triple Bottom Line, TBL, formerly an output of the Brundtland Commission 1987, was later introduced to business accounting and research (Elkington, 1998; OECD, 2012; Bryden et al., 2011; Brydel et al., 2013; Rogers and Ryan, 2010). The TBL considers environmental, social, economic activities and their outcomes as endogenous processes (e.g. Elkington, 1998, Bryden et al. 2008, 2011). Notably, the environmental and social outcomes of bioenergy systems are not mere externalities of economic activities but they mutually influence bioenergy development via internal feedback relations. A 'bioenergy system' is intended as the complex interrelation of causal processes that include social, economic and environmental, as well as material factors (e.g. social conflicts, profit, investments, GHG emissions and local warming, farmland). These processes are thought to be the result of regulations, actors' decisions and agency, knowledge interchanges between them and biophysical-material processes (e.g. anaerobic digestion, combustion, etc.). Based on these concepts, the study aims to develop a comparative explanation of causal processes of bioenergy development and sustainable outcomes.

The study draws on systems thinking theory (Bertalanffy von, 1968; Checkland, 1981; Senge 1990; Richardson, 1991; Forrester 1968; Sterman, 2000). Systems thinking theory is a broad theoretical tradition, which tends to see phenomena as a complex interrelation of processes characterized by feedback relations. Feedback relations are the cause of structural constraints (e.g. Forrester, 1994; Senge, 1990). Given that the discipline includes different understandings of how systems emerge and develop - i.e. constructivist-interpretative and positivist philosophies (see for instance Checkland, 1981; Forrester, 1994; Lane and Oliva, 1998; Lane, 1999, 2000) - this study finds its theoretical ground in between these, and particularly in the work of Senge (1990, 1994) and Checkland (1981). Thus, it understands bioenergy development as a complex system made of interconnected social and physical processes interpreted by located actors (see Land 1999, 2000; Senge, 1990). Assuming that that people hold different visions of the world (or problem under investigation), the feedback interrelations of different mental models shape the trajectory of change. These feedbacks may lead to unexpected consequences that eventually alter the direction of change. Senge (1994) proposes a set of systems archetypes (pp. 121- 150) that can help understanding the forces that drive the system's trajectory and test the mental models about those systems (p.121). To this purpose, the study employs qualitative system dynamics, i.e. causal mapping via causal loop diagram - CLD (see for instance the work of Haraldsson, 2004; Maani, 2002; Maani and Cavana, 2007; Spector et al., 2001; Cavana and Mares, 2004; and on archetypes Atwater&Pittman, 2006; Warwick, 2008). A CLD enhances the understanding of how different stakeholders' views of a problem interrelate and trigger certain processes and outcomes. Undoubtedly, CLDs and archetypes are an oversimplification of reality but, as

such, may assist and enhance issue structuring, organizational learning and problem solving (see for instance Checkland, 1981; Senge, 1990; Wolstenholme, 1999). The comparison will make use of the systems archetypes to explain the case studies' outcomes and shed light on the combination of social, institutional and material factors that produce [un]sustainability thus contributing the understanding of a sustainable bioeconomy innovation paradigm.

The two case studies are respectively biogas in Emilia Romagna (Italy) and forest-based bioheat in Hedmark County (Norway). The two cases are similar on the extent of bioenergy adoption, available resources (i.e. natural, human, technical and knowledge), link between existent industries (i.e. forestry and agriculture) and bioenergy. They differ on institutional and policy framework, and to some extent on triple bottom line processes and outcomes. They both present sustainability issues but on different dimensions, e.g. on the three bottom-lines in Emilia Romagna, and on economic and social lines in Hedmark. The paper uses causal mapping and qualitative methods for data collection. These include semi-structured interviews, public documents and policy analysis, public reports and databases and relevant literature. This raw data was processed into the causal loop diagrams via an iterative and reflexive process that matches and crosschecks interview data with official public and policy documents, relevant publications and statistics (see for instance Noble and Smith, 2016; Shenton, 2004; Golafshani, 2003; Silverman, 2001; Yin, 1994; Alvesson and Sköldbberg, 2009). This process is aimed to assure the validity and reliability of CLDs and empirical findings. Empirical findings suggest that the most critical feedback processes for sustainability occur within the biomass and land-related resources use and social legitimization. Notably, when the price of biomass is too high, suppliers may not have incentives to provide it, while consumers (i.e. bioenergy producers) would see an increase in the overall costs. Additionally, the fast growing use of a limited natural resource such as farmland (or forests) may increase the costs for users and lead to social conflicts. Beyond this, cooperation and local synergies are determinant of continuous adoption and use of bioenergy, its long-term economic feasibility and redistribution of economic benefits. These processes also affect environmental sustainability, which seems to be more preserved where local cooperation is constant and redistribution mechanisms are at play.

These findings could contribute to the innovation paradigm and policy by stressing the focus on platform building, learning and knowledge sharing, besides technology-oriented initiatives. Additionally, inclusive governance (i.e. participation of public and private, national and local actors) should be promoted and supported where it is not in place. Other related issues should be covered, as for instance adaptable environmental criteria, diversified incentives as both in terms of technology (e.g. demand and supply, both within biomass and bioenergy production) and participatory learning processes.

References

- Alvesson, M. and Sköldbberg, K. 2009. *Reflexive Methodology*. New Vistas for Qualitative Research, Sage Publications, second edition.
- Atwater, J. B. and Pittman, P. H. 2006. Facilitating systemic thinking in business classes, *Decision Science Journal of Innovative Education* 4 (2), pp. 273-292.
- Batel, S., et al. (2013) Social acceptance of low carbon energy and associated infrastructures: A critical discussion. *Energy Policy*, 58,, 1–5
- Bennet, A., Elman, C. 2006. QUALITATIVE RESEARCH: Recent Developments in Case Study Methods. *Annual Review Political Science* 9, pp. 455–76.
- Bennet, A., The mother of all isms: Causal mechanisms and structured pluralism in International Relations theory. *European Journal of International Relations* 19(3), pp. 459-481.
- Bryden, J. et al. (2011) Towards Sustainable Rural Regions in Europe. Exploring Inter-Relationships Between Rural Policies, Farming, Environment, Demographics, Regional Economies and Quality of Life Using System Dynamics. Routledge, Taylor&Francis, New York and London.
- Bryden, J.M., et al. (2013) Governing Innovation for Sustainable Development: Designing Creative Institutions, Working Paper 2013-5, Norsk Institutt for Landbruksøkonomisk forskning, Oslo.
- Buchholz, T.S., et al. (2009) Sustainability criteria for bioenergy systems: results from an expert survey. *Journal of Cleaner Production*, 17, S86–S98.
- Carrosio, G. (2013) Energy production from biogas in the Italian countryside: Policies and organizational models. *Energy Policy* 63, 3-9.
- Cavana, R.Y., Mares, E.D., 2004. Integrating critical thinking and systems thinking: from premises to causal loops. *System Dynamics Review* 20(3), pp. 223-235.
- Cavicchi, B. et al. (2014) A comparison of bioenergy policies and institutional frameworks in the rural areas of Emilia Romagna and Norway. *Energy Policy* 67, 355-363.
- Checkland, P. 1981. *Systems thinking, systems practice*. Wiley
- Domac J. et al. 2005. Socio-economic drivers in implementing bioenergy projects, *Biomass and Bioenergy*, 28, pp. 97-106.
- Elkington, J. (1998) Partnerships from Cannibals with Forks: The Triple Bottom line of 21st Century Business. *ENVIRONMENTAL QUALITY MANAGEMENT*, 37-51.
- Elman, C. 2005. Explanatory Typologies in Qualitative Studies of International Politics. *International Organization* 59(02), pp. 293 – 326,
- Forrester, J. 1968. *Principles of Systems*, 2nd ed. Pegasus Communications
- Forrester, J. 1994. *System dynamics, systems thinking and soft OR*. System Dynamics Review.
- Geels, F., Raven, R. 2006. Non-linearity and Expectations in Niche-Development Trajectories: Ups and Downs in Dutch Biogas Development (1973–2003). *Technology Analysis & Strategic Management*, Special Issue: The Sociology of Expectations in Science and Technology, 18 (3-4), 375-392.
- Golafshani, N. 2003. Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report* 8(4), pp. 597-607, <http://www.nova.edu/ssss/QR/QR8-4/golafshani.pdf>
- Haraldsson, H.V. 2004. Introduction to Systems and Causal Loop Diagrams. Report 1:2004, Reports in ecology and environmental engineering, Lund University.
- Lane, D. 1999. Social Theory and system dynamics practice. *European Journal of Operational Research* 113, 501-527.
- Lane, D. 2001. Rerum cognoscere causas: Part II – Opportunities generated by the agency/structure debate and suggestions for clarifying the social rhetoric position of system dynamics. *System Dynamics review* 17 (4), 293-309.
- Maani, K. E. (2002). Consensus Building through Systems Thinking - The Case of Policy and Planning in Healthcare. *Australian Journal of Information Systems*, 9(2), 84-93.
- Maani, K., E., Cavana, R., Y. 2007. *Systems Thinking, System Dynamic: Managing Change and Complexity* (2 ed.). Pearson: Prentice Hall.
- Mangoyama, B., Smith, TF. 2011. Decentralized bioenergy systems: a review of opportunities and threats. *Energy Policy* 39, 1286–1295.

- Noble, H., Smith, J. 2016. Issues of validity and reliability in qualitative research. *Research made simple* 18, pp. 34-35. 10.1136/eb-2015-102054
- OECD, 2012. Linking Renewable Energy to Rural Development. OECD Publishing, Paris <http://dx.doi.org/10.1787/9789264180444-en>. (OECD Green Growth Studies).
- Richardson, G. 1991. *Feedback thought in Social Science and Systems Theory*. Pegasus Communications, University of Pennsylvania Press, Philadelphia.
- Rogers, M., Ryan R. 2010. The Triple Bottom Line for Sustainable Community Development, Local Environment. *The international Journal of Justice and Sustainability* 6 (3), 279-289.
- Senge, P. 1990. *The Fifth Discipline: the art and practice of the learning organization*. New York, Doubleday.
- Silverman, D. 2001. *Interpreting qualitative data: methods for analysing talk, text and interaction*, 2nd ed. London: Sage, 2001.
- Shenton, A.K. 2004. Strategies for ensuring trustworthiness in qualitative research projects. *Education for information* 22, pp. 63-75.
- Spector, J.M. et al. 2001. Models and simulations for learning in complex domains: using causal loop diagrams for assessment and evaluation. *Computers in Human Behavior* 17 (5-6), pp. 517-545.
- Sterman, J. 2000. *Business Dynamics. Systems thinking and modeling for a complex world*. Irwin McGraw-Hill, United States.
- Thornley, P. et al. 2009. Sustainability constraints on UK bioenergy development. *Energy Policy*, 37 (12), 5623-5635.
- Upreti, B.R. 2004. Conflict over biomass energy development in the United Kingdom: some observations and lessons from England and Wales. *Energy Policy* 61, 802-810.
- Yin, R.K. 1994. *Case study research: design and methods*, 2nd ed., Thousand Oaks: Sage, 1994, Applied Social Research Methods Series, Vol. 5.
- Warwick, J. 2008. Modelling the demand for learning resources in academic libraries. *Library and Information Research* 32 (101), pp. 23-38
- Wolstenholme, 1999. Qualitative vs Quantitative Modelling: The Evolving Balance, *Journal of the Operational Research Society* 50(4), pp. 422-428
- Wüstenhagen, R., et al. 2007. Social acceptance of renewable energy innovation: An introduction to the concept. *Energy policy* 35, 2683-269

Policy supported innovation network formation in the bioeconomy – the case of biorefinery technology innovation in Sweden

Fredric Bauer*(Lund University), Teis Hansen(Lund University), Hans Hellsmark(Chalmers University of Technology) and Johanna Mossberg(CIT Industriell Energi)
fredric.bauer@chemeng.lth.se

KEYWORDS: Bioeconomy, Biorefineries, Innovation networks, Social network analysis

1. Relevance

The idea of a sustainable bioeconomy is being promoted ever more often as the next needed and necessary structural transformation of the economy and society by global actors such as the OECD, the IEA and the WEF, as well as by the EU (McCormick and Kautto, 2013) and national governments (Staffas et al., 2013). In the realm of policymaking, increasing attention is also given to the bioeconomy as it is seen as a key part of the solution to multiple grand challenges, e.g. climate change, resource scarcity, and energy security (Coenen et al., 2015). Efforts to promote the bioeconomy through innovation can thus be seen as a form of mission-oriented policy (Mazzucato and Penna, 2015). An important sector of a future bioeconomy is biorefining, which will be crucial for the production and refining of fuels, chemicals, materials and energy. Biorefineries are argued to be both a remedy for industry sectors struggling for survival in a changing global economy, such as the forestry sector (Kleinschmit et al., 2014), as well as an important pathway to reduce the demand for fossil resources throughout the economy (Kircher, 2014).

While many strategies use different operationalizations of the bioeconomy, ranging from an emphasis on industrial biotechnology to one on resource efficiency, they do share the understanding of the bioeconomy as an indispensable part of our future society. Irrespective of the exact understanding of the bioeconomy, a number of key characteristics of bioeconomy innovation processes are frequently emphasised, specifically, the need for collaboration across industries, sectors and national boundaries. Even though interactions and networks have been pointed towards as important factors within innovation studies research for a long time, it seems that these aspects of innovation are being highlighted in the bioeconomy discourse. Important policy instruments relating to these issues are different forms of RDI support, encouraging collaborations between private and public actors, firms from different sectors, and international collaborations – all intended to expand and strengthen the networks in the innovation system. However, we argue that there is a lack of systematic assessment of the extent to which these characteristics are indeed frequently associated with bioeconomy innovation processes.

2. Research aims and questions

Our aim is to contribute to the literature on innovation processes and paradigms in the bioeconomy by empirically analyze innovation processes in Sweden related to biorefinery technology innovation. The focus of the study is the formation and development of innovation networks comprising both private and public actors.

Our two research questions are:

- In what ways are innovation networks in the bioeconomy bridging sectors and regions?
- Do innovation networks in the bioeconomy evolve to become more diverse?

3. Definitions

Biorefinery – a processing plant converting biomass feedstocks into different products, such as chemicals, materials, fuels, fibres, and energy, analogous to a petroleum refinery.

Biorefinery technology – platform technologies being developed to be used in future biorefineries. Categorized as biomass gasification, torrefaction, lignin conversion, or biochemical sugar conversion.

Innovation network – interconnected network of actors (firms, universities, research institutes, and government agencies) in the innovation system collaborating on developing, diffusing, or using new technologies.

4. Theoretical framework

The understanding of innovation as an interactive process between multiple actors has been well-established since early work on innovation systems (Freeman 1987, Lundvall 1988) and supporting network formation is thus an important activity for innovation policy (Borrás and Edquist, 2013). Today, such collaborations are of growing importance due to the faster diffusion of knowledge and the increasing technological complexity of the economy (Powell, Koput and Smith-Doerr 1996, Amin and Cohendet 2004). Thus, it is now very rarely the case

that all the competencies needed for a given innovation project are available within a single organisation. This implies that participation in inter-organisational innovation projects becomes more frequent and important (Grabher 2002).

As highlighted in the seminal work by Cohen and Levinthal (1990), absorptive capacity is needed to interpret and exploit new knowledge, and inter-industry collaborations require higher degrees of absorptive capacity. However, while inter-industry collaborations may be effective, they may also lead to a limited degree of novelty (Nooteboom et al., 2007). Thus, collaborations between similar firms may have a limited effect on innovativeness (Sampson 2007) and the more similar collaborations are, the less diverse are the resulting innovations (van Rijnsoever et al., 2015). This can be explained by a higher propensity to think along similar lines and thereby overlook superior alternatives (Frenken, Hekkert and Godfroij 2004), and an inability to provide different distinct resources, which can be recombined into new innovations (Jensen, Johnson, Lorenz and Lundvall 2007).

Implicitly, the argument made in work by academics and policymakers on the bioeconomy is that innovation in this field requires a particularly high degree of novelty creation, which necessitates collaboration across industries, despite the negative effects on collaboration effectiveness. This prompts the question to what degree policies aiming to support the formation of innovation networks in the bioeconomy manage to engage with a truly diverse set of actors and go beyond traditional, sectoral collaborations.

5. Empirical materials

The empirical materials used for this study were documents – formal project proposals and government agency decisions – describing biorefinery technology innovation projects from 2002-2014, which were co-funded by the Swedish Energy Agency (SEA), or the Swedish Innovation Agency (VINNOVA), as well as private partners. The projects were identified in online databases using search terms reflecting the identified technology platforms, and all relevant documentation was then requested from the agencies. Through the descriptions of the projects the participating actors, their contribution, and the relations between projects were identified.

6. Description of the methodology

We make use on social network analysis (SNA) to study the innovation network engaged in biorefinery technology innovation. A database was created, describing all the identified projects, enabling the creation of a 2-mode network of projects and organizations. A 1-mode network of organisations and their collaborations was formed from the 2-mode network. The network of collaborating actors was then been mapped and analysed using the SNA softwares Gephi and R. Initial analyses focused on structural properties of the network (e.g. density, centrality and community detection), whereas final analyses will focus on the dynamics of the network development in three four-year periods using the stochastic actor-based model for network dynamics SIENA (Snijders et al., 2010).

7. Expected outcomes

Collaborations do not stretch across the entire network for most actors. Indeed, several subgroups were identified with modularity class algorithms, showing that collaborations are mainly limited within smaller networks. The analyses shows that actors in the network most often collaborate within their own sector and that cross-industry collaboration is not a prominent feature of these networks. Further, the network also shows that many actors tend to collaborate with other actors in their region. Thus, despite the need for new knowledge geographical proximity is still an important factor for these innovation networks.

The scientific contribution is thus new empirical knowledge about innovation networks in the bioeconomy, showing that it may be questionable to claim that innovation in the bioeconomy is a radically new paradigm. For policy makers it is relevant to note that supporting network formation through project co-funding and collaborations is by no means a guarantee for a diverse network. If diversity and cross-sectoral collaborations are important goals for the policy this must be emphasized, as tendencies of streamlining collaborations are otherwise clear.

References

- Amin A, and Cohendet P (2004) *Architectures of Knowledge: Firms, Capabilities and Communities*. Oxford, Oxford University Press
- Borrás, S, Edquist, C (2013). The choice of innovation policy instruments. *Technological Forecasting and Social Change*, 80 (8): 1513–1522
- Coenen L, Hansen T, and Rekers JV (2015) Innovation Policy for Grand Challenges. *An Economic Geography Perspective*. *Geography Compass*, 9 (9): 483–496
- Cohen WM, and Levinthal DA (1990) Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly* 35 128–152
- Freeman C (1987) *Technology Policy and Economic Performance: Lessons from Japan*. London, Frances Pinter
- Frenken K, Hekkert M, and Godfroij P (2004) R&D portfolios in environmentally friendly automotive propulsion: Variety, competition and policy implications. *Technological Forecasting and Social Change*, 71 (5): 485–507

Grabher G (2002) Cool Projects, Boring Institutions: Temporary Collaboration in Social Context. *Regional Studies*, 36 (3): 205-214

Jensen MB, Johnson B, Lorenz E, and Lundvall B-Å (2007) Forms of knowledge and modes of innovation. *Research Policy*, 36 (5): 680-693

Kircher, M (2012) The transition to a bio-economy: emerging from the oil age. *Biofuels, Bioproducts and Biorefining*, 6 (4): 369–375

Kleinschmit, D. et al. (2014) Shades of green: a social scientific view on bioeconomy in the forest sector. *Scandinavian Journal of Forest Research*, 29 (4): 402-410

Lundvall B-Å (1988) Innovation as an interactive process: from user-producer interaction to the national system of innovation. In: Dosi G, Freeman C, Silverberg G and Soete LL (Eds.) *Technical Change and Economic Theory*. Pinter, London 349-369

Mazzucato, M, and Penna, C (Eds.) (2015) *Mission-Oriented Finance for Innovation: New ideas for investment-led growth*. Rowman & Littlefield International.

Nooteboom B, Van Haverbeke W, Duysters G, Gilsing V, and van den Oord A (2007) Optimal cognitive distance and absorptive capacity. *Research Policy*, 36 (7): 1016-1034

McCormick K, and Kautto N (2013) The Bioeconomy in Europe: An Overview. *Sustainability*, 5 (6): 2589-2608

Powell WW, Koput KW, and Smith-Doerr L (1996) Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology. *Administrative Science Quarterly*, 41 (1): 116-145

Sampson RC (2007) R&D Alliances and Firm Performance: The Impact of Technological Diversity and Alliance Organization on Innovation. *The Academy of Management Journal*, 50 (2): 364-386

Snijders TAB, van de Bunt GG and Steglich C (2010) Introduction to actor-based models for network dynamics. *Social Networks*, 32 (1): 44–60.

Staffas L, Gustavsson M, and McCormick K (2013) Strategies and Policies for the Bioeconomy and Bio-Based Economy: An Analysis of Official National Approaches. *Sustainability*, 5 (6): 2751-2769

van Rijnsoever FJ, van den Berg J, Koch J, Hekkert MP (2015). Smart innovation policy: How network position and project composition affect the diversity of an emerging technology. *Research Policy* 44 (5): 1094–1107

CAPABILITIES TOWARDS BIOECONOMY: ANALYSING REGIONAL CAPABILITIES AND THE ROLE OF REGIONAL INNOVATION POLICY IN THE THREE FINNISH CASE-REGIONS

Valtteri Laasonen* and Jari Kolehmainen

University of Tampere

*valtteri.laasonen@mdi.fi

KEYWORDS: Bioeconomy, Capabilities, Innovation policy, Resource-based view

1. Relevance

The rise of the bioeconomy (or bio-based economy) has become one of the key drivers of the renewal of the Finnish economy. The concept of the bioeconomy is very multifaceted (Birch & Tyfield, 2012), but generally speaking it can be defined as a branch of economy which relies on the use of renewable biological resources to produce food, energy, products and services (European Commission, 2012; The Finnish Bioeconomy Strategy, 2014). The bioeconomy is also one of the key substance areas of the research and innovation policies conducted by European Union (e.g. Horizon 2020). In Finland, the rise of the bioeconomy has also been recognized in the field of innovation policy. The course has been set for a low-carbon society and a sustainable economy and because of the considerable expertise accumulated in refining biomasses and a strong industrial background Finland is seen to have an outstanding position to develop and facilitate innovation within the field of the bioeconomy. In this respect, the focus is on the knowledge-based bioeconomy, in which the role of new technology, scientific knowledge and innovation activities is fundamental. Consequently, the regional innovation system and innovation policy have crucial role when aiming towards a more economically, socially and sustainable bioeconomy.

The literature concerning regional innovation systems (RIS) has become both a conceptual and analytical tool and a key component of innovation policy discourse stressing the need to implement policies to strengthen and renew innovation system itself (Uyarra & Flanagan, 2010). Over the last two decades the regional innovation system has been a major conceptual framework to understand knowledge and innovation-driven regional development. Nonetheless, few studies have revealed the role of capabilities in knowledge-based regional development and innovation policy. We still don't know much about the multi-layered nature of these capabilities, how they appear in regional networks and what is the role of innovation policy on these resources and capabilities.

2. Research aims and questions

In this paper, the regional development measures and processes related to knowledge-based bioeconomy are analysed. The aim is to shed light on the very essence of regional renewal process and the role of regional innovation policy by reflecting the regional resource and knowledge base and identifying capabilities of the private firms and public organisations developing and facilitating innovation within the field of the bioeconomy. Thus, we pose the following two research questions: 1) What kind of resources and capabilities are identified when developing the knowledge-based bioeconomy on the regional level? and 2) What is the role of regional innovation policy in mobilizing, renewing, building and acquiring new resources and capabilities for economic renewal?

3. Theoretical framework and definitions

The point of departure of our paper is that developing and facilitating innovation within the field of the bioeconomy calls for new measures, procedures and capabilities both from private firms and public organisations. This notion is linked to more general development trends in regional innovation activities. Capabilities of the actors involved in innovation processes and activities are in the core of regional innovation systems and regional renewal processes towards bioeconomy.

Influenced by resource based view of the firm (Penrose, 1959; Wernerfelt, 1984; Barney, 1991; Hamel & Prahalad, 1996) a stream of literature has formed, examining regional innovation system's inner dynamics by stressing the role of regional resources and capabilities (e.g. Lawson, 1999; Maskell & Malmberg, 1999; Lawson & Lorenz, 1999; Harmaakorpi, 2004; Cooke, 2007; Pihkala et al., 2007). According to this literature economic renewal and the region's ability to compete is linked to and embedded in regional (unique) assets and capability

of regions to utilize and renew these assets and capabilities (e.g. Lawson, 1999; Maskell & Malmberg, 1999; Harmaakorpi, 2004). Thus, it is relevant to analyse capabilities of regional actors and networks to renew and/or create new knowledge and businesses for economic renewal – in this case towards bioeconomy.

Following the idea of resource-based view and capability framework (see e.g. Wang and Ahmed, 2007; Vesalainen and Hakala, 2014) we need to understand the multi-layered nature of capabilities in regional innovation activities. We also need to grasp the contexts in which complex networked policy making processes take place and influence innovation and research. Thus regional innovation activities rests on available resource and knowledge base and actors' capability to exploit diverse resource and knowledge. But to fully exploit the potential of organisational level resources network level capabilities are needed to connect resources widely distributed within a region and link them to external strategic interactions. This is where also innovation policy may have role to mobilize, renew, build and acquire new resources and capabilities for economic renewal, i.e. directing and influencing the regional innovation activities.

4. Empirical material and description of the methodologies

The paper is a work in progress. The analysis is based on case studies conducted in three Finnish city-regions, namely Seinäjoki, Jyväskylä and Joensuu. These city-regions have been chosen as the leading ones in the context of the bioeconomy and they are part of the national INKA (Innovative Cities) programme. The aim of the programme is to generate new business and new companies from high-quality competence within the field of sustainable bioeconomy. The programme is underpinned by close local cooperation and pooling of resources between science, education, companies and the government. All three case regions specialise with their own focus in bioeconomy. Jyväskylä region has a focus in resource-wisdom solutions, bio products (especially on fiber based solutions), biomass burning technologies, building and forestry machinery, Seinäjoki region focuses on agrobioeconomy and sustainable and effective solutions for food systems and Joensuu has a focus in forest bioeconomy, forest biomass technology, new materials, software industry and innovation technology. The empirical data analysis rests on a combination of document analysis and personal in-depth interviews with recognised key stakeholders in the regions mentioned above. The interview data was gathered through 41 semi-structured interviews with regional and business development agencies, municipalities, universities, research institutes and companies operating in the field of bioeconomy. The interviews were conducted between October 2015 and January 2016 and they were recorded and transcribed.

5. Expected outcomes

This study is expected to have important implications for both academics and policy makers. Preliminary analysis of the results indicates that studies on innovation policy should pay more attention to develop capabilities of the actors involved in innovation processes and network level capabilities to connect regional resources and capabilities and link them to external strategic interactions. This study guides towards more analytical understanding of capabilities in regional innovation activities and enlightens crucial elements and bottlenecks in networked development processes in the context of the bioeconomy.

REFERENCES

- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17, pp.99–120.
- Birch, K., & Tyfield, D. (2012). Theorizing the Bioeconomy: Biovalue, Biocapital, Bioeconomics or . . . What? *Science, Technology & Human Values*, 38(3), 299–327.
- Cooke, P., 2007. To Construct Regional Advantage from Innovation Systems First Build Policy Platforms. *European Planning Studies*, 15(2), pp.180–194.
- Harmakorpi, V. (2004). Building a competitive regional innovation environment – the regional development platform method as a tool for regional innovation policy. Helsinki University of Technology, Lahti Center.
- European Commission (2012). Innovating for Sustainable Growth: A Bioeconomy for Europe. Communication from the Commission to the European Parliament, the Council, The European Economic and Social Committee and the Committee of the Regions. <http://ec.europa.eu/research/bioeconomy/pdf/official-strategy_en.pdf>
- The Finnish Bioeconomy Strategy (2014). Sustainable growth from bioeconomy - The Finnish Bioeconomy Strategy. <http://biotalous.fi/wp-content/uploads/2014/08/The_Finnish_Bioeconomy_Strategy_110620141.pdf>
- Horizon (2020). Horizon 2020 – Work Programme 2014-2015. Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy. <http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-food_en.pdf#page=62>
- Lawson, C. (1999). Towards a competence theory of the region. *Cambridge Journal of Economics*, 23(2), pp.151–166.
- Lawson, C. & Lorenz, E., 1999. Collective Learning, Tacit Knowledge and Regional Innovative Capacity, 33(4), pp.305–317.
- Maskell, P. & Malmberg, A. (1999). Localised learning and industrial competitiveness. *Cambridge Journal of Economics*, 23 (2), pp.167–185.
- Pihkala, T., Harmaakorpi, V. & Pekkarinen, S., 2007. The role of dynamic capabilities and social capital in breaking socio-institutional inertia in regional development. *International Journal of Urban and Regional Research*, 31(4), pp.836–852.
- Penrose, E. (1959). The theory of the growth of the firm. Oxford University Press.
- Uyarra, E., 2010. What is evolutionary about “regional systems of innovation”? Implications for regional policy. *Journal of Evolutionary Economics* Econ, 20, pp.115–137.
- Vesalainen, J., & Hakala, H. (2014). Strategic capability architecture: The role of network capability. *Industrial Marketing Management*, 43(6), 938–950.

Wang, C. L., & Ahmed, P. K. (2007). Dynamic capabilities: A review and research agenda. *International Journal of Management Reviews*, 9(1), 31–51.

Wernerfelt, B. (1984). A Resource based view of the firm. *Strategic Management Journal*, 5(2), pp.171–180.

THE BUSINESS OF BIOECONOMY: PATENT RACES IN LIGNOCELLULOSIC BIOFUELS

Hannes Toivanen*(VTT) and Michael Novotny(KTH Royal Institute of Technology)

*hannes.toivanen@teqmine.com

KEYWORDS: Bioeconomy, Patent Analysis, Commercialization of research, Biofuels, Innovation

The notion of “Bioeconomy” has gained recently significant traction as a phenomenon requiring society, even global, wide coordinated transition towards cleaner and more sustainable socio-technological system. Much of recent scholarly literature on Bioeconomy and policy (Novotny and Laestadius 2014; McCormick and Kautto 2013) has focussed on the governance and policy aspects (Hekkert et al. 2007) of this looming transition, and while we agree much of this literature, this paper argues that the focus of this type of analysis should be redirected to more operative aspects of this transition. Currently, calls for governance or transition models are overlooking how the actual implementation of Bioeconomy is already changing some of its aspects.

The central point of this paper is to explore how the actual activity of implementing of Bioeconomy through technological innovations and firms is re-shaping the nature of innovation and innovation trajectories. To this end, we demonstrate in detail how the broader social, economic and technological features of lignocellulosic biofuels are being transformed because of the on-set of a patent race. The escalating economic and business interest in new, promising, technology is translated into rapidly increasing claims for intellectual property rights (IPR), and the nature, intensity and extent of this phenomenon are such that the very nature of lignocellulosic biofuels technology development and industrial mobilization are transformed.

Lignocellulosic biofuels form an important part of the emerging family of sustainable and renewable biofuels family. The second generation, i.e. non-food, applications of lignocellulosic biofuels are particularly potent in recasting energy dependency, energy system, and energy economics in wood rich regions, and have attracted considerable interest by governments, academia, and industry globally.

This paper offers a focussed patent analysis of lignocellulosic biofuels, and in particular analysis confirms to what extent the technology is emerging and to what extent we can identify clear signs of patent races. Furthermore, by detailing the nature and speed of technological change, we discuss how the paradigm of innovation in this particular sub-category of Bioeconomy may be changing, and consider more broadly how the nature of inventive and business activity may be changing at the frontiers of Bioeconomy.

In more detail, we ask: How increasing economic and technological interest in biofuels shapes the nature of intellectual property rights (IPR) of concerned technological fields, and the nature of inventions themselves? This article provides a patent analysis of lignocellulosic biofuels with U.S. patent publications between 2002 and 2015 in order to cast light on the broader economic and regulatory factors affecting the development of new technologies in the area. Specifically, we analyse in what ways the nature of lignocellulosic biofuel technologies, and indeed the business itself, is transformed by the increasing research and development and IPR effort. Our results show a relatively small, but a nascent technology, with some key technology areas increasing 4 or up to 10 fold over the last decade. Such intensified and industry wide claims for IPR reveals an on-going patent race with multiple implications for the industry and engineering community. Most importantly, industry’s technological inter-dependence is likely to increase as the likelihood for broad exclusive patent regimes diminishes, making the industry more likely to increasingly explore collaborative technological solutions when investing in new production facilities in the future.

Methods and Data

To process data, we have used semi-supervised learning processes to focus, classify, analyse, data. Unsupervised learning part has consisted of application of Latent Dirichlet Allocation (LDA) based algorithm to the data as described below, whereas supervised and semi-supervised learning parts have been employed in the text-mining strategy, iteration of LDA results, and application of technology class (IPC) categories to focus data. Our eventual presentation will detail methods in full.

Patent data was obtained from the USPTO patent data base maintained by Teqmine Analytics Ltd, which is based on USPTO issued XML-publications. The data for analysis was prepared in five steps for final analysis. In the first phase, we text mined all USPTO full-text publications between 1990 and 2015 (inclusive) with the key words string “lign” and “fuel”. This search yielded 82 580 publications. In the second phase, this data was processed with LDA and all records allocated into 20 topics. By visual inspection and using four reference patents (e.g. US20140256979A1 and US20130333652A1) we identified two topics capturing patents focussing

on pyrolysis and catalyst in biomass and hydrocarbon context. Patents in this area totalled 5144. In the third phase, the 4803 patents were divided with the LDA into 10 topics (see below for methods).

Fourth phase consisted of selecting the final patent pool providing best evidence on recent evolution of the lignocellulosic fuel technology. To this end, data was limited to publications between 2002 and 2015 (inclusive) and kind types A1, B1, P1 and P2. These cover first time publications of utility and plant patent applications, as well as first time publication of granted patents without prior publications. Because the data continued to include noise and patents of no immediate relevance to lignocellulosic fuel processing technologies, we excluded redundant patents from the data.

To this end we visually inspected the Topic Modelling classification, as well as analysed the classification of our above mentioned reference US patents. More importantly, we controlled our LDA results by comparing our results with the International Patent Classification (IPC) at record level. This work confirmed that the Topic 9 captured effectively all patents that were of relevance to us, and as demonstrated in Table 1. that depicts Topic distribution of patents by World International Patent Organization introduced 33 aggregate technology categories of the IPC classifications.

The fifth and final stage of data processing consisted of eliminating as much as possible redundant data from the selected Topic 9. Consisting of 2562 records, the Topic 9 is effectively contaminated with unrelated patents addressing mostly Fuel Cell, Pharmaceutical, and Lubricant patents. While Pharmaceutical and Lubricant patent areas are technologically closely related to lignocellulosic fuel processing, Fuel Cell technologies carry are only linguistic similarity. Elimination of such “noise” form patent data is an enduring patent analysis challenge, and a pre-requisite of credible analysis. Thus, we resorted to use a sample of record level IPC classifications to choose patents for the final analysis data.

Final lignocellulosic biofuel technology patent data consisted of 1069 records, and – in our judgement – included at most very few non-relevant patents and captures effectively relevant USPTO patent publications bearing upon lignocellulosic fuel processing and production technologies.

Results

Lignocellulosic biofuels embodies relatively small but a nascent technology area. Annual patenting in the technology has increased about 8 fold between 2002-2015 to about 130-160 annual filings. An increase in patenting rate of this size can only be interpreted as significant – although we have not controlled for divisional applications or patent families-, suggesting intensified technological and economic interest in the technology. Given its recent growth and likelihood of continued intense technological research and development, lignocellulosic biofuels is appropriately characterized as an emerging technology with high probability of patent races.

Table 1. Lignocellulosic Biofuel Patents, 2002-2015

The increased patenting rate may also be interpreted as changed nature of technology or inventions, and can also carry implications for competitive strategies. Whereas early lignocellulosic biofuel patents often embodied wider claims and were filed within relatively vacant patent space, contemporary patent applications must navigate an increasingly tense and occupied IPR space. This development can translate to more narrow and focussed claims in patents, as well as establish increasing inter-dependency between key patent portfolio owners and prompt the need for a range of new collaboration strategies.

Table 2. Technological Inter-Relatedness of Patents, 2002-2015.

Lignocellulosic biofuel technologies are evidently growing in size, to the extent that they are best described as “emerging technology”. Here we turn to analyse whether this growth is accompanied by shifting technological focus, and, more specifically, what are the key technological focus areas within lignocellulosic biofuels R&D effort, and are they displaying different dynamics? To answer this question, Table 2.. shows annual filings by key IPC class level for the largest technology groups.

Lignocellulosic Biofuel patenting concentrates on four technology class areas, of which the C07C “Acyclic or carbocyclic compounds”, especially covering electrolysis approaches, is the most significant, covering almost 40% of all Lignocellulosic Biofuel patents. Almost non-existing as Lignocellulosic Biofuel technology in the early 2000s, contemporary patenting in the IPC class is between 60 and 100, and demonstrates how rapidly technological and economic interest in the area have proliferated. This class and patents selected through our methods constitute a key technology Second key area is established by the IPC class area C10L, “Fuels not otherwise provided for”, which covers some 28% of total patenting in lignocellulosic biofuels area, and totals some 25-40 patents per year. Although this technology area has substantially increased since 2002, it cannot be

characterized as “emerging”. Area’s patenting has declined substantially in the early 2002’s, and has begun to recover only recently. While we have made an effort to eliminate pure fuel additives and lubricants from the selection, this group continues to include to some degree patents that focus more at these technology areas rather than biofuels. However, often it is difficult to establish a clear demarcation between wood-based fuels, fuel additives and lubricants.

IPC class B01J, “Chemical or physical processes, e.g. Catalysis...” embodies another clearly emerging, yet small technology area. Patenting in the area has increased within lignocellulosic biofuels from practically nothing to about 20-40 per year, and it captures more than 10% of the whole patent group. Class C12P, “Fermentation or enzyme-using processes to synthesize....” captures also some 10% of total lignocellulosic patenting volume. It is best described as moderately emerging, increasing from few annual patents to about 15-30 between 2002 and 2015.

Technologically, patents assigned to B01J, C07C, and C12P in our patent data embody the core technologies for the emerging lignocellulosic biofuels production technologies and methods, and are likely to continue to high growth rates in the near future. C01L class includes a significant number of patents relevant to lignocellulosic biofuels, but it remains a challenge to separate biofuels patents from fuel additives and lubricants in the class.

Table 2. describes an emerging technology that clearly concentrates on few key technologies. Investment in research and development of lignocellulosic biofuel technologies is likely to continue on current or increased rate in the near future, and likely the key technologies will demonstrate more pronounced growth dynamics.

Conclusions

Given the fact that R&D and patenting in lignocellulosic biofuels is increasing substantially, several key countries and cities are in practice being transformed into repeat invention hubs, producing an increasing number of intellectual property claims with the business area. This interpretation is strengthened by the fact that much of the leading actors in key regions are firms, either incumbent industry leaders or highly specialized new entrants. This development likely to exercise significant impact on the nature of lignocellulosic biofuel business, as well as shape the nature of patenting and technological trajectories.

The final presentation will elaborate, based on our empirical work, the broader implications of our work to contemporary conceptualization and framing of Bioeconomy, especially our argument that the broader Bioeconomy debate needs to pay more attention to the concrete and rapidly advancing practical implementation of new technological and business solutions, and risk to be stuck in theoretical discussion with diminishing relevance to policy makers and business leaders concerned with fast-moving reality.

LITERATURE

- Hekkert, M P, R A A Suurs, S O Negro, S Kuhlmann, and R.E.H.M. Smits. 2007. “Functions of Innovation Systems: A New Approach for Analysing Technological Change.” *Technological Forecasting and Social Change* 74 (4) (May): 413–432. doi:<http://dx.doi.org/10.1016/j.techfore.2006.03.002>.
<http://www.sciencedirect.com/science/article/pii/S0040162506000564>.
- McCormick, Kes, and Niina Kautto. 2013. “The Bioeconomy in Europe: An Overview.” *Sustainability* 5 (6) (June 10): 2589–2608. doi:10.3390/su5062589.
<http://www.mdpi.com/2071-1050/5/6/2589/htm>.
- Novotny, Michael, and Staffan Laestadius. 2014. “Beyond Papermaking: Technology and Market Shifts for Wood-Based Biomass Industries – Management Implications for Large-Scale Industries.” *Technology Analysis & Strategic Management* (May 21): 1–17. doi:10.1080/09537325.2014.912789.
<http://dx.doi.org/10.1080/09537325.2014.912789>.

1E. TECHNOLOGY AND R&D

Does rivalry in R&D foster harmful innovations ?

Sylvain Hours

LAMETA, University Montpellier 1, F-34000 Montpellier, France.

sylvainhours@hotmail.com

KEYWORDS: Innovation, R&D, Patent race, Rivalry, Harmful Innovations

In « Capitalism, Socialism and Democracy » (1942) Joseph Schumpeter stresses the importance of innovation. He explains that only innovative activities have the ability to break the stationarity of the economic cycle and thus to increase population's standards of living. He admits that innovation condemns large parts of the economy to obsolescence which is costly because it entails a reallocation of the factors of production in the short term. Yet, he states that this « perpetual storm » generated by the « creative destruction » mechanism is a necessary evil that fosters economic drive over the long-term.

Innovations have some properties that have induced economists suggest that free markets are not able to convey sufficient incentives to innovate. First, introducing an innovation on the market is often the outcome of a Research and Development (R&D) process that requires time and money. In the pharmaceutical industry, an 2011 estimation revealed that the average duration of R&D is 12 years for an average cost of over a billion euros. Those figures might significantly differ from one firm to the other because of the thick uncertainty that surrounds that process. Attempts might fail, firms can be preempted by a rival and thus lose the benefits of their efforts. Firms undertake innovative activities so long as they anticipate that they will be able to make their investment profitable as the innovation is exploited commercially. Yet, in many industries, once the new device or process is introduced on the market, it can be imitated at no cost through reverse engineering. This is the typical free riding issue. In that case, the original innovator is unable to fully corner the private value of the innovation and the R&D costs might not be recouped. When innovative activities are only perceived as the driving force of economics growth, free markets are generally failing since they are unable to sufficiently stimulate innovation. The combination of those factors have led public authorities to design innovation policies whose trivial objective is to support firms considering to innovate to make such activity profitable. Multiple tools such as subsidies, the creation of innovation incubators, prizes or industrial protection rights are available to the regulator. Each of them has its strengths and weaknesses but they all aim at encouraging innovation.

When several firms are engaged in a R&D process leading to a single prize or industrial property right, then there are engaged in a so-called "innovation race". In that case, those rival firms compete to be the first to introduce a new process or device. Existing literature studies the relationship between the intensity of rivalry and the amount of investment units rivals devote to R&D (Scherer (1967), Loury (1979), Lee & Wilde (1981), Reinganum (1981), Fundenberg (1983), Grossman & Shapiro (1985), Denicolò (1996)). So as to keep models tractable, the characteristics of the innovation are generally assumed to be exogenous and perfectly known ex ante. It implies that firms do not have any influence over the characteristics of the innovation that they introduce on the market. Their only function is to devote investment units to R&D to make that process successful. Such framework is convenient in the sense that it depicts innovation as a one-dimensional activity. However, critical aspects of innovations such as their physical properties, their quality, their impact on public health or on the environment result from firms' decisions at the time they are engaged in R&D. Hence, this traditional framework is very restrictive since it denies the firms the ability to decide what technology to use, what precaution level to implement, etc.

Schumpeter understood innovation as the driving force of economic growth. Yet, it is recognized that per capita wealth is a poor proxy for measuring welfare. What Schumpeter's thinking implicitly suggests is that the innovation improves each and every one of the characteristics of the previous product or process (quality, physical properties, ability to fulfil one's needs, impact on human health or on the environment etc.). Yet, it may well be that an innovation improves an already existing product from a certain point of view it deteriorate it from another. As noted by Immordino and al. (2011), "research on genetically modified (GM) seeds may pave the way to higher yields in farming, yet pose unknown risks to public health". Likewise, they argue that "the introduction

of new derivatives may open profit opportunities for intermediaries and offer new hedging tools for investors, while creating new dangers for unsophisticated investors who cannot master the information needed to invest in the new securities". When innovative activities are assumed to generate benefits as well as costs for the society, the legitimacy of our innovation policies needs to be reassessed. In particular, its design should be such that innovative activities are supported if and only if they are welfare improving. This task is all the more justified when firms are able to influence the characteristics of their innovation. If it is not the case, innovation policies affect the incentives to innovate alone and a sound policy should stimulate beneficial innovations and deter innovations whose harmfulness is proved true. However, when firms are able, while engaged in R&D, to take actions aiming at influencing the characteristics of their innovation, the optimal design of innovation policies should take into consideration two types of incentives : the incentives to innovate and to contain the innovation's damage.

In this paper, we assume that the innovation generates a damage whose magnitude depends on the winner's effort to contain it while engaged in R&D. We explore the extent to which the intensity of rivalry affects both the speed of R&D and the social impact of the innovation per se. To address this issue, we provide a model in which several firms are engaged in an innovation race. The amount of investment units that each firm devotes to R&D determines her conditional instantaneous probability of success (hazard rate). The private and social value of the innovation depend on the winner's effort to contain the damage. This effort may consist in using state-of-the-art technologies, in hiring highly skilled labour or in implementing strict precautionary measures. Though firms might reach innovations that have different characteristics depending on how intense their containment effort is, we assume that they are eligible for a single prize. In other words, both innovations fall under the scope of a single industrial property title. The larger the effort, the greater the private and social prize but the more costly it is to use each investment unit. In other words, we assume that it is more profitable for the firm to introduce an innovation that does not induce a damage. We justify this assumption as follows : First, it is possible that innovators are directly and at least partially by such damage. Besides, the damage induced by innovations might make consumers less willing to pay to purchase the new device or process, which reduces the market's profitability. Such profitability gap could be explained by the fact that when the innovation induces no damage, consumers are more willing to pay to purchase the new device or process, that it fulfils the needs of a larger number of consumers or that they manifest a lower mistrust about the innovation and they do not adopt a precautionary approach by deferring their consumption.

Moreover, as they face an innovation that is perceived as harmful, public authorities might decide to deny its introduction on the market *ex ante*, to withdraw it *ex post* or to impose financial sanctions on the innovator. Likewise, when the structure of industrial property rights depend on the characteristics of the innovation or on the firm's containment effort, then the latter might be better off exerting such effort. Finally, an innovation that generates a damage might have a shorter lifetime in the sense that it creates an in-draught be condemned to obsolescence by improved products specifically designed to aimed at providing a damage-free innovation. to be improved by rivals supplying a damage-free process or device which condemns the original innovation to obsolescence.

From a methodological point of view, we must provide a suitable measure of the intensity of rivalry. First, we can exploit the number of firms engaged in the race to get an idea of how intense rivalry is. Second, if firms enter the race one after the other, it then becomes possible to measure the intensity of rivalry through the size of the head start early entrants benefit from. Third, if R&D is a multi-stage process. In that case, the achievement of an innovation results from the completion of successive intermediary targets. Firms cannot proceed to the next stage before they succeed in completing the current stage. (Grossman & Shapiro (1985), Harry & Vickers (1987)), we are then able to measure the intensity of rivalry through rivals' relative progress : when several firms are neck to neck and about to introduce the innovation, then rivalry is intense, when one firm is way ahead of her rivals, then rivalry is weak. Finally, when we introduce some flexibility in the division of the innovation's private value among competing firms (Denicolò (2010)), it is possible to measure the intensity of rivalry through the fraction of the innovation's private value, that goes to the winner.

Our preliminary conclusions suggest that rivalry has no impact on firms' containment effort so long as the extra-cost it induces is sufficiently small with respect to the extra-benefit factor. Otherwise, we observe a negative correlation between the intensity of rivalry and firms' containment effort. This conclusion supports Gilbert & Shapiro's finding that patents should be infinitely long and as narrow as possible. Indeed, the wider the patent, the more numerous the firms competing for a single industrial property right. Besides, our conclusions indicate

that public authorities should not subsidize competing firms in the sense that feeding the rivalry could favor the appearance of harmful innovations. Finally, it seems that the implementation of a policy rewarding containment efforts could neutralize the impact of rivalry on innovation's harmfulness.

References :

1. Dasgupta, P., & Stiglitz, J. (1980). Uncertainty, industrial structure, and the speed of R&D. *The Bell Journal of Economics*, 1-28.
2. Denicolò, V., & Franzoni, L. A. (2010). On the Winner-Take-All Principle in Innovation Races. *Journal of the European Economic Association*, 8(5), 1133-1158.
3. Fudenberg, D., Gilbert, R., Stiglitz, J., & Tirole, J. (1983). Preemption, leapfrogging and competition in patent races. *European Economic Review*, 22(1), 3-31.
4. Gilbert, R., & Shapiro, C. (1990). Optimal patent length and breadth. *The RAND Journal of Economics*, 106-112.
5. Grossman, G. M., & Shapiro, C. (1987). Dynamic R & D competition. *The Economic Journal*, 372-387.
6. Harris, C., & Vickers, J. (1985). Perfect Equilibrium in a Model of a Race. *The Review of Economic Studies*, 52(2), 193-209.
7. Immordino, G., Pagano, M., & Polo, M. (2011). Incentives to innovate and social harm: Laissez-faire, authorization or penalties?. *Journal of Public Economics*, 95(7), 864-876.
8. Kamien, M. I., & Schwartz, N. L. (1972). Timing of innovations under rivalry. *Econometrica: Journal of the Econometric Society*, 43-60.
9. Lee, T., & Wilde, L. L. (1980). Market structure and innovation: a reformulation. *The Quarterly Journal of Economics*, 429-436.
10. Loury, G. C. (1979). Market structure and innovation. *The Quarterly Journal of Economics*, 395-410.
11. Reinganum, J. F. (1981). Dynamic games of innovation. *Journal of Economic theory*, 25(1), 21-41.
12. Scherer, F. M.. "Research and Development Resource Allocation Under Rivalry". *The Quarterly Journal of Economics* 81.3 (1967): 359--394.

The variety of related variety studies: technological relatedness in analysis of inter-firm R&D cooperative projects

Jiří Blažek (Faculty of Science, Charles University in Prague), **David Marek*** (Technology Centre ASCR) and Viktor Květoň(Faculty of Science, Charles University in Prague)

* marek@tc.cz

KEYWORDS: Relatedness, R&D collaboration, Firms, Czechia

1. Relevance

The paper conceptually review a recent literature on related variety and emphasizes that that there are not only profound differences between ex-ante and ex-post conceptualisation of relatedness, but also several striking methodological peculiarities within this research stream. Therefore, it is argued, that the growing number of studies on relatedness using different conceptualisations and methodologies can result in hollowing out of the original explanatory power of the concept. Empirically, the paper amplifies the variety of related variety studies by exploring one of the main channels through which the effects of relatedness can operate. Joint R&D projects among companies represent a vigorous mechanism of the knowledge exchange and of mutual learning, but as of yet, these studies have not been systematically linked to the concept of related variety. Therefore, while there are numerous studies on related variety based on evaluation of potential for knowledge spillover allowed by a mutual relatedness, this study investigates the intentionally undertaken interactions among companies in their quest for knowledge creation and innovation. Consequently, patterns of knowledge creation and sharing within collaborative R&D projects among companies are investigated.

2. Research aim and question

The analysis is based upon an extensive database covering all joint R&D projects undertaken among Czech firms with the public support over the period 2003-2014. Insight into these data allows us to answer the following main research question: To what extent does the R&D cooperation among companies follow their technological relatedness? Consequently, it is desirable to investigate the role of (ex-ante as well as ex-post) relatedness in join R&D projects across the whole spectrum of industries.

3. Definitions of the most central concepts

Contemporary evolutionary economic geography is enjoying a prominent attention within economic geography studies (e.g. (Boschma and Martin, 2010) in order to elucidate how countries and regions develop over time (Neffke et al., 2011). One of important theoretical advances achieved within this research stream has been employment and further development of the concept of related variety, building upon works of (Rosenberg and Frischtak, 1983) on technological systems and upon studies on learning and innovation (Nooteboom, 2000). Concept of related variety is based on now already well proven argument that a range of technologically related industries in a region is more beneficial for its development than diversified, but unrelated spectrum of industries (Neffke et al., 2011). Technologically related industries can spur knowledge sharing and innovation, especially, if their cognitive distance is optimal (Nooteboom, 2000; Broekel and Boschma, 2012). However, the probability that inter-firm cooperation according to technological distance follows an inverted U-shape curve has been identified already by (Mowery et al., 1998). Nowadays, there is a large body of literature insisting that optimal cognitive distance enhances effects of agglomeration economies (Boschma and Iammarino, 2009).

4. Theoretical frameworks

Two distinctive approaches within the study of related variety can be distinguished. Firstly, the pioneering contributions to a study of potential for mutual knowledge spillovers among industries have been focused predominately on ex-ante relatedness. These studies in fact succeeded in refining a long-established argument of the agglomeration economies, namely, that the clustering of economic activity occurs because firms are benefiting via various sorts of external economies from their nearby location (Frenken et al., 2007). The second stream within the related variety school was to a large extent inspired by a seminal study by (Hidalgo et al., 2007) who insisted that there are various dimensions of relatedness among products and conceptualised the notion of product space based on revealed comparative advantage. Nevertheless, there are important conceptual differences among these two notions of relatedness. On the one hand, the principal deficiency of ex-ante measures based on closeness in standard industrial or product classifications is that it remains obscure to what extent such relatedness is relevant in practice (Neffke et al., 2011). On the other hand, the definition of

relatedness based on standard industrial classification schemes is relatively easy to interpret and allows comparisons across various regions and countries. In contrast, revealed or ex-post relatedness encompasses much broader and conceptually diverse set of dimensions of relatedness among industries or products, which are by far exceeding the mere technological relatedness.

5. Description of the empirical materials

Undoubtedly, one of vigorous mechanisms for knowledge creation and sharing represent various forms of cooperation in the sphere of R&D. There is already an extensive literature on the geography of collaborative knowledge production (for overview, see Hoekman et al., 2008; Broekel, 2015). Existing studies of R&D networks are often limited to analysis of patent data or co-publication of scientific papers. However, none of these data sources is particularly suitable for analysis of the role of relatedness in moulding R&D networks among companies (see e.g. Boschma and Capone, 2015b). According to our knowledge, no study has empirically tested the extent to which the inter-firm R&D collaboration projects follow the prepositions stemming from the concept of related variety across a whole spectrum of industries. An exception is the study by (Fornahl et al., 2011), in which the authors confirmed the role of R&D subsidies, geographic proximity and relatedness on patent performance of German firms within a single biotech industry. In contrast, this inverted-U relationship between the likelihood to cooperate and cognitive proximity coined by (Mowery et al., 1998) has not been confirmed in case of Dutch aviation industry (Broekel and Boschma, 2012).

6. Description of the methodologies

Our research is based upon the analysis of a Czech database on R&D activities co-financed by public sources. The database contains interconnected records on beneficiaries, programmes and projects retrospectively. Our analysis started with projects that had been initiated between 2003 and 2014. Altogether, 1667 companies participated in our sample of 1743 joint projects. Within the collaborative network, 4132 linkages of different weight were found among businesses based on the co-presence of partners in joint projects. In order to investigate the variation in frequency of linkages according to technological distance, our dataset was extended by detailed information from the Business Register about all types of economic activities performed by companies as captured by 272 3-digit NACE groups. Almost 17 thousand NACE groups were assigned to 1667 collaborating firms. Consequently, for 4132 linkages more than 494 thousand combinations of NACE groups was identified. Subsequently, two methods were used to calculate the relatedness among cooperating firms. First, the ex-ante relatedness is derived from the hierarchical structure of NACE classification. Industries sharing the same category at some of the upper levels within this classification system are thought to be related. On the other hand, the ex-post relatedness is based on the co-occurrence analysis by assessing whether two industries are frequently found together in one company.

7. Expected outcomes

Our expectation is that inter-firm R&D collaboration would follow an inverted-U curve with the peak corresponding with the optimal level of relatedness and we foresee that the intensity of collaboration would be falling with both increase and decrease of knowledge distance among firms. From a policy perspective, several factors may hinder future efforts to translate the role of relatedness into tangible measures stimulating regional economies. There is a plethora of particular and ever-changing constellations of industrial specialisations. Evolution of economic structure of the region is also driven by institutional frameworks as well as by other types of proximities (Boschma, 2005; Balland et al., 2016) that could be more or less supportive to knowledge spillovers. So far, analyses of the role of relatedness have been mostly concentrated upon advanced countries boasting with highly developed statistics. Therefore, an open question remains to what extent the concept of related variety is relevant for countries and regions which competitiveness is not primarily based upon knowledge, but on other competitiveness factors such as low production costs. Despite the fact that this study investigates the role of relatedness in Czechia, which still represents a less developed country in Central Europe, it deals with upper segment of Czech economy, i.e. with segment of firms which are engaged in joint R&D activities. Therefore, as a future research agenda, the role of related variety in countries and regions, which competitiveness is not primarily based upon knowledge can be proposed.

References

- Balland, P.-A., Belso-Martínez, J.A., Morrison, A., 2016. The Dynamics of Technical and Business Knowledge Networks in Industrial Clusters: Embeddedness, Status, or Proximity? *Economic Geography* 92, 35–60.
- Boschma, R., 2005. Proximity and innovation: a critical assessment. *Regional studies* 39, 61–74.
- Boschma, R., Capone, G., 2015. Institutions and diversification: Related versus unrelated diversification in a varieties of capitalism framework. *Research Policy*

44, 1902–1914.

Boschma, R., Iammarino, S., 2009. Related variety, trade linkages, and regional growth in Italy. *Economic Geography* 85, 289–311.

Boschma, R., Martin, R., 2010. *The Handbook of Evolutionary Economic Geography*. Edward Elgar Publishing, Cheltenham.

Broekel, T., 2015. Do Cooperative Research and Development (R&D) Subsidies Stimulate Regional Innovation Efficiency? Evidence from Germany. *Regional Studies* 49, 1087–1110.

Broekel, T., Boschma, R., 2012. Knowledge networks in the Dutch aviation industry: the proximity paradox. *J Econ Geogr* 12, 409–433.

Fornahl, D., Broekel, T., Boschma, R., 2011. What drives patent performance of German biotech firms? The impact of R&D subsidies, knowledge networks and their location. *Papers in Regional Science* 90, 395–418.

Frenken, K., Oort, F.V., Verburg, T., 2007. Related Variety, Unrelated Variety and Regional Economic Growth. *Regional Studies* 41, 685–697.

Hidalgo, C.A., Klinger, B., Barabási, A.-L., Hausmann, R., 2007. The Product Space Conditions the Development of Nations. *Science* 317, 482–487.

Hoekman, J., Frenken, K., Oort, F. van, 2008. The geography of collaborative knowledge production in Europe. *Ann Reg Sci* 43, 721–738.

Mowery, D.C., Oxley, J.E., Silverman, B.S., 1998. Technological overlap and interfirm cooperation: implications for the resource-based view of the firm. *Research Policy* 27, 507–523.

Neffke, F., Henning, M., Boschma, R., 2011. How Do Regions Diversify over Time? Industry Relatedness and the Development of New Growth Paths in Regions. *Economic Geography* 87, 237–265.

Nooteboom, B., 2000. *Learning and innovation in organizations and economies*. Oxford University Press, Oxford.

Rosenberg, N., Frischtak, C., 1983. Long Waves and Economic Growth: A Critical Appraisal. *The American Economic Review* 73, 146–151.

Douglas K. R. Robinson, **Philippe Laredo***, Aurelie Delemarle and Axel Lagnau
(LISIS, Universite Paris-Est, France)
*philippe.laredo@enpc.fr

--Motivation--

Looking at emerging technology fields with a view to their embedding in spaces is the motivation, and contribution, of this paper. We further develop and integrate existing concepts to allow a holistic view of embedding processes in research and markets.

Understanding the dynamics of embedding of emerging technology fields into spaces is was the motivation of the MDET project, and we take the findings apply it to understand the embedding of emerging converging technologies in this project. This approach has origins in work on analysing research, where Barre et al (2013)) developed a multi-layered approach to functions of a research system with a focus on process. We further elaborate this multilayered approach by describing the Barre framework and reframe it as a multi-layered arrangement of “spaces” (following Nedeva’s distinction of Field and Space – Nedeva 2013) that shapes directions of research. We add to this by creating a parallel multi-layered framework of spaces that shape markets (see Figure 1)

XXX

50

progressively extended and has entailed a strong movement towards the creation of dedicated agencies for the implementation of policies, what Rip has called already 30 years ago, ‘implementation structures’ (Rip 1990). These structures and agencies not only ‘mediate’, they become actors on their own and ‘embedding’ needs thus to be analysed at the 3 levels: of performance (in PROs and Universities, through positions, labs and curricula mostly), of programming (through the existence of funding programmes mostly) and of orientation (through the policy recognition of the emerging field as a ‘national priority’). What makes it complex is that the situation might differ between countries, driving to different types of embedding, and different dynamics in the production of knowledge.

For spaces in markets, the performance layer is clearly the activity of innovation actors, mostly firms, and can be traced through conventional indicators (for example patents or mergers and acquisitions). The parallel of Programming for emerging markets are roadmaps and agenda building consortia which create “market building programmes” to structure the market at its early (pre-competitive) stages. We see a strong example in the International Roadmap for Semiconductor Technologies, a strong case of early stage market programming (Le Masson et al 2012). The parallel of Governments and their orientation policies for markets is standards setting organisations as the infrastructures (Delemarle and Laredo forthcoming) that support markets. Observing the embedding of the new field of technology in standard setting organisations provides an indication of the degree of embedding of the new technology field and by knowing the content of the standards, which development avenues are enabled and constrained.

--Empirical Materials--

In this paper, we show how this framework can help us explore the embedding of new technology field into institutions. We use the cases of nanotechnology, asynchronous logic and additive manufacturing to show that there are a variety of “embedding pathways” for new technology fields to emerge and anchor in institutions. Where Nanotechnology shows a classical top-down emergence (from macro-level government orientation) and a spread through research and markets, the story of additive manufacturing shows the opposite, the emergence locally in firms, bottom up coordination and standards before any traditional research programmes and policy discourse. The case of asynchronous logic follows a similar path of embedding as nanotechnology, however its failure to embed in markets has led to a retraction back into the world of research. Our case studies indicate that there are potentially a variety of different embedding pathways of new fields of technologies into institutions, and that embedding is far from guaranteed – thus a need to analyse processes of embedding to inform research and innovation policy and governance.

--Outcomes and Outlook--

We close the paper with a suggestion of this “embedding” framework to assist in assessing the emergence and uptake of emerging technology fields into institution.

- We see different embedding pathways
- A usable framework (to guide other approaches and also to translate analyses into recognizable intelligence by decision makers in the different spaces represented in the framework.

This has research has prompted us to recognise the importance of ‘protected spaces’ and ‘niches’ (Rip and Kemp, 1998) both for early design and testing of the technology, but also for initial market introduction of new products embodying the new technology (Geels, 2002). But it has also driven us to questions about the collective conditions that help the products that embed the new technology get out of their niches and widely ‘diffuse’ (Rogers, 1961, 2003) and generalise.

--Relevance to EU-SPRI 2016--

We believe this research connects with a number of ongoing activities in the EU-SPRI community, about research and innovation policies and programmes, but also in EU-SPRI activities to understanding the emergence of protected spaces and increased legitimation up to (and including) generalisation of a new technology field into research, markets and society. As described in Deuten et al. (1997) for protected spaces or generalisation to occur, a number of alignments have to be in place. In this contribution, we propose a model that captures these alignment (re-alignments) through the notion of embedding of a new field into spaces (organisations and institutions).

--Acknowledgment--

This work continues and builds on a special session in EU-SPRI 2014 on “Innovation and Market Infrastructures” and the Mapping Dynamics of Emerging Technology project (Final report July 2015). This research has been conducted as part of the Open Research Area (ORA) Project entitled: “Mapping the Dynamics of Emerging Technologies” (MDET).

--References--

- Barré, R., Henriques, L., Pontikakis, D., & Weber, K. M., 2013. Measuring the integration and coordination dynamics of the European Research Area, *Science and Public Policy*, 40(2), 187-205
- Delemarle, A. and Larédo, P. (forthcoming) Tentative governance for new markets by creating market infrastructures. Submitted to a special issue of *Research Policy*.
- Deuten, J.J., Rip, A., & Jelsma, J. (1997). Societal embedding and product creation management. *Technology analysis & strategic management*, 9(2), 131-148
- Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research policy*, 31(8), 1257-1274.
- Henriques, L., & Larédo, P. (2013). Policy-making in science policy: The 'OECD model' unveiled. *Research Policy*, 42(3), 801-816.
- Larédo P., Robinson D.K.R, Delemarle A., Lagnau A., Revollo M., Villard L., 2015, Mapping and characterising the dynamics of emerging technologies to inform policy, Final report of the ANR MDET project, IFRIS, July, 106 pp
- Le Masson, P., Weil, B., Hatchuel, A., & Coge, P. (2012). Why are they not locked in waiting games? Unlocking rules and the ecology of concepts in the semiconductor industry. *Technology Analysis & Strategic Management*, 24(6), 617-630.
- Nedeva, M. (2013). Between the global and the national: Organising European science. *Research Policy*, 42(1), 220-230
- Rip, A., & Kemp, R. (1998). *Technological change* (pp. 327-399). Battelle Press.
- Rip, A. (1990). Implementation and evaluation of science & technology priorities and programs. In *The research system in transition* (pp. 263-280). Springer Netherlands.
- Rogers, E. M. (1962). *Diffusion of In-novations*. New York: The Free Press of Glencoe.
- Robinson, D. K. R., & Rip, A. (2013). Indications of Socio-Economic Impacts of Nanotechnologies: The Approach of Impact Pathways. In: K. Konrad & H. Van Lente & C. Coenen & A. Dijkstra & C. Milburn (Eds.), *Shaping Emerging Technologies: Governance, Innovation, Discourse*. IOS Press, pp153 - 166. ISBN 9781614993001. .

1F. TRACK THEME 3: CAN WE STILL LEARN FROM EVALUATIONS? EXPLORING NEW AVENUES IN THE EVALUATION OF STI POLICIES (I)

Taking the Road Less Travelled: Evaluating and Monitoring the Socio-Economic Impact of Investment in Research Infrastructures

Elina Griniece(Technopolis Group)*, Alasdair Reid(REID Consulting SPRL) and Dr Jelena Angelis(Technopolis Group)

*elina.griniece@technopolis-group.com

KEYWORDS: Socio-economic impact, Assessment, Research infrastructures

Research infrastructures (RI) are crucial to the advancement of science and breakthrough research discoveries. RIs refer to facilities, resources (including human) and related services needed by the research community to conduct research in any scientific or technological field. While RIs are designed for research needs, the impacts of these facilities reach beyond fuelling scientific excellence. The advanced technical opportunities and the concentration of skilled human capital and know-how can foster innovation, create new or expand the existing markets, attract inward investment, increase economic activity and potentially have an impact on the social and cultural life in a particular region. In this regard RIs can be viewed as focal points for continuous interaction between scientific, technological and socio-economic development and one of the eminent developments on the STI policy arena.

Governments and funding agencies could greatly benefit from robust and reliable evaluations of the RIs and their socio-economic impacts, and indeed routinely request such information to inform the funding of new or up-graded RIs. This is of particular importance because setting-up or renovating RI usually requires a considerable level of financial investment and planning of a long-term operation strategy.

However, given that the primary objective of a RI is to support excellent science, traditional cost-benefit analysis models (as used for industrial or transport infrastructures) can only be applied to a limited extent and other evaluation models and appropriate indicators are necessary. More so, currently there is no unified framework for the impact assessment (IA) of investment in research infrastructures. Various conceptual frameworks exist in parallel comprising a range of observable direct and indirect effects and longer-term impacts. Therefore, important socio-economic contributions remain poorly understood. This opens avenues for the creation of new conceptual framework and application of evaluation methods in assessing the socio-economic impacts of publicly funded Research Infrastructures.

The aim of the research and conceptual development presented in this paper is to disentangle and characterise the concrete benefits of RI investment for different stakeholders and to build a comprehensive schematic impact assessment framework that can be used in evaluations of Research Infrastructures to trace the core impact pathways. The framework concentrates on one specific type of RIs, namely single-site facilities.

We look into direct and indirect benefits that arise during three key periods of a research facility's lifecycle: 1) design and construction phase; 2) operational phase of research facilities; and 3) decommissioning and present a logical framework for socio-economic impacts of investment in research infrastructure was designed as a result of this research. The identified impact pathways involve complex and multidimensional phenomena, which in most cases cannot be captured with standard quantitative indicators, but require a thorough triangulation of quantitative and qualitative evidence. We elaborate on the appropriate indicators for each type of impact (i.e. economic impacts, impacts on innovation, impacts on human resource capacity, and scientific impacts) and provide additional guidance on the respective data requirements, their potential sources and advice on possible collection routines. Reflections on the limitation and challenges of the application of this IA framework are also outlined.

The designed framework builds on the existing literature on evaluation as well as Research Infrastructures; long-term experience of Technopolis Group in working on the assignments about RIs for the policy-makers and on the useful feedback on the earlier draft of the paper received during the Workshop on Methodologies and Tools for assessing Socio-Economic Impact organised by the OECD Global Science Forum in November 2015. One of the key projects which contributed valuable empirical evidence into the development of the current socio-economic impact assessment framework was "Monitoring the Implementation of Integrated Science, Studies and Business

Centres (Valleys) in Lithuania”.

During this 3.5-year-long technical assistance type project Technopolis Group experts together with partners delivered services both at policy-making level to ministries and related agencies and provided hands-on operational support and training services to the Valley project managers and related stakeholders. The consortium set up a monitoring system to facilitate the collection and analysis of information on project progress, including a review of the key performance indicators and the initial targets. In parallel, we conducted a strategic review of the national science and innovation policy management system. Taking into account the need to optimise the return from the Valley projects the consortium proposed a ‘management and coordination’ model. To enhance the management of Lithuanian research infrastructure, we reviewed good practice in other European countries, as well as in Canada and Australia. Based on this work, we suggested several alternatives for research infrastructure management in Lithuania and developed three competitive funding schemes to support the operational phase of the Valley projects.

Recognising that each RI is embedded in specific socio-economic conditions, there will never be a ‘one-size fits all’ approach to mapping all socio-economic impacts. This work should be regarded as a step towards defining a typology of possible effects and accounting for the conditions and patterns that enable their creation and diffusion. Key benefits of this conceptual development are: 1) new opportunities to present and articulate broader socio-economic implications of investments in RI for policy makers and other relevant stakeholders; 2) expand the toolbox of practitioners in novel evaluation area and advance experience in its practical application; 3) foster debate and promote further conceptual and empirical contributions to understanding how such a major strand of research and innovation policy as investment in RI trigger wider socio-economic changes.

Bibliography

1. Autio, E. (2014) Innovation from Big Science: Enhancing Big Science Impact Agenda. Report to UK Department for Business, Innovation & Skills. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/28_8481/bis-14-618-innovation-from-big-science-enhancing-big-science-impact-agenda.pdf
2. Autio, E., Streit-Bianchi, M., and Hameri, A.-P. (2003) Technology Transfer and Technological Learning Through CERN's Procurement Activity, CERN Scientific Information Service. Geneva
3. Bianchi-Streit, M. et al (1984) Economic utility resulting from CERN contracts (second study). Report of the European Organisation for Nuclear Research (CERN). Available at: <http://indico.cern.ch/event/66952/contribution/0/2/material/paper/0.pdf>
4. Bozeman, B. (2000) Technology transfer and public policy: a review of research and theory. Research Policy, 29(4–5)
5. Clarke, S. et al. (2013) Project Preparation and CBA of RDI Infrastructure Projects. JASPERS Staff Working Paper. Available at: <http://www.jaspersnetwork.org/display/for/Project+Preparation+and+CBA+of+RDI+Infrastructure+Projects>
6. European Strategy Forum on Research Infrastructures (2011) Evaluation Report 2011. Available at: http://ec.europa.eu/research/infrastructures/pdf/esfri_evaluation_report_2011.pdf
7. Fotakis, C. (2010) Analyses of FP7 supported Research Infrastructures initiatives in the context of ERA. Available at: http://ec.europa.eu/research/evaluations/pdf/archive/fp7-evidence-base/experts_analysis/c.%20fotakis_-_research_infrastructure.pdf
8. Hallonsten, O., Benner, M. and Holmberg, G. (2004) Impacts of Large-Scale Research Facilities- A Socio-Economic Analysis. A study done at the Research Policy Institute, Lund University. Available at: http://rifi.gateway.bg/upload/docs/public_doc_REPORT_impact_of_large_scale_RI.pdf
9. von Hippel, E. (1976) The Dominant Role of Users in the Scientific Instrument Innovation Process, Research Policy 5 (3)
10. Hickling Arthurs Low Corporation (2013) Return on Investment in Large Scale Research Infrastructure. Report for National Research Council Canada. Available at: <http://www.triumf.ca/sites/default/files/HAL-ReturnOnInvestmentStudy-May-2013.pdf>
11. Horlings, E. et al (2012) The societal footprint of big science. Report of the Rathenau Instituut. Available at: <http://www.rathenau.nl/en/publications/publication/the-societal-footprint-of-big-science.html>
12. National Research Council Canada (2013) Return on Investment in Large Research Infrastructure. Available at: <http://www.triumf.ca/sites/default/files/HAL-ReturnOnInvestmentStudy-May-2013.pdf>
13. OECD (2014) International Distributed Research Infrastructures: Issues and Options. Available at: <http://www.oecd.org/sti/sci-tech/international-distributed-research-infrastructures.pdf>
14. OECD (2014) Report on the Impacts of Large Research Infrastructure on Economic Innovation and on Society: Case Studies at CERN. Available at: <http://www.oecd.org/sti/sci-tech/CERN-case-studies.pdf>
15. Rizzuto, C. and Wood, J. (eds.) (2013) RAMIRI Handbook. Deliverable of FP7 project Realising and Managing International Research Infrastructures. Available at: <http://www.ramiri-blog.eu/index.php?n=Main.HomePage>
16. Rizzuto, C. (2012) Benefits of Research Infrastructures beyond Science, presentation at ERF Workshop “The Socio-Economic Relevance of Research Infrastructures”, 31 May-1 June 2012, Hambourg
17. Sallee, C.M., Watkins, S.D and Rosaen, A.L. (2011) The Economic Impact of Fermi National Accelerator Laboratory. Anderson Economic Group report to the University of Chicago. Available at: https://ovprnl.uchicago.edu/sites/research.uchicago.edu/files/Fermilab_Economic_Impact_Full_Study.pdf
18. Simmonds, P. et al (2013) Big Science and Innovation. Technopolis Group report for the UK Department for Business, Innovation & Skills. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/24_9715/bis-13-861-big-science-and-innovation.pdf
19. Wissenschaftsrat (2011) Recommendations on Research Infrastructures in Humanities and Social Sciences. Available at: http://www.wissenschaftsrat.de/download/archiv/10465-11_engl.pdf
20. Wissenschaftsrat (2013) Report on the Science-Driven Evaluation of Large Research Infrastructure Projects for the National Roadmap (Pilot Phase). Available at: http://www.wissenschaftsrat.de/download/archiv/2841-13_engl.pdf
21. Zuijdam, F. et al (2011) The role and added value of large-scale research facilities. Technopolis Group report. Available at: http://www.technopolis-group.com/wp-content/uploads/2011/02/1379_Report_Large-scale_Research_Facilities_EN1.pdf

Towards a Typology of Innovation System Evaluation Practices - Evidence from EU Member States

Mart Laatsit* and Susana Borrás
(Copenhagen Business School, Denmark)
*mla.dbp@cbs.dk

KEYWORDS: Innovation policy, System-evaluation, Systems of Innovation, Evaluation, Policy-learning

1. Introduction

There is a growing discussion in Europe to move from individual research and innovation program evaluations towards more systematic approaches, analysing innovation systems in their entirety. Some countries have already started experimenting with system evaluations, carrying out system-level analyses of their innovation policies (a few recent examples include Denmark, Finland, Czech Republic, Estonia), while many more countries are contemplating it. These efforts are supported by international organisations, such as European Commission and OECD, who are trying to introduce new tools and provide policy advice and assistance. This paper seeks to study this phenomenon and give a solid conceptual framework for categorising system evaluation using the framework of ‘evaluation machines’. Last but not least, evaluation systems are highly relevant for the discussion about the role of policy learning in innovation policy making. Hence, we look at how system evaluations act as an input to the policy learning process to make sense of the performance of innovation policy.

2. The originality and relevance of the proposal for the conference theme

The project looks at an under-researched strand in the field of innovation studies – system evaluation. With more than 30 years of research into the concept of national system of innovation, there is still a considerable lack of knowledge on how to assess the effectiveness of complex policy systems. Only a few examples of academic research on system evaluation (Arnold 2005, Edler et al 2008, Magro and Wilson 2011) have been published over the past decade, which is hardly a match to the increasing demands for novel approaches from policy-makers. In addition, we need to develop a better understanding if innovation indicators are being used systematically in evaluating systems of innovation. All-in-all, the relevance of the project for the conference theme is underlined by the assumption that pursuing new avenues for innovation policies must be matched with an adequate understanding of the efficiency and effectiveness of the current policy-mixes, provided via tools of system evaluation.

2. Research aim and question

This research aims to explore the different types of system evaluation used by governments for assessing innovation policy. The conceptual aim of our project is to create a typology of system evaluations following the theoretical concept of ‘evaluation machine’. More concretely, the project seeks to:

- Develop a theory-based typology of system evaluation practices by using the five dimensions inherent to the concept of ‘evaluation machine’;
- Provide a comparative analysis of the policy tools and procedures governments use for assessing the performance of innovation systems.
- Assess empirically the different types of system evaluation and ways of using indicators and impact assessment that emerge from the comparative analysis of system evaluation practices in Europe.

3. Theoretical and conceptual frameworks

In broad terms, the paper is based on two theoretical frameworks, one referring to national system of innovation and innovation policy literature, and the other referring to the evaluation and impact assessment literature. While there are many competing definitions for national systems of innovation, most of them agree that a national system of innovation is defined by set of interactions between public and private institutions (Freeman 1987, Lundvall 1992, Nelson 1993) Drawing from classic definitions, we define a national system of innovation as the combination of public and private sector institutions, whose interactions provide for the innovative performance of companies related to a nation state. For the current research, this understanding provides a useful framework of analysis, by allowing for a theoretical perspective on the role that the institutional set-up of a country’s innovation policy plays vis-à-vis the productive sector. Furthermore, this allows for a useful distinction

between the policy level, affecting the institutional set-up and the firm level as the ultimate beneficiary of the knowledge created through the interactions in the system. Hence, we define innovation policy-mix as the specific combination of innovation-related policy instruments which interact explicitly or implicitly in influencing innovation intensities (Borrás and Edquist 2013).

This paper studies how the national systems of innovation and their constituting policy-mixes are evaluated using system evaluations. We see evaluation as the careful assessment of government policy, concerned with both the implementation as well as the results of policy (based on Vedung 1997). However, individual research or innovation program evaluations are not seen as sufficient for assessing innovation systems in their entirety, which has led to a call in evaluation studies for more attention towards broader forms of evaluation that examine the whole system. (Georghiou 1998, Perrin 2002, Feller 2007, Warwick and Nolan 2014). Therefore, this paper develops the notion of system evaluation, defined as an evaluation framework that combines information from three interrelated levels relevant to policy-making, namely, the programme level (at the level of individual research programs or other specific policy instruments), policy-mix level (examining the effects of particular combinations of policy instruments in mixes), and economic performance level (at the broadest level of the innovation system).

Of particular relevance to understanding and conceptualising the term system evaluations is the notion of ‘evaluation machine’ (Dahler-Larsen 2011), defined as “mandatory procedures for automated and detailed surveillance that give an overview of organisational activities by means of documentation and intense data concentration”. We use this notion to analyse the variety of system evaluation practices being used by governments. Building on earlier work in evaluation studies (Leeuw and Furubo 2008, Rist and Stame 2006, Scott 1995), he suggests that evaluation systems should be analysed along five dimensions: permanence, organisational responsibility, focus on the prospective use of evaluation, distinctive epistemological perspective, abstract and generalised coverage (Dahler-Larsen 2011). This set of five dimensions will be applied to operationalise the notion of system evaluation and categorise the different types of system evaluations used by governments.

Furthermore, we conceptualise policy learning as the alteration or change in the thinking or beliefs of actors in the policy setting, based on experience, information or knowledge and concerned with policy objectives (Sabatier and Jenkins-Smith 1999, Bennett and Howlett 1992). The primary input to policy learning can be seen as experience, information or knowledge. Therefore, we argue that a systematic way to gather this knowledge is through evaluations, emphasising the importance of system evaluation for learning about the performance of the whole system of innovation. This makes system evaluations an important source of policy-learning in the field of innovation policy.

4. Empirical materials to be used

The main source of empirical data is collected through semi-structured interviews with policy-makers from the 28 EU member states. Interviews are carried out with the heads of innovation policy or other senior officials in the field of innovation policy, provided that they have a thorough understanding of the foundations of their evaluation framework. Via the interviews, data is collected on the evaluation practices in general and system evaluation practices in particular, with an emphasis both on current state as well as future plans. More specifically, we gather information on three aspects: how is the performance of a country’s innovation policy evaluated, who are the actors involved, what are the main characteristics of the evaluations in terms of scope, regularity and methods.

We also use secondary data sources, such as evaluation reports, evaluation protocols or other government documents to provide an insight into the national evaluation practices. To that end, data from the OECD Innovation Policy Platform is also consulted and possibly included in the analysis.

5. Methodologies applied

We will use qualitative content analysis, using the NVIVO software for coding and analysing data. We will use the exploratory data to create a system for coding the data and analyse the in-depth data for determining the content of learning of each main group of actors in the learning process. By using this method, we will determine the key characteristics of system evaluation practices that we will then match with the specific type of innovation policy pursued in a country.

6. Expected outcomes

Firstly, by bringing together the literatures on innovation systems and on evaluation, this paper will develop a

clear and elaborated conceptual framework about system evaluation.

Secondly, we expect the project to bring new evidence about to what extent (and if so, how) are European governments conducting encompassing system evaluations. This aims at bringing forward the diversity of forms and contents in the practice of these evaluations.

Thirdly, the conceptual framework and the empirical findings will serve as a solid basis to discuss the way in which indicators and data from impact assessment are currently used (and how it should be used) in the design and re-design of innovation policies. It will allow us to identify problems and bottlenecks in current forms and practices of system evaluation.

Last but not least, the items above will serve as a basis for developing novel approaches on to how systems of innovation should be evaluated.

7. References

- Arnold, E. (2004) Evaluating research and innovation policy: a systems world needs systems evaluations. *Research Evaluation*, 13, 3–17.
- Borrás, S., Edquist, C. (2013) The choice of innovation policy instruments. *Technological Forecasting & Social Change*, 80(8)
- Bennett, C. J. & Howlett, M. (1992) The lessons of learning: Reconciling theories of policy learning and policy change. *Policy Sciences*, 25, 275-294.
- Dahler-Larsen, P. (2011) *The evaluation society*. Stanford University Press.
- Edler, J., Ebersberger, B., Lo, V. (2008) Improving policy understanding by means of secondary analyses of policy evaluation. *Research Evaluation*, 17, 175–186.
- Feller, I. (2007) Mapping the frontiers of evaluation of public-sector R&D programs, *Science and Public Policy*, 34, 681-690.
- Freeman, C. (1987) *Technology and Economic Performance: Lessons from Japan*, Pinter, London.
- Georghiou, L. (1998) Issues in the evaluation of innovation and technology policy. *Evaluation*, 4(1), 37-51.
- Leeuw, F. L., & Furubo, J. E. (2008) Evaluation Systems What Are They and Why Study Them? *Evaluation*, 14(2), 157-169.
- Lundvall, B.-A. (ed) (1992) *National Innovation Systems: Towards a Theory of Innovation and Interactive Learning*, Pinter, London.
- Magro, E. & Wilson, J.R. (2013) Complex innovation policy systems: Towards an evaluation mix, *Research Policy*, 42, 1647–1656.
- Nelson, R. (ed.) (1993) *National Innovation Systems. A Comparative Analysis*, Oxford University Press, NY.
- Perrin, B. (2002) How to – and how not to – evaluate innovation. *Evaluation* 8(1): 13–28.
- Rist, R. C., & Stame, N. (2006) From studies to streams. *Managing Evaluative Systems. Comparative Policy Evaluation*, 12.
- Sabatier, P. A., & Jenkins-Smith, H. C. (1999) The advocacy coalition framework: An assessment. *Theories of the policy process*, 118.
- Scott, W. R. (1995) *Institutions and organizations*. Thousand Oaks, CA: Sage.
- Vedung, E. (1997) *Public Policy and Program Evaluation*, New Brunswick, NJ: Transaction Publishers.
- Warwick, K. & A. Nolan (2014) “Evaluation of Industrial Policy: Methodological Issues and Policy Lessons”, *OECD Science, Technology and Industry Policy Papers*, No. 16, OECD Publishing.

Towards a novel method of research evaluation: tracking proximity change in translational research projects

Frédérique Lang*(SPRU, University of Sussex), Michael Hopkins(SPRU, University of Sussex), Jordi Molas-Gallart(INGENIO (CSIC-UPV)), Ismael Rafols(INGENIO (CSIC-UPV)) and Puay Tang(SPRU, University of Sussex)

* F.lang@sussex.ac.uk

KEYWORDS: Research evaluation, Translational research, Proximity, Biomedical projects

Motivation and research question: Biomedical breakthroughs are often disappointingly slow to emerge (Hopkins et al. 2006; Hopkins et al. 2007). Frustrations around apparent inefficiency have led to a policy push promoting translational research. This paper is concerned with the question: How can the progress of such efforts be evaluated? Traditional research evaluation tends to focus on outputs and so may not be suitable for detecting translation in progress, particularly when these outputs may take many years to emerge (Molas-Gallart et al. forthcoming). By definition, translational research aims to connect scientific and clinical findings for the development of new therapies, medical practices and health impacts (Zerhouni 2003, MRC 2012). This paper presents a novel framework for capturing links that emerge between different scientific specialisations as a result of grant funded research projects such as those supported by translational research programmes. It particularly focuses on how such a framework could inform the evaluation of translational biomedical research projects and their performance in terms of creating such links (although the utility of such an approach is not necessarily limited only these translational research programmes).

Academic studies such as Swan et al. (2007) have identified that successful biomedical innovation depends on more than simply a shared cognitive understanding between collaborators, but also other dimensions too, such as shared incentives. Thus the research evaluation framework developed here must take into account a range of dimensions that are necessary for individuals to collaborate, and learn from each other. Such dimensions are described by Boschma (2005) as ‘proximities’ and these are believed to be critical for successful collaboration leading to knowledge creation and innovation (Ponds et al. 2007; Davids & Frenken 2014). The five proximities Boschma (2005) describes are: cognitive, organizational, social, institutional and geographical proximities.

Novel methods: In this paper we track changes in the five proximities in order to follow change in the nature of a given team’s research during and after a period of research funded by a grant award. The framework assesses research projects using both quantitative tools (bibliometrics and social network analysis) and qualitative tools (interviews).

On the quantitative side, publications can be seen as traces of collaboration generated by individual researchers, which can generate information about the cognitive background, formal relationships, institutional background and geographical location. Using overlay mapping methods (Rafols et al. 2010) we aim at understanding the change in the cognitive background of the research team before and after the project started. We also use publication data to build networks of collaboration that emerged as part of the research project. This data is used to show formal relationship between people before and after the project has started between project participants and used as a proxy for social proximity.

However, publications are only traces of research activities. These just provide a portion of information about the outcomes of the research that has been conducted. Publications also appear with a time lag and may not be fully inclusive of all the research activities conducted by the researchers. Secondly, this type of data provides little indication about some of the dimensions we wish to study, such as the organisational and institutional arrangements that may have changed as a result of the research activities conducted and that may serve as a vehicle or conduit for translational work.

For these reasons the method we develop also rely upon qualitative tools such as semi-structured face to face interviews with people involved in the case study project, and telephone interviews based on a shorter version of the face-to-face questionnaire. One novel feature of the method is the emphasis placed on drawing a map of interactions between project partners, with the interviewees during interviews in order to have a systematic way to record the people, organisations, places, and institutions that have shaped the research project implementation. The various aspects of proximities and evolution of relationships are then further discussed in order to get a sense of how relationships have evolved and how the individuals have learned from each other and overcome potential barriers of communication. This method helps us to gather data that can be represented via

quantitatively-based mapping approaches (social network analysis - SNA), showed through a variety of visualisations as well as being used as the basis for development of partial indicators for changes in the five proximities. Combining interviews with analysis of publications allows the capture of informal and formal relationships as well as those that may not have (yet) resulted in publication. SNA-based data on individuals is also the basis for analysis of organisational proximity (distance within hierarchies or across organisations) and institutional proximity (i.e. distance in terms of incentive regimes). Interviews also provide narrative accounts from interviewees that give further explanatory insights. Through interviews we also collect information about the early outputs and achievements of the research project to assess early signs of translation.

The aim of the paper focuses on operationalising the framework on proximities into measurable outputs. The indicators developed around the five proximities use both quantitative and qualitative data. Types of projects involving different translational activities may not need to involve strong proximities along the five dimensions. Rather than saying that a project has performed well or less well in different proximities, the paper will determine a proximity profile, which characterise the type of proximities that a given project has helped to address.

Empirical focus of the paper: In order to develop partial indicators for each of the proximities the paper focuses on an illustrative case study. The case study is a biomedical research project focused on a neglected disease, podoconiosis. Podoconiosis (also known as non-filarial elephantiasis) is recognised by the swelling it generates to the feet and the lower parts of the leg. It is estimated that around 4 million people are affected in Africa only, but the disease can also be found in Central America and North-West Africa. The specific work of the podoconiosis project focuses on two countries, Ethiopia and Cameroon, and includes two types of work. The first part of the work mainly carried out in Ethiopia consists on a geostatistical mapping of area affected, based on soil analysis and disease incidence. Another part of the study focuses on a genetic predisposition analysis of people in Cameroon (similar work has already been conducted in Ethiopia before this particular research grant).

Discussion of initial results: Analysis of the Podoconiosis project provides insights into activities along the five dimensions identified in the theoretical framework and enabled us to define a translational profile for the project. The early results firstly show that in terms of cognitive and social proximity the project generated some strong changes. In terms of cognitive proximity, the partners within the project are quite diverse featuring disciplines like tropical medicine and public environmental studies in medical sciences, but also geography and statistics in environmental sciences and engineering, soil sciences and mineralogy in earth sciences and finally immunology and endocrinology in biological sciences. The qualitative evidence shows that people working with each other have developed an understanding in skills from disciplines they had not been exposed to before and therefore we concluded that the cognitive proximity has changed to a large extent as a result of the project.

In terms of the geographical and institutional dimensions, the project has resulted in a marked evolution in those proximities. In terms of geographic proximities, organisations from 4 different countries have been recorded as being involved in the project, bringing collaboration across three different continents. Geographical links between the UK participants and African participants can be considered as being strengthened through periods of fieldwork where UK scientists visited these countries for several weeks in order to work cooperatively.

In terms of institutional proximities five out of the six types of institutional incentive regimes involved in biomedical research are represented in the project (these are university hospitals, university and Education institutions, Hospital and care institutions, non-governmental organisation, governmental organisations, Industry).

Preliminary conclusions: The paper concludes that the case study project had a strong impact on cognitive and social aspect within the funded research group, a strong impact on the institutional and geographic aspect. The paper also provides an opportunity to reflect on the advantages / disadvantages of both the methods introduced in the qualitative data gathering, but also in the way to operationalise the different proximities with qualitative and quantitative indicators.

References:

- Bioscience Innovation & Growth Team (2003). Bioscience 2015. Dept. of Trade and Industry.
- Boschma, R. (2005). "Proximity and innovation: a critical assessment." *Regional Studies* 39(1): 61-74.
- Davids, M. & Frenken, K. (2014) "Proximity, knowledge base and the innovation process: The case of Unilever's Becel diet margarine" *Papers in Evolutionary Economic Geography* (PEEG) 1504, revised Feb 2015.
- Hopkins, M. M., et al. (2006). "Putting Pharmacogenetics into Practice." *Nature Biotechnology* 24(4): 403-410.
- Hopkins, M. M., et al. (2007). "The myth of the biotech revolution: An assessment of technological, clinical and organisational change." *Research Policy* 36(4): 566-589.

House of Lords S&T Committee (2009). *Genomic Medicine*. London, Stationery Office Ltd.

Molas-Gallart, J. et al. (forthcoming). "Towards an alternative framework for the evaluation of translational research initiatives" *Research Evaluation* (published online November 24, 2015) doi:10.1093/reseval/rvv027.

MRC (2012) *Measuring the link between research and economic impact: report of an MRC consultation and workshop*.

Ponds, R. et al. (2007) The geographical and institutional proximity of research collaboration. *Papers in Regional Science* 86(3): 423–443.

Rafols, I. et al. (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): 1871-1887.

Swann, J., A. et al. (2007). "Modes of organizing biomedical innovation in the UK and US and the role of integrative and relational capabilities." *Research Policy* 36(4): 529-547.

Wanless, D. (2002). *Securing our future health: taking a long-term view*. Final report. London, HMSO.

Zerhouni, E. (2003). "The NIH Roadmap." *Science* 302: 63-72.

Do vouchers make a difference? A study of vouchers for improving organizational capabilities in firms

Edurne Magro*(Orkestra, Basque Institute of Competitiveness) and Jon Mikel Zabala-Iturriagagoitia(Deusto Business School)

* edurne.magro@orquestra.deusto.es

KEYWORDS: Vouchers, Organizational capabilities, Innovation, Policy evaluation

1.- Introduction

There is a common understanding in the innovation studies literature about the importance of combining R&D based and organisational innovation in order to boost firms' competitiveness. In evolutionary economics (Nelson and Winter, 1982) the cognitive capabilities of the firms are embedded in their organisational routines, which are the result of learning processes. As a matter of fact, there is ample evidence suggesting that learning firms are also the most innovative.

In addition, Teece (2007) goes beyond and states that the firms' capabilities have to be dynamic in order to be competitive. Dynamic capabilities (Teece et al., 1997) are thus defined as higher level competences that determine the firm's ability to integrate, build, and reconfigure internal and external resources/competences to address, and possibly shape, rapidly changing business environments.

Managerial and organizational capabilities are thus central in firm competitiveness. Therefore, adopting dynamic capabilities and transforming them into organisational routines constitutes a key learning process for firms. This provides a conceptual justification for public policy to evolve so that new types of programs are introduced supporting the internal management of innovation. In addition to the programs based on a linear view of the innovation process, such as those aiming at improving innovation through R&D resources injection (i.e. R&D subsidies), collaborative R&D programs (based on a systemic innovation view) and vouchers have become increasingly popular.

2.- Vouchers as a policy instrument

Vouchers have become very popular among policy makers in organisational innovation programs oriented to improve the dynamic capabilities of the firms. The rationale behind voucher based schemes is that external experts can have a positive impact on the performance of organizations. Learning is one of the outcomes of these programs, which is the result of the interaction between an external expert (i.e. a consultant) and the managerial team of the firm. The assumption made is that improving those capabilities will lead firms to learn and innovate and thus, gain in competitiveness.

This paper focuses on a voucher scheme that has been running for more than 20 years in the Basque region (Spain). It is a program that dates back to 1995 and aimed at improving the management of SMEs. Since its inception, the key rationale for the program has been that organizations require time and space to reflect on the different areas of the internal management of the firm in order to learn about those elements that either are missing or are superfluous. Thus, the program intends to make a difference in the effective management of organizations, so these take action to overcome the identified weaknesses. Our aim is to understand the influence of government programs based on vouchers on firms' organizational capabilities and innovation performance.

3.- Methodology

Through an evaluation exercise the paper aims to shed light into the impact of this type of programs. This exercise was conducted following a mixed approach that triangulates quantitative (matching approaches) with qualitative techniques (semi-structural interviews). First, desk research and analysis on documentation text on the program was carried out so as to get to have a detailed view of the objectives of the program and its *modus operandi*. The next step was a qualitative research work in which semi-structured interviews with program beneficiaries were undertaken. On the one hand, this stage not only allowed us to make an initial assessment of the characteristics of the beneficiaries of the program, but also to make an inventory of the possible effects these beneficiaries had perceived as a consequence of their involvement in the program. This stage can be named as a participatory evaluation, as both policy-makers in charge of managing the program and beneficiaries defined the set of indicators that might be deemed more sensible in its evaluation. These indicators were oriented toward the measurement not only of input and of behavioural and output additionality (Clarysse et al., 2009) but also to seeking to assess changes in behaviour (behavioural additionality).

Within neoclassical theory, the concepts of input and output additionality are the most commonly used in policy evaluation (Clarysse et al., 2009). Input additionality (David et al., 2000; Ebersberger, 2005; Aerts and Schmidt, 2008) refers to the additional amount of resources subsidized firms invest in the innovation process. Output

additionality (Czarnitzki and Hussinger, 2004; Czarnitzki and Licht, 2006) measures the additional outputs achieved as a consequence of policy intervention (i.e. new innovations in the market, increases in productivity). However, even more important than this is the measurement of the behavioural additionality, as these schemes aim at changing the behaviour of firms.

In the last years, a complementary concept has emerged in the literature: behavioural additionality. Behavioural additionality is linked to a systemic or evolutionary view of the economy and refers to changes in firms' behaviour as a result of policy support (Georghiou et al., 2002). These effects are perceived in a longer term than in the other types of additionalities and according to Georghiou (2002) are closer to system failures. More precisely, behavioural additionality includes those behavioural changes that lead firms to collaborative patterns, to continue with R&D investments after the subsidized project has finalized, to internationalize their R&D activities, etc. All of them are related to the organizational learning achieved by the firm after public intervention. As Clarysse et al. (2009) stress, little empirical evidence can be found to date on the behavioural additionality of R&D programs (Autio et al., 2008). This is the gap we aim to address in this paper.

Additionality measurement was articulated by an online survey, which was circulated to all beneficiaries. A similar questionnaire was also distributed to a set of "peer" companies that had not participated in the program. This control group was composed of firms that share essential features with beneficiaries, so as to isolate the net impact of the program. This requires the application of a matching technique between beneficiaries and non-beneficiaries controlling for the following variables: size of the company, sector of activity, age. Overall, 45 beneficiaries (representing an 11% response rate) and 127 companies forming the control group (representing 3% of the universe considered) responded to the survey.

4.- Results

Our results suggest that the program has functioned as a facilitator of incremental improvements and innovations (i.e. product, process and managerial). Beneficiaries indicate (via interviews and the survey) they have evolved positively in almost all aspects of internal management in the years after participation. However, it has not been a decisive element in improving the economic and financial state of the firms in the sample. When comparing the output additionality of the programme for the beneficiaries vis a vis the control group, the only statistically significant variables that indicate differences between the two groups are the variable return on funds and return on assets. The results of the matching approach reveal that beneficiaries have a significantly higher return on assets and a significantly lower return on funds than the control group.

Although there are beneficiaries who have profited from participating, it cannot be concluded that the programme has led to any statistically significant additionality. This along with the modest influence attributed to the program by the beneficiaries suggests that it has not been a major catalyser of firm performance. Our results are in line with the evidence of other similar experiences in the Netherlands (Dialogic, 2008). The limited impact of vouchers is attributed to being a light and non-committal instrument (Kamp and Bevis, 2012), so that the less investment and sacrifice a measure public support requires, the less the gained performance.

5.- Discussion

Vouchers as a policy instrument may play a role as eye-openers, awareness raisers, creating culture and mentality, which is not to be disdained. However, their long term effects seem to diffuse and the additionality of the public intervention vanish.

References

- Aerts, K. and Schmidt, T. (2008) Two for the price of one? Additionality effects of R&D subsidies: A comparison between Flanders and Germany. *Research Policy*, 37, 806-822.
- Autio, E., Kanninen, S., Gustafsson, R. (2008) First- and second-order additionality and learning outcomes in collaborative R&D programs. *Research Policy*, 37, 59-76.
- Clarysse, B., Wright, M., Mustar, P. (2009) Behavioural additionality of R&D subsidies: A learning perspective. *Research Policy*, 38, 1517-1533.
- Czarnitzki, D. and Hussinger, K. (2004) The link between R&D subsidies, R&D input and technological performance. ZEW Discussion Paper 04-56, Mannheim, Germany.
- Czarnitzki, D. and Licht, G. (2006) Additionality of public R&D grants in a transition economy: the case of Eastern Germany. *Economics of Transition*, 14(1), 101-131.
- David, P. A., B. H. Hall, et al. (2000) Is public R&D a complement or substitute for private R&D? A review of the econometric evidence. *Research Policy*, 29, 497-529.
- Dialogic (2008) Evaluatie innovatievoucherregeling 2005/2006 eindrapport. Dialogic, Utrecht.
- Ebersberger, B. (2005) The Impact of R&D Funding. VTT Publications 588. VTT, Espoo, Finland.
- Georghiou, L. (2002) Impact and Additionality of Innovation Policy Innovation Policy and Sustainable Development: Can public innovation incentives make a difference? Brussels, Six Countries Programme on Innovation.
- Georghiou, L., Rigby, J. and Cameron, H. (2002) Assessing the Socioeconomic Impacts of the Framework Programme. PREST, University of Manchester.
- Kamp, B., Bevis, K. (2012) Knowledge transfer initiatives as a doorstep formula to open innovation. *Int. J. Automotive Technology and Management*, 12, 22-54.
- Nelson, R.R. and Winter, S.G. (1982), *An Evolutionary Theory of Economic Change*. Harvard University Press: Cambridge, MA.
- Teece, D.J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28, 1319-1350.
- Teece, D.J., Pisano, G., Shuen, A. (1997) Dynamic capabilities and strategic management. *Strategic Management Journal*, 18, 509-533.

Parallel session 2

2A. TRACK THEME 1: CONCEPTUALIZING SOCIAL INNOVATION THROUGH 'CLASSICAL' INNOVATION STUDIES AND APPROACHES (II)

Modelling Actors' Roles and Interactions in Social Innovation Processes

Judith Terstriep* and Anna Butzin

(Westphalian University, Institute for Work and Technology)

* terstriep@iat.eu

KEYWORDS: Innovation, Social innovation, Actors, Interactions, Descriptive model

1 RELEVANCE

Research on social innovation has gained momentum over the past years, spurred notably by the many complex and interrelated socio-economic challenges Europe is facing (e.g. unemployment, ageing population, migration). However, while technological innovations are well understood and supported by established policy and support infrastructures, social innovations lack such underpinning (Terstriep & Totterdill, 2014). So far, the idea of social innovation as innovation concept remains undeveloped leaving considerable space for theoretical and practical contributions (Cajaba-Santana, 2014). In response to Cajaiba-Santana's call for the development of complex descriptions of social innovation processes, this contribution develops a descriptive model on actors' roles and interactions in social innovation initiatives. It is based upon 'classical' innovation studies' conceptualizations of actors in innovation settings and extensive empirical material generated in two main EU-funded research projects on social innovations. The model contributes to advance understanding of social innovation processes. Moreover, it is of high relevance for policy making, in particular with regard to facilitate the set-up of policy programs and tools aiming at fostering social innovations.

The contribution would most appropriately be positioned within the first track theme "Conceptualizing Social Innovation through 'classical' innovation studies and approaches". It specifically addresses the track theme's research question "How do the sources (inputs, actors), organizations, institutions, interactions and outputs (benefits, impacts) compare across 'classical' and 'social' innovation processes?", but will also touch upon the other track theme's research questions.

2 RESEARCH AIMS

The overall aim of this paper is to develop a descriptive model of actors' roles and interactions in social innovation to better understand social innovation processes. To this end, it is envisaged to explore what lessons can be transferred from traditional innovation theories, while accounting for the specifics of social innovation. Hence, (i) operationalising 'classical' innovation studies knowledge about actors shall provide the basis for developing the model. Next, (ii) social innovation actors' roles and interactions shall be analysed as second input for (iii) the model development. Furthermore, (iii) the model's implications for policy making shall be discussed. Finally, (iv) comparing the model against conceptualizations of actors and interactions in 'classical' innovation settings in order to elaborate commonalities and differences of the two innovation logics will be sought.

3 DEFINITIONS

As the field of social innovation research grows, and becomes subtler and more complex, an increasing number of (competing) definitions emerge invoking concepts such as institutional and social change, social purpose, market failure etc. (Rüede & Lurtz, 2012; Jenson & Harrison, 2013; Nicholls, Simon & Gabriel, 2015; Pelka & Terstriep, 2016). Generally speaking, social innovation is about new ideas, initiatives and opportunities within (non-)market contexts. Innovations are different from given widespread practices, therefore comes at no surprise that social innovations tend to originate in contradictions, tensions, and dissatisfactions. 'Hence, social

innovations are manifested in changes of attitudes, behaviour, or perceptions, resulting in new social practices' (Cajaba-Santana, 2014: 44). It embodies the simultaneous development of political, social, economic and cultural constructs as well as novel business practices. At a micro level, initiatives are driven by individual and organisational capacities to cope with increasingly complex environments, social and economic challenges as well as market failures and shortcomings. Social innovation is characterised by an iterative process of experimentation and learning with an open end including abandonment and failure. They go beyond singular individual activities. Thus, '[...] social innovation doesn't solely concern outcomes, but process as well – and more specifically the social relations between groups' (Defourny & Nyssens, 2013, 47). In contrast to profit-seeking innovation, social innovations pursue to solve social problems and do not necessarily involve a commercial motive, though they do not preclude such interest (Phills et al., 2008; Westley & Antadze, 2010).

Accounting for the above, social innovation in the sense used here refers to novel combinations of ideas as well as practices and distinct forms of collaboration that transcend established institutional contexts with the effect of empowering and (re-)engaging the target group either in the process of the innovation or as a result of it (Rehfeld et al., 2015). An innovation is therefore social to the extent that it alters social action, and is socially accepted and diffused in society, larger parts of it or certain sub-areas (Howaldt et al., 2014).

4 CONCEPTUAL FRAMEWORK

The role of diverse actors is fundamental in many conceptualisations of 'classical' innovation settings. Well-known examples such as triple and quadruple helix approaches (Etzkowitz & Leydesdorff, 2000; Carayannis & Campbell, 2009) underline the shift from an industrial to a knowledge society in which relations to knowledge carriers are a crucial component of innovative actions (Martín-de Castro, 2015; Martin, 2013). From a spatial perspective, also within debates on regional innovation systems, relationships among actors (customers, industry, associations, firms, research, financial intermediaries, etc.) are worked out in detail in order to specify their role and position within the regional system (Huggins & Prokop, 2016; Tripl & Tödtling, 2005). Diversity of actors has also been studied from a knowledge combination perspective, since cooperation among actors from different sectoral backgrounds is a promising avenue to stimulate innovations (Strambach & Klement, 2012; Fagerberg, Landstrom & Martin, 2012). The advantage of conceptual clarity going along with a sophisticated body of knowledge about innovation actors is also obvious in terms of policy making. It enormously facilitates support and the set-up of tailored policy programs. When it comes to social innovation, the picture is rather different. The role of involved actors remains to be studied in detail, and there is a lot to learn from 'classical' innovation studies, not only in terms of conceptualizations, but also in terms of methodologies (Mulgan, 2012). The review of social innovation literature reveals, however, that although the importance of cross-sector collaboration (private, public, third sector, civil society) in social innovation is well recognised, empirical evidence on distinct types of actor constellations remains scarce. This particularly applies to actors' roles, needs, and modes of collaboration. The lack of knowledge is also problematic for policy making. Programs and other supporting instruments remain in a rather general shape, and thus cannot unfold its full potential.

5 EMPIRICAL MATERIAL & METHODOLOGY

To build rich descriptions and gain in-depth insights, our analysis of social innovation actors' roles and interactions is based upon a mixed-method design whereby the qualitative results provide the basis for the formulation of research questions for the quantitative analysis (Morgan, 2014; Creswell 2014). Qualitatively, we will analyse 60 social innovation cases which have been collected by means of social biographies and business case studies that were conducted as part of the ongoing 7th Framework project "SIMPACT - Boosting the Impact of Social Innovation in Europe through Economic Underpinnings" (Terstriep, Kleverbeck, Deserti & Rizzo, 2015). Innovation Biographies allow grasping the evolvement of an innovation process from first idea until its implementation including involved actors and networks, drivers and barriers, knowledge dynamics, etc. (Butzin & Widmaier 2016). Quantitatively, we will analyse data of 1'005 social innovation initiatives collected during a global mapping exercise of the 7th Framework project "SI-Drive: Social innovation driving force of social change". The data is based upon a survey of publicly available material (websites, press articles, etc.) of social innovation initiatives. The two data sets have in common the micro perspective on social innovation, i.e. the level where concrete initiatives arise, stakeholders interact, and where drivers and barriers of social innovations become most apparent. Data collection placed main emphasis on involved actors, their roles and interactions throughout the innovation process.

6 EXPECTED OUTCOMES

The study is expected to make three main contributions to social innovation, with implications for both research and practitioners. First, drawing on established research on ‘classical’ innovation, offers valuable insights to advance understanding social innovation processes. While former research acknowledged the diversity of actors and cross-sector collaboration, neither the role nor the interactions among stakeholders have been examined. This study is a first step to fill this gap by empirically investigating actors’ distinct roles and interactions. Second, by providing a descriptive model, actors’ roles and interactions in the innovation process are made explicit. Third, the descriptive model is expected to help (i) policymakers to identify central levers for an uptake of social innovation ideally resulting in the formulation more suitable funding programmes, support (ii) social innovators to critically reflect upon their networks and relationships necessary to gain access to relevant knowledge and provide (iii) social investors with information to better assess social innovations’ potential for scaling.

References

- Butzin, A. & Widmaier, B. (2016). Exploring territorial knowledge dynamics through innovation biographies. *Regional Studies*, 20(2), 220-232.
- Carayannis, E.G. & Campbell, D. (2009). “Mode 3” and “Quadruple Helix”: Toward a 21st Century Fractal Innovation Ecosystem. *International Journal of Technology Management*, 46 (3/4), 201-234.
- Creswell, J.W. (2014). *Research Design. Qualitative, Quantitative and Mixed Methods Approaches*. Thousand Oaks: Sage Publications.
- Defourny, J. & Nyssens, M. (2013). Social innovation, social economy and social enterprise: what can the European debate tell us? In: F. Moulaert, D. MacCallum, A. Mehmood & A. Hamdouch (eds.), *The International Handbook on Social Innovation*, Northampton: Edward Elgar, 40-52.
- Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and “Mode 2” to a Triple Helix of university–industry–government relations. *Research Policy*, 29(2), 109–123.
- Fagerberg, J., Landstrom, H., & Martin, B. (2012). Exploring the emerging knowledge base of ‘the knowledge society’. *Research Policy*, 41(7), 1121-1131.
- Howaldt, J., Butzin, A., Domanski, D., & Kaletka, C. (2014). Theoretical Approaches to Social Innovation - A Critical Literature Review. A deliverable of the project ‘Social Innovation: Driving Force of Social Change’ (SI-DRIVE), Dortmund: Sozialforschungsstelle.
- Huggins, R., & Prokop, D. (2016). Network structure and regional innovation: A study of university-industry ties. *Urban Studies*. doi:10.1177/0042098016630521
- Martin, R. (2013). Differentiated Knowledge Bases and the Nature of Innovation Networks. *European Planning Studies*, 21(9), 1418-1436.
- Morgan, D. L. (2014). *Integrating Qualitative and Quantitative Methods. A Pragmatic Approach*. Thousand Oaks: Sage Publications.
- Moulaert, F. (2009). Social Innovation: Institutionally Embedded, Territorially Re-Produced. In: MacCallum et al. (eds.), *Social Innovation and Territorial Development*, Fullham, UK: Ashgate, 11-24.
- Mulgan, G. (2012). Social Innovation Theories: Can Theory Catch Up with Practice? In: H.-W. Franz, J. Hochgerner & J. Howaldt (Eds.), *Challenge Social Innovation. Potentials for Business, Social Entrepreneurship, Welfare and Civil Society*. Berlin, New York: Springer, 19-42.
- Nicholls, A., Simon, J. & Gabriel, M. (2015). Introduction: Dimensions of Social Innovation. In: A. Nicholls, J. Simon & Gabriel (eds.), *New Frontiers in Social Innovation Research*. Basingstoke: Palgrave Macmillan, 1-26.
- Pelka, P. & Terstriep, J. (2016). Mapping Social Innovation Maps – The State of Research and Practice across Europe. *European Social Innovation Review*, 1(1), forthcoming.
- Rehfeld, D., Terstriep, J., Welschhoff, J. & Alijani, S. (2015). Report on Social Innovation Framework. Deliverable D1.1 of the project «Boosting the Impact of Social Innovation in Europe through Economic Underpinnings» (SIMPACT), European Commission – 7th Framework Programme, Brussels: European Commission, DG Research & Innovation.
- Rüde, D. & Lurtz, K. (2012). Mapping the various meanings of social innovation: Towards a differentiated understanding of an emerging concept. EBS Business School: Research Paper Series 12-03.
- Strambach, S. and Klement, B. (2012). Cumulative and Combinatorial Micro-dynamics of Knowledge: The Role of Space and Place in Knowledge Integration. *European Planning Studies* 20 (11), 1843-1866.
- Terstriep, J. & Totterdill, P. (2014). Economic Foundation of Social Innovation. New Ways of Policy Production. Paper presented at RIP 2014, University of Stavanger, 16-17 October 2014.
- Terstriep, J., Kleverbeck, M., Deserti, A. & Rizzo, F. (2015). Comparative Report on Social Innovation across Europe. Deliverable D3.2 of the project «Boosting the Impact of Social Innovation in Europe through Economic Underpinnings» (SIMPACT), European Commission – 7th Framework Programme, Brussels: European Commission, DG Research & Innovation.
- Tripl. M. & Tödtling, F. (2005). One size fits all?: Towards a differentiated regional innovation policy approach. *Research Policy*, 34(8), 1203–1219.
- Turner, S. F., Cardinal, L. B., & Burton, R. M. (2015). Research Design for Mixed Methods: A Triangulation-based Framework and Roadmap. *Organizational Research Methods*, online first. doi:10.1177/1094428115610808.
- Westley, F.W. & Antadze, N. (2010). Making a Difference: Strategies for Scaling Social Innovation for Greater Impact. *The Public Sector Innovation Journal*, 15(2), 1-19.

The role of societal engagement in social innovation.

Effie Amanatidou*, Dimitri Gagliardi, Rafael Popper, Deborah Cox and Guillermo Velasco
(University of Manchester)

*effie.amanatidou@manchester.ac.uk

KEYWORDS: Social innovation, Typology of social innovation, Innovation systems approach, Sustainable social innovations

Introduction

Social innovation has been intensely debated in academic and policy cycles in the last years, not least due to the shift of European research and innovation policies towards societal challenges. Positioning social innovation in the arena of innovation has attracted significant attention. Howaldt et al. (2014) argue that the new paradigm of innovation calls for social innovation to be considered an independent field and going even further, Haxeltine, et al. (2013) attempt to develop a theory for transformative social innovation, while Hochgerner (2011) argues that all innovations are socially relevant, and suggests the notion of an extended paradigm of innovation.

This diversity of perspectives on what is social innovation lends itself to a thorough examination of similarities and differences among the conceptualisations of social innovation, thus leading to a typology of social innovations.

The objective of this paper is to build a typology of social innovations informed by similarities and differences of social innovation activities in relation to motives, drivers, incentives and key factors.

The approach applied in the analysis will be based on the innovation systems approach considering the key actors, institutions and interactions in the innovation system. Thus, the aim and approach of the paper lies at the heart of the conference and of Track theme 1 in particular ‘Conceptualizing Social Innovation through ‘classical’ innovation studies and approaches’.

Theoretical background

The term ‘social innovation’ is not new but has returned to prominence in the last 15 years. It is used in ideological and theoretical debates about the nature and role of innovation in contemporary society, either to confront mainstream concepts of technological and organizational innovation, or as a conceptual extension of the innovative character of socio-economic development (MaCallum, et. al. 2009).

Nonetheless, the ‘Innovation’ element has mostly referred to the conceptualisations originated in the Schumpeterian tradition: innovation is intended as a process whose outcome consists in the 1) launch of a new product and services or a new version of an already known product and services; 2) application of new methods of production or sales of a product; 3) opening of new markets; 4) acquiring new sources of supply of raw material or semi-finished goods; 5) new industry structure such as the creation or destruction of a monopoly position. Innovation is the driver of a long term process of structural change of the economy (Schumpeter, 1934, Metcalfe, 2004; Metcalfe et al, 2012; Sledzik, 2013).

A definition widely used within the EU institutions refers to social innovation as the development and implementation of new ideas, products, services and models to meet social needs and create new social relationships. (Murray, et al. 2010) It represents new responses to pressing social demands, which affect the process of social interactions. This definition has its origins in the writing of Geoff Mulgan and his colleagues at the Young Foundation. Building on this definition, BEPA adds another characteristic, i.e. social innovation “is social in both their ends and means” (BEPA, 2011). According to this definition, social innovations may be conceived and executed by individuals, organisations or groups under a process of collective creation.

Trying to provide further clarity, other innovation scholars highlight that social innovations are not about material production or technical crafts. It lies in social behavioural patterns, routines, practices and settings (Kesseling and Leitner, 2008). Hochgerner identifies social innovations in businesses, civil society, government and social milieus whose content relates to participation, procedural rules and behaviour as a special type of innovation to be distinguished from technological and non-technological business innovations (Hochgerner, 2009).

The ‘social’ dimension of social innovation is extensively discussed in a strand of literature which includes other than innovation scholars, sociologists, geographers and environment and sustainability scholars. For example, Moulaert (2005) places particular importance on the ‘empowerment dimension’ and the increasing level of participation of individuals and deprived groups in social innovations whereby the stakeholders of this social system are individuals, organizations, neighbourhoods, communities and whole segments of society (Moulaert, et al. 2005). Taking this conceptualisation further, social values are a major driving force of social innovation

(Harrison et al 2009., p. 11) and the values that social innovations are based on are not oriented primarily towards economic utility (Kesselring and Leitner, 2008). The Stanford Social Innovation Review also adds that the value created from social innovations accrues primarily to society as a whole rather than the private individuals (Phills, et. al. 2008).

There seem to be variations in the way the social aspect is reflected in the different definitions of social innovation. These mainly echo the role of society in the innovation process. Three such variations can be distinguished as follows:

1st level of social innovation; Social innovation deriving from private initiative with social aim

- new ideas translated in products, services and models
- economic viability
- meet social needs where society is the end-user
- create new social relationships, collaborations
- social in both ends and means

2nd level of social innovation: Private initiative with social aim and society involved in the delivery of social innovation

- Society / consumers as co-creators, co-producers
- new forms of participation that affect the process of social interactions

3rd level of social innovation: Society directly involved in the social innovation process from inception to delivery with distributed benefits beyond the ‘innovator’s sphere’

- society in the driving seat throughout the process: from identifying to solving a societal challenge
- solutions alternative to the mainstream market economy
- underpinning values: citizens’ empowerment, social justice, solidarity, social cohesion, openness, social responsibility

First, there are social innovations that originate from private initiatives with a strong social aim. In these cases, society is mostly seen as the end-user of the innovations without a major role or say in any of the phases of the innovation process - generation and design, delivery and diffusion.

Second, there are social innovations in which the role of society is somehow more strengthened than in the first case. We may think of society as co-creators or co-producers of the innovations in initiatives driven by individual – social innovation champions - and social groups as active partners. This role presupposes that society has the ability to think creatively and thus contribute to the innovation generation process.

The third type includes initiatives with society playing the key role from the initiation to the diffusion and delivery phase of the innovation cycle. This means that society is the key player from the early identification of the problem, it has a key role in searching phases and it drives the implementation of a possible innovative solution. This case presupposes that society is strongly engaged in the social innovation process and that there are effective capabilities and resources to think creatively and innovate.

Source Amanatidou et al, unpublished

Methodology and empirical materials

In this paper we adopt a qualitative approach based on a large variety of in depth cases. The case study approach allows us to look in detail to the various characteristics of social innovation and capture the nuances that may contribute to building more articulated theoretical foundations (Yin 2003). Building on a large number of detailed case studies we infer on ‘critical issues’ characterising social innovations with the “shared” overarching goal of achieving sustainable social, economic and environmental transformations (Eisenhardt and Graebner 2007).

To achieve this, the paper draws on a subset (48 cases) of the CASIPEDIA database (<http://www.casi2020.eu/casipedia/cases/>) to further analyse selected CASI project findings (Popper et al, 2016), with an emphasis on ‘critical issues’ from common practices, outcomes and players of social innovations focused on wide ranging, yet interconnected, sustainability-oriented objectives.

The selected 48 social innovations cover a plurality of socio-economic sectors (e.g. education, health/social services, agriculture, etc.) and priority areas linked to the EU societal challenge on climate action, environment, resource efficiency and raw materials (such as Climate action by sustainable lifestyle, Raw materials conscious sustainable lifestyle, Strategic intelligence and citizens’ participation, Eco-solutions to reduce raw materials use, and Climate change mitigation solutions, among others). The prevailing territorial scope of cases is either

national or local, however a few cases (e.g. Freecycle network) have benefited from a more international outreach.

The classification of cases by levels of societal engagement in the innovation will further advance our understanding of success factors, drivers, barriers, opportunities and threats associated to social innovations in a variety of contexts, while also refining the typology developed.

Expected outcomes

The analysis of social innovations by levels of societal engagement would help us understand how such engagement could influence on the generation, analysis and categorisation of possible ‘actions’ (i.e. policy recommendations) for social innovation at different levels of decision making, addressing the strategic / policy, programming and operational levels.

The role of societal engagement in social innovation 1st level of social innovation 2nd level of social innovation 3rd level of social innovation

Policy level Lesson type 1 Lesson type 4 Lesson type 7

Programming level Lesson type 2 Lesson type 5 Lesson type 8

Operational level Lesson type 3 Lesson type 6 Lesson type 9

References

- BEPA. 2011 Empowering people, driving change Social Innovation in the European Union. Luxembourg: Publications Office of the European Union, 2011.
- Haxeltine, A., Kemp, R., Dumitru, A., Avelino, F., Pel, B., and Wittmayer, J., 2015 TRANSIT WP3 deliverable D3.2 – “A first prototype of TSI theory”
- Hochgerner J., 2011. The Analysis of Social Innovations as Social Practice.
- Howaldt, J., Butzin, A., Domanski, D., & Kaletka, C. (2014). Theoretical Approaches to Social Innovation - A Critical Literature Review. A deliverable of the project: “Social Innovation: Driving Force of Social Change” (SI-DRIVE). Dortmund: Sozialforschungsstelle.
- MacCallum, D., Moulaert, F., Hillier, J., and Vicari Haddock, S., 2009 Social Innovation and Territorial Development. Ashgate e-book.
- Miles, I. 1993. Services in the New Industrial Economy. *Futures* 25 (6): 653–672, doi:10.1016/0016-3287(93)90106-4.
- Mulgan, Geoff, Simon tucker, Rushanara Ali and Ben Sanders. 2007. Social Innovation: What it Is, Why it Matters and How it Can Be Accelerated. Working paper, Skoll Centre for Social Entrepreneurship, Saïd Business School, University of Oxford.
- Murray Robin, Julie Caulier-Grice, Geoff Mulgan. 2010. The Open Book of Social Innovation. Social Innovator Series: Ways To Design, Develop And Grow Social Innovation. The Young Foundation and NESTA.
- Phills Jr. James A., Kriss Deiglmeier, & Dale T. Miller. 2008. Rediscovering Social Innovation. Stanford Social Innovation Review.
- Schumpeter, J.A. 1934, The theory of economic development: an inquiry into profits, capital, credit, interest and the business cycle, Harvard Economic Studies, Vol. 46, Harvard College, Cambridge, MA.
- Eisenhardt, K.M., and M.E. Graebner. 2007. Theory building from cases: Opportunities and challenges. *Academy of Management Journal* 50, no. 1: 25–32.
- Yin, R.K. 2003. Case study research: design and methods. Applied social research methods series 3rd ed. Thousand Oaks, CA: Sage.
- Popper, R., Velasco, G., and Ravetz, J. (2016) State-of-the-art of Sustainable Innovation, CASI project report, www.casi2020.eu

Taking a Multi-Level Perspective on Social Innovations - from Grass Root Movement to Transformation"

Susanne Giesecke
(AIT)
susannegiesecke@yahoo.com

KEYWORDS: Social innovation, Social housing, Community-based participatory health research, Social grid, Multi-level perspective, Case studies, Social transformation, Niche, Landscape

This paper builds on the understanding of two different theoretical approaches to illustrate change and transformation in social innovations: First Beckert (2010) noted in his social grid model that common analyses of markets as social structures fail to integrate established approaches that tend to focus exclusively on one explanatory theory alone. This siloed thinking fails to give a full account of the social enactment of economic structures and social exchange relationships and, as a consequence, typically does not acknowledge socio-economic exclusion as a product of market arrangements.

Second, we will utilise a multi-level-approach, helping to analyse how an innovation starts from a niche position, becomes a regime and finally a social transformation. During this process, many success and failure factors are influenced by "landscape" developments or (Geels and Schot 2007).

For a more adequate analysis of such an unusual theoretical combination we focus on two longer term case studies: social housing and Community-based participatory health research (CPHR). Social housing – at times also called municipal or community housing – today is still a response to severe social challenges we are facing today in the EU, even though we witnessed massive changes and even social transformation on the field of homelessness and shortage of adequate housing during the last 100 years. We will show in our case studies how social innovation was able to reintegrate economically marginalized parts of the population into society and thus attempted to alter the anticipated path of unregulated capitalist development. Community-based participatory (health) research (CBPR), means cooperation between research, health care, and engaged citizens to jointly achieve new insights in the improvement of public health. (Israel 1998; Minkler & Wallerstein 2008; Macaulay 1998 & 1999; Green & Kreuter, 2005).

CBPR is regarded as an effective method for transferring evidence-based research from clinical settings to communities that can benefit most; thereby, it can improve people's health. CBPR's community-partnered research processes offer the potential to generate better informed hypotheses, develop more effective interventions, and enhance the translation of the research results into practice. Thus, CBPR is an essential tool for action-oriented and community-driven public health research.

These two case studies are at different stage in their development. Social Housing has become something similar to a social transformation. CBPR is still a niche, but could become a social transformation if the circumstances and policies are preferable. We will sketch the paths and stages of these two developments and intend to open the debate for "governance" of social innovations.

Beckert contended that the formation and continuation of such grids is not a neutral process but (re)enacts existing power relations and social structures, resisting changes in social relations that disrupt extant benefit regimes. Finally, Beckert saw the three analytic elements – social networks, institutions, and cognitive frames - of his model as closely related in multiple interactions and feedback loops. What Beckert's model does not explain in enough detail however, is how change actually occurs or what the inhibitors of change are. This is why we apply the approach of Schot and Geels to use a multi-level perspective on the social grid and developments at the landscape level that allow for a significant change in some niche innovations to establish a new regime or even lay the basis for a social transformation with long-term effect in society.

Especially in the city of Vienna this case is a good example of social transformation, and today still determines to a large degree the integration policy of the city. By the same token, the focus will be on the significance of this case to build resilience within its specific social context and against the laws of the market economy. Thus

the theoretical part of this paper will discuss how to govern social innovation in order to build a more resilient society, especially improving the living and health situation of marginalized groups in our society - in the past, the present and the future.

Findings presented in this work in progress paper are for the most part based on an ongoing FP7 research project on “Creating Economic Space for Social Innovation” – CRESSI.

REFERENCES

- Beckert, J., 2010, 'How Do Fields Change? The Interrelations of Institutions, Networks, and Cognition in the Dynamics of Markets', *Organization Studies*, 31:605
- Beckert, J., 2014, 'Capitalist Dynamics – Fictional Expectations and the Openness of the Future'. MPIfG Discussion Paper 14/7
- Green, L.W., Kreuter, M.W. (2005): *Health program planning: an educational and ecological approach*. 4th ed. New York: McGraw-Hill, 2005.
- Israel B.A., Schulz A.J., Parker E.A., Becker A.B. Review of community-based research: assessing partnership approaches to improve public health. *Annual Review of Public Health*; 19: 173-202.
- Israel, B., A.J. Schultz, E.A. Parker and A.B. Becker (2001): Review of community-based research: as-sessing partnership approaches to improve public health. *Annual Rev Public Health.*; 19; pp. 173–202.
- Macaulay, A.C., Commanda, L. E., Freeman, W. L., Gibson, N., McCabe, M. L., Robbins, C. M., et al. (1999): Participatory research maximises community and lay involvement. *North American Prima-ry Care Research Group. BMJ*; 319 (7212): 774-778.
- Macaulay, A.C., Delorimier, T., McComber, A.M., Cross, E.J., Potvin, L.P., Paradis, G., et al. (1998): Participatory Research with Native Community of Kahnawake Creates Innovative Code of Re-search Ethics. *Canadian Journal of Public Health*; 89 (2): 105-108.
- Minkler, M., Wallerstein, N., (eds.) (2008): *Community-Based Participatory Research For Health: From Process to Outcome*, 2nd edition. 2nd ed. San Francisco: Jossey-Bass.
- Nicholls, A., and Murdock, A. eds., 2011, *Social Innovation: Blurring Boundaries to Reconfigure Markets*, Palgrave MacMillan
- Sen, A. 1979, 'Utilitarianism and Welfarism', *The Journal of Philosophy*, LXXVI, 463-489
- Westley, F., O. Tjornbo, L. Schultz, P. Olsson, C. Folke, B. Crona and Ö. Bodin 2013. 'A Theory of Trans-formative Agency in Linked Social-Ecological Systems', *Ecology and Society*, 18 (3), 27

Cooperating in Policy and Theory for Social Innovation: Linking Cooperative Enterprises, Social Innovation and Social Entrepreneurship

Lisa Dale-Clough and **Kate Barker***
(Manchester Institute of Innovation Research)
*kate.barker@manchester.ac.uk

KEYWORDS: Financial institutions and social innovation, Governance of social innovation, Relationship between social innovation and social entrepreneurship

This paper can contribute to either theme 1 social innovation, or the papers on social innovation in the emerging themes element of the general conference programme (social innovation). It seeks to make an original contribution by considering the field of social innovation through the prism of cooperative enterprises, and will consider some of the policy and conceptual requirements of understanding the innovation potential of social enterprises.

Enterprises in the social economy are ‘forced’ to innovate to achieve social objectives within structures prioritising economic activities (Bouchard, 2012) and governments continue to promote the growth of social enterprise based on assumptions about its innovation potential (Chew and Lyons, 2012). The UK government’s current social investment strategy aims to increase the capitalisation of social enterprise to facilitate innovation and competitiveness (HM Government, 2013). One mechanism being encouraged is individual investment in Community Shares; a provision of nineteenth century law recently employed to develop markets of shares in community energy, rural pubs and shops, farming, transport and other cooperative societies. Cooperative enterprises can intervene in markets by shifting power, ownership structures and the norms and values governing production, exchange and enterprise, and have subsequently been used as responses to poverty, de-regulation, and to organise in the general public interest (Moulaert and Ailenie, 2005; Watkins, 1986: 111). The values and structures of Cooperatives make them one of the oldest forms of social enterprise, and their popularity is experiencing a global resurgence a result of the recent crises in financial and political governance, with 1 billion members reported worldwide during the 2012 United Nations Year of Cooperatives [1].

Under the Community Shares provisions, Cooperative societies can gain long-term risk capital that they can use as leverage as it demonstrates demand for the goods or service offered; individuals benefit from a small return on their social investment, the service provided and social engagement, and community ownership can overcome barriers to adopting innovations (Warren and McFayden, 2010). The Cooperative model enshrines democratic governance and the limits on individual investment (£20,000) reinforce the need to for societies to build communities of investors. The government support for Community Shares presents an interesting case of local social innovation policy, in which historical legislation is being used to integrate new financial and governance institutions needed to enable the social sector to take on a broader role in delivering local change (Murray et al., 2010).

Contribution of this paper: The policy benefits of studying this model and its application are clear: it will help develop insight into emergent social investment behaviour and the introduction of disruptive process innovations in sectors like energy, retail and transport. Furthermore, whilst resilient, the cooperative business model has not traditionally been viewed as dynamic or responsive due to issues in decision-making and performance management is its pluralistic governance structures (Levi and Davis, 2008). The Community Shares model is praised by the UK government as a means of encouraging enterprising and self-reliant behaviour at local level in response to societal challenges, hailing communities for “[showing] they have the ambition and determination to secure ownership of important local assets and get new projects off the ground”[3]. Will this praise be misplaced in the long-term?

However, the conceptual and theoretical framework for such an investigation is not as clear, and demands an integrated multi-theoretical perspective (Grassl, 2012) to understand the role of formalised social enterprises in the production of social innovations, and how the multiple and diverse understandings of innovation in the SE and SI field may be useful. For example, definitions of social entrepreneurship (SE) include innovation within the “catalytic behaviour of non-profit organisations that engenders value and change in the sector, community or industry through the combination of innovation, risk-taking and pro-activeness” (Helm and Anderson, 2010: 263), and in the construction of organisational designs to balance social mission with entrepreneurial functions

and generate positive externalities for society (Grassl, 2012, Casadesus-Masaell and Ricart, 2007, Brouard and Larivet, 2011).

But the locus of the SE field in economic theory of markets restricts its attractiveness to social innovation theorists as it has a profoundly different point of departure (Grimm et al., 2013). The challenge is subsequently to study the economic underpinnings of society under a holistic understanding of innovation (Grimm et al., 2013). As both the institutions and demand re-designed by actors in the social economy to address unmet needs (Levesque and Vaillancourt, 1998) are territorially embedded in social relations, a coherent understanding of social innovation also requires understandings of democracy and the socio-political capabilities and resources of different groups (Moulaert et al., 2005a: 1973-1976). These are issues of community, governance and reproduction, and include topics such as the re-emergence of the self-help tradition fundamental to modern Cooperatives and issues of subsidiarity between community initiatives and the central state (Moulaert et al., 2005) that are reflected in the practices and debates about community shares.

Aims of paper: This paper will attempt to reflect on these conceptual and policy issues through an analysis of the recent evolution of the Community Shares model amongst UK cooperative societies. It will present a synthesis of concepts from the innovation, social innovation and social enterprise literatures that may contribute towards a holistic understanding of the emergence and governance of social innovations. It will use quantitative data on the financial geography of community share investments, the sectors community share markets are emerging in, and the enterprise models used so far to reflect on the literatures. The analysis will be synthesised to propose a taxonomy of approaches to entrepreneurship and innovation being implemented within this emerging sector of the social economy.

Expected Findings: Early analysis indicates that CSOs can be divided into those that represent ‘active social innovation’, in that they insert an intervention that addresses a newly prioritised problem such as enabling investment in new infrastructure to produce cleaner energy, and those that represent ‘reactive social innovation’ and are responses to the withdrawal of an existing service or provision by government or business. These include community responses to the closure of local shops and pubs, and local community facilities among other things. Business models used by reactive SIs include widening the offer previously made by the business or facility to make the enterprise more viable. For example, cases to raise investment in shops are made based on the idea that the shop is not just a retail experience but is also a social facility providing information about a range of community activities, networks and services, and providing a lifeline in extreme weather conditions. Another model of reactive innovation is to merge previously separate businesses which are no longer viable, e.g. post offices, coffee shops and pubs, into local ‘spaces’ of interaction that create social value. Active social innovations also emphasise combination approach, but these tend to be schemes like energy, farming and transport investments that combine environmentally-motivated enterprises with education and employment programmes to drive change and learning. These models may be driven by a concern to demonstrate to the regulators that the activities being funded fall within the definition of a social investment to justify the tax relief and charitable status of the organisations involved. Particular tensions demonstrating the tangible local community benefits of energy efficiency schemes whose output (green energy) is distributed nationally through the national grid have created governance challenges for the whole sector.

The analysis indicates a fourfold typology of community share investment in social innovation underpinned by regulatory context and the sector the innovation is inserted into, which will be developed and explained in the paper. The implications of this typology for the social innovation and entrepreneurship literatures will be discussed, as will the extent to which the activities receiving investment may or may not be classed as innovative. The merits of the current policy framework for encouraging investment in social innovation will also be considered.

References

- Baker, S., Mehmood, A. (2013): Social innovation and the governance of sustainable places. *Local Environment: The International Journal of Justice and Sustainability*. <http://dx.doi.org/10.1080/13549839.2013.842964>.
- Bouchard, M.J. (2012). Social innovation, an analytical grid for understanding the social economy: the example of the Que'bec housing sector. *Serv Bus* (2012) 6:47–59. DOI 10.1007/s11628-011-0123-9.
- Brouard, F. & Larivet, S. (2011). Essay of Clarifications and Definitions of the Related Concepts of Social Enterprise, Social Entrepreneur and Social Entrepreneurship. In A. Fayolle & H. Matlay (eds.), *Handbook of Research on Social Entrepreneurship*. Cheltenham: Edward Elgar, 29-56.
- Casadesus-Masaell, R. and Ricart, J. (2007) *Competing Through Business Models*. ISESE Business School, Working Paper 713: 1-28.
- Chew, C. and Lyon, F. (2012) Innovation and social enterprise activity in third sector organisations. Third sector Research Centre Working Paper 83. Third Sector Research Centre: University of Birmingham and University of Southampton.
- Demoustier, D. (2001) “France: Voluntary Sector Initiatives for Work Integration” in Spear, R. (ed.), *Tackling social exclusion in Europe*, London: Ashgate, pp.

Grassl, W. (2012) Business Models of Social Enterprise: A Design Approach to Hybridity. *ACRN Journal of Entrepreneurship Perspectives*, 1(1): 37 – 60, Feb. 2012. ISSN 2224-9729.

Grimm, R., Fox, C., Baines, S., and Albertson, K. (2013) Social innovation, an answer to contemporary societal challenges? Locating the concept in theory and practice, *Innovation: The European Journal of Social Science Research*, 26(4): 436-455, DOI: 10.1080/13511610.2013.848163.

Helm, S.T., Andersson, F.O. (2010) Beyond Taxonomy. An Empirical Validation of Social Entrepreneurship in the Nonprofit Sector. *NONPROFIT MANAGEMENT & LEADERSHIP*, 20(3): 259-276. DOI: 10.1002/nml.253.

HM Government (2013) Growing the Social Investment Market: 2014 Progress Update. London: Cabinet Office, 2013.

Levesque, B. and Vaillancourt, Y. (1998) in Bouchard, M. (ed) (2003) *Innovation and the Social Economy: The Quebec Experience*, Business & Economics, University of Toronto Press, 7 Mar 2013, pp. 1913.

Levi, Y., Davis, P. (2008) Cooperatives as the “enfants terribles” of economics: Some implications for the social economy. *The Journal of Socio-Economics*, 37: 2178–2188.

Moulaert, F., Martinelli, F., Swyngedouw, E., and González, S. (2005) Towards Alternative Model(s) of Local Innovation. *Urban Studies*, 42(11): 1969-1990.

Moulaert, F., and Ailenei, O. (2005) Social Economy, Third Sector and Solidarity Relations: A Conceptual Synthesis from History to Present. *Urban Studies*, 42(11): 2037-2053.

Moulaert, F., and Nussbaumer, J. (2005a) Defining the Social Economy and its Governance at the Neighbourhood Level: A Methodological Reflection. *Urban Studies*, 42(11): 2071-2088.

Murray, R., Caulier-Grice, J. and Mulgan, G. (2010) *The Open Book of Social Innovation*. London: NESTA and The Young Foundation. ISBN 978-1-84875-071-5.

Warren, C.R., and McFayden, M. (2010) Does community ownership affect public attitudes to wind energy? A case study from south-west Scotland. *Land Use Policy*, 27: 204–213.

Watkins, W.P. (1986) *Cooperative Principles Today and Tomorrow*. Manchester: Hoylake Books.

[1] <http://www.worldwatch.org/membership-co-operative-businesses-reaches-1-billion-0>

[2] <http://www.worldwatch.org/membership-co-operative-businesses-reaches-1-billion-0>

[3] <https://www.gov.uk/government/news/new-community-shares-to-boost-local-services> Published 5 October 2012, accessed 6 October 2014.

2B. ENERGY, INNOVATION AND ENVIRONMENT

Cross-pollination in bioenergy: Innovation networks between the bioenergy and biotechnology in Denmark

Kalle Piirainen
(Technical University of Denmark – DTU)
kalpii@dtu.dk

KEYWORDS: Innovation systems, Functions of innovation systems, Biotechnology, Bioenergy, Bioeconomy

1. The originality of the proposal and its relevance for the conference theme and for the track theme (if chosen)
This paper explores the interactions between technological innovation systems and the development of those interactions. The empirical context is the Danish bioenergy innovation system and its interaction with biotechnology innovation system. The significance of the research is twofold. In the academic context it yields more insights about the influence of interactions between innovation systems, enabling better understanding of their development. In the practical context the findings illuminate the particular dynamics between bioenergy and biotech, in its part paving the way for supporting further development of bioenergy and industrial biotechnology.

It is well-known that bioenergy in Denmark is often closely connected to the agricultural sector. In terms of renewable energy production and use in Denmark, biomass is by far the most important source (e.g. in 2013 out of a total consumption of 187PJ, 134 PJ [Petajoule] was generated out of biomass as opposed to 40 PJ from wind power). Overall Denmark satisfies a total of approximately 24% of gross energy consumption by renewable sources. (Danish Energy Agency 2014). The Danish biomass and bioenergy system has been previously studied by several authors (e.g. Raven & Gregersen 2007). Beside the relatively strong renewable energy industry, Denmark has in relative terms exceptionally strong bio-medical industry. For example, Denmark is among top countries in clinical trials per capita, RDI and publishing on biomedical area (Invest in Denmark 2014). The connections between the bioenergy sector and biotech industry can be expected to be of high importance for the future competitiveness of new bioenergy solutions also on other markets than in Denmark. The examples can appear in different sub areas of the bioenergy, e.g., biomass for heat and power plants, urban-waste use, biogas from agricultural waste products, and biofuels for transport. In this study we focus on investigating the connections between these innovation systems.

2. The clarity and explicitness of the research aim(s) and question(s)

There is need of more systematic insight and better understanding of innovation activities and networks between biotech actors and bioenergy actors, and transfer of technology between industries, especially in Denmark. The research questions for this paper are:

- What is the structure and evolutions of networks between bioenergy and biotech industries?
- What has been the role of actors and their contribution to innovation from the collaboration between the sectors?

3. The clarity and explicitness of the definitions of the most central concepts used

For the purposes of the identification of relevant technologies and the following analysis, ‘bioenergy’ in the context of this paper refers to the use of biomass from various industrial and household side-flows, residues, and wastes or virgin biomass from forestry and agriculture to produce energy by direct combustion or through conversion to solid, gaseous or liquid fuels for power plants, vehicles, or households. The processes are varied depending on the aimed end product or use. The main conversion technologies can be split to direct thermal (McKendry 2002; Küçük & Demirbaş 1997; Demirbaş 2001), thermochemical conversion (Demirbaş 2001; McKendry 2002), biochemical (Saxena et al. 2009), and chemical conversion (Boz et al. 2009; Saka & Kusdiana 2001; Zwart & Boerrigter 2005; van Steen & Claeys 2008), and as newer entrants photo-biological conversion (Turner et al. 2008), and electrochemical conversion (Logan & Rabaey 2012).

As for the theoretical concepts, the most central is the concept of ‘innovation system’, as in “the set of institutions whose interactions determine the innovative performance of ... national firms” (Nelson 1993, p.4).

The behavior of the system arises as the various actors interact through networks within boundaries set by the framework conditions, infrastructure and cultures (e.g. Nelson 1993; Carlsson & Stankiewicz 1991).

4. The outline of the theoretical frameworks to be used (if relevant)

The current literature on technical innovation systems (TIS) has had a strong focus on describing the development of a particular TIS, in many cases focusing on renewable energy, especially wind power (Alkemada et al. 2007; Kern et al. 2015; Verhees et al. 2015) or bioenergy and biomass (Hellsmark & Jacobsson 2009; Negro et al. 2008; Verbong et al. 2008; Geels & Raven 2006; Wirth & Markard 2011; Furtado et al. 2011; Kivimaa & Mickwitz 2011). The research focus has been to a large extent on tracing the functions of innovation systems and their contribution to the development, and identifying the ‘motors of change’ (Hekkert et al. 2007), ‘motors of innovation’ (Negro & Hekkert 2012) and growth or ‘cumulative causation’ (Suurs & Hekkert 2009) i.e. beneficial feedback loops between the actors of the TIS and the functions (Negro & Hekkert 2012; Suurs & Hekkert 2009; Jacobsson & Bergek 2011).

This focus has provided a substantial body of knowledge on the inner workings of TISs. However it is pointed out that TISs do not work in isolation and the dynamics of the surrounding context as well as other interconnected TISs have their own influence to the dynamics through connected knowledge flows, and shared input-output relationships (Jacobsson & Bergek 2011; Bergek et al. 2015). Thus the focus on examining the dynamics interactions between the innovation systems and their effect to growth.

5. The description of the empirical materials to be used (if relevant)

The data used to map the networks include the database for publicly funded research, development and innovation. This database includes information on collaborative RDI projects and in particular description of technologies and consortia, that will be used to gauge knowledge development and transfer between the two industries under investigation. Further data will be joint publications from identified actors, as well as secondary data including published academic and other literature or archival data on bioenergy innovation that will enable gauging the functions of these innovation systems.

6. The clarity and explicitness in the description of the methodologies applied

The research approach is built on the ‘Manual for analysts’ of TISs (Hekkert et al. 2011). The analysis proceeds from describing the structure of and networks within these TISs, assessing the functions, and analyzing the interplay between the functions and the TIS development. The analyses include mapping of the existing networks and relevant institutions. The network analysis is based on analysis of the RDI programs as well as bibliometric analysis of relevant publications. Particular attention will be paid to technological trajectories and their convergence.

7. Expected outcomes (scientific and policy advances) likely to be achieved

The contribution of this research specifically is exploration of interconnectedness between technical innovation systems and the interplay between TISs in their context. This provides further understanding of the development dynamics of TISs and the roles of the functions. Particular findings include description of knowledge networks and actors, their interaction, and knowledge flows, as well as effect to innovation activities. These findings will give grounds for analysis of effect of networking within and between TISs towards innovation. The analysis in turn enables design of more effective policy instruments for ‘system building’ and supporting thriving innovation (eco-) systems.

References

- Alkemada, F., Kleinschmidt, C. & Hekkert, M., 2007. Analysing emerging innovation systems: a functions approach to foresight. *International Journal of Foresight and Innovation Policy*, 3(2), pp.139–168.
- Bergek, A. et al., 2015. Technological innovation systems in contexts: Conceptualizing contextual structures and interaction dynamics. *Environmental Innovation and Societal Transitions*.
- Boz, N., Degirmenbasi, N. & Kalyon, D.M., 2009. Conversion of biomass to fuel: Transesterification of vegetable oil to biodiesel using KF loaded nano- γ -Al₂O₃ as catalyst. *Applied Catalysis B: Environmental*, 89(3–4), pp.590–596.
- Carlsson, B. & Stankiewicz, R., 1991. On the nature, function and composition of technological systems. *Journal of Evolutionary Economics*, 1(2), pp.93–118.
- Danish Energy Agency, 2014. *Energy Statistics 2012*, Copenhagen, DK.
- Demirbaş, A., 2001. Biomass resource facilities and biomass conversion processing for fuels and chemicals. *Energy Conversion and Management*, 42(11), pp.1357–1378.
- Furtado, A.T., Scandiffio, M.I.G. & Cortez, L.A.B., 2011. The Brazilian sugarcane innovation system. *Energy Policy*, 39(1), pp.156–166.
- Geels, F. & Raven, R.P.J.M., 2006. Non-linearity and Expectations in Niche-Development Trajectories: Ups and Downs in Dutch Biogas Development (1973–2003). *Technology Analysis & Strategic Management*, 18(3–4), pp.375–392.

Hekkert, M. et al., 2011. Technological Innovation System Analysis: A manual for analyst, Utrecht, NL.

Hekkert, M.P. et al., 2007. Functions of innovation systems: A new approach for analysing technological change. *Technological Forecasting and Social Change*, 74(4), pp.413–432.

Hellsmark, H. & Jacobsson, S., 2009. Opportunities for and limits to Academics as System builders—The case of realizing the potential of gasified biomass in Austria. *Energy Policy*, 37(12), pp.5597–5611.

Invest in Denmark, 2014. Start with Denmark - The Heart of Life Sciences for Research and Business, Copenhagen, DK.

Jacobsson, S. & Bergek, A., 2011. Innovation system analyses and sustainability transitions: Contributions and suggestions for research. *Environmental Innovation and Societal Transitions*, 1(1), pp.41–57.

Kern, F. et al., 2015. Empowering sustainable niches: Comparing UK and Dutch offshore wind developments. *Technological Forecasting and Social Change*.

Kivimaa, P. & Mickwitz, P., 2011. Public policy as a part of transforming energy systems: framing bioenergy in Finnish energy policy. *Journal of Cleaner Production*, 19(16), pp.1812–1821.

Küçük, M.M. & Demirbaş, A., 1997. Biomass conversion processes. *Energy Conversion and Management*, 38(2), pp.151–165.

Logan, B.E. & Rabaey, K., 2012. Conversion of wastes into bioelectricity and chemicals by using microbial electrochemical technologies. *Science*, 337(6095), pp.686–90.

McKendry, P., 2002. Energy production from biomass (part 2): conversion technologies. *Bioresource Technology*, 83(1), pp.47–54.

Negro, S.O. & Hekkert, M.P., 2012. Identifying Typical (Dys-) Functional Interaction Patterns in the Dutch Biomass Innovation System. In D. Jansen, K. Ostertag, & R. Walz, eds. *Sustainability Innovations in the Electricity Sector. Sustainability and Innovation*. Heidelberg: Physica-Verlag HD, pp. 175–193.

Negro, S.O., Suurs, R.A.A. & Hekkert, M.P., 2008. The bumpy road of biomass gasification in the Netherlands: Explaining the rise and fall of an emerging innovation system. *Technological Forecasting and Social Change*, 75(1), pp.57–77.

Nelson, R.R., 1993. *National Innovation Systems: A Comparative Analysis* R. R. Nelson, ed., New York, NY: Oxford University Press.

Raven, R.P.J.M. & Gregersen, K.H., 2007. Biogas plants in Denmark: successes and setbacks. *Renewable and Sustainable Energy Reviews*, 11(1), pp.116–132.

Saka, S. & Kusdiana, D., 2001. Biodiesel fuel from rapeseed oil as prepared in supercritical methanol. *Fuel*, 80(2), pp.225–231.

Saxena, R.C., Adhikari, D.K. & Goyal, H.B., 2009. Biomass-based energy fuel through biochemical routes: A review. *Renewable and Sustainable Energy Reviews*, 13(1), pp.167–178.

van Steen, E. & Claeys, M., 2008. Fischer-Tropsch Catalysts for the Biomass-to-Liquid (BTL)-Process. *Chemical Engineering & Technology*, 31(5), pp.655–666.

Suurs, R.A.A. & Hekkert, M.P., 2009. Cumulative causation in the formation of a technological innovation system: The case of biofuels in the Netherlands. *Technological Forecasting and Social Change*, 76(8), pp.1003–1020.

Turner, J. et al., 2008. Renewable hydrogen production. *International Journal of Energy Research*, 32(5), pp.379–407.

Verborg, G., Geels, F.W. & Raven, R.P.J.M., 2008. Multi-niche analysis of dynamics and policies in Dutch renewable energy innovation journeys (1970–2006): hype-cycles, closed networks and technology-focused learning. *Technology Analysis & Strategic Management*, 20(5), pp.555–573.

Verhees, B. et al., 2015. The role of policy in shielding, nurturing and enabling offshore wind in The Netherlands (1973–2013). *Renewable and Sustainable Energy Reviews*, 47, pp.816–829.

Wirth, S. & Markard, J., 2011. Context matters: How existing sectors and competing technologies affect the prospects of the Swiss Bio-SNG innovation system. *Technological Forecasting and Social Change*, 78(4), pp.635–649.

Zwart, R.W.R. & Boerrigter, H., 2005. High Efficiency Co-production of Synthetic Natural Gas (SNG) and Fischer-Tropsch (FT) Transportation Fuels from Biomass. *Energy & Fuels*, 19(2), pp.591–597.

The Need for Governance by Experimentation: the Case of Biofuels

Lotte Asveld
(Delft University of Technology)
l.asveld@tudelft.nl

KEYWORDS: Governance, Experimentation, Biofuels, Innovation policies

The policies of the European Union (EU) concerning the development of biofuels can be considered to have reached a lock-in. One of the first and most prominent biobased innovations: first generation biofuel, is surrounded with controversy. The sustainability claims attached to biofuels by policymakers and producers (EC, 2006, EBB, 2014) have been questioned by environmentalists and scientists (such as EEA, 2006, Callagher Review, 2008, Searchinger et al, 2008, Croezen et al, 2010, Plevin et al, 2010). In the face of this criticism, some of it well documented, the European Commission has tried to alter the course of its policies but met with fierce resistance from some member states, and fierce support from others. The resistance stems from the economic interests of parties that have invested in (unsustainable) biofuels and countries that see economic opportunities in (unsustainable) biofuels.

Eventually the European Commission arrived at a policy proposal that reduces support for biofuels, but considering the evidence on the sustainability effects of first generation biofuels, this support might have been reduced even more, as was initially proposed by the European Commission. This political failure to assure the sustainability goals that originally motivated the biofuels policies, gives cause for reflection on the governance of other uses of biomass. How should policies be designed to assure that biobased innovations are indeed sustainable?

The social resistance towards adaptation of existing policies in support of biofuels, indicates a classical Collingridge dilemma. This dilemma states that when a technology can still be easily changed, at the beginning of its use, so little is known about its possible consequences that social actors can't adequately anticipate that. Therefore they cannot avert any unwanted consequences at this stage by adapting the technology. Once a technology is widely used, the consequences become known, but at that stage it is very difficult to adapt the technology to avert unwanted effects because the technology has become socially entrenched (Collingridge, 1980).

To avoid such lock-ins, Collingridge himself saw two solutions: one is to increase knowledge at earlier stages of the development of a new technology and the other is to increase social control over technological trajectories (Nordmann, 2010). However existing approaches along these lines such as anticipation, adaptive management and strategic niche management do not suffice in the context of the bio-economy. These approaches either do not reduce uncertainty sufficiently or fail to explicitly address conflicts between values motivating political and economic support for new technologies.

In this presentation, I suggest to apply an experimental framework to the development of sustainable biobased technologies. This framework has been proposed by Van de Poel (2011). Such an approach can serve to increase the social control over a specific innovation, even if it is surrounded with a considerable degree of uncertainty. As such it has relevance beyond the scope of biofuels and might also be applicable to other emerging technologies.

Uncertainties about the impact of innovations usually exists at three distinct but related levels: physical, institutional and moral (cf Van de Poel, 2011). Physical impact refers to the measurable risks and benefits of a specific technology, such as its environmental impact. The institutional impact refers to the kind of social structures needed to adequately embed a technology. We consider institutions to be the formalisation of a consensus between multiple actors (cf Bachman & Inkpen, 2011), with sufficient legal or moral status to impact on the further development and use of relevant technologies. Examples are the regulation of risky technologies, subsidy schemes or voluntary schemes for the monitoring of sustainability effects. Moral impact refers to the norms and values we use to evaluate a technology. In some case the technology may have such an impact that the prevalent norms shift. Social media have for instance shifted our perception on the value of privacy. Many people appear to value other things, such as being in touch with friends continuously, over privacy in the context

of using social media.

These uncertainties can most likely not be completely reduced, but strategies can be deployed to deal with them and to accommodate learning effects in supporting governance structures. These governance structures should thus allow for adaptation to new insights. What is specifically needed is more attention for the explication of norms and values motivating policies in support of new technologies and learning effects thereon.

An experiment is always conducted with the explicit aim of learning. The aforementioned approaches of adaptive management and strategic niche management offer tools for learning about impact and institutional effects. The experimental approach adds the notion of moral learning, i.e. learning about how values play out in practice, what relevant different interpretations of values abound and how values, or the balance between values might change due to the introduction of new technologies.

In the case of biofuels, two competing values motivated the supporting policies: one was sustainability and the other increased income for European farmers. Of these values, sustainability was clearly articulated while the other: increased income for farmers, was less clear.

Up to a certain point, the co-existence of two motivating values was an asset to the development of biofuels, because in this way resources (financial and material) were mobilized. The farming community was willing to co-operate and to invest because their interests were taken to heart. Such support is needed for any technology to move beyond a small scale application.

However these values turned out to be incompatible in the long run. The political clash over Indirect Land Use Change (ILUC) is basically a clash between these two values. The agricultural lobby seeks to protect its investment and economic prospects, the environmental lobby seeks to guarantee a positive sustainability impact of the use of biofuels. A lock-in might have been avoided if the possible contradictions between these lobbies and their values had been explicated and addressed from the early stages of the development of biofuels (cf Van de Laak et al, 2007). It would have enabled policy makers to develop institutions to accommodate both values.

Based on the insights from governance of first generation biofuels, a few guidelines can be formulated for the governance of biobased innovation. Governance by experimentation should organise small scale exploration of new technologies and built on the knowledge that is derived from this small scale application. The applications that appear promising can be scaled up, both in quantity and in institutional support, i.e. in the form of tax exemptions and subsidies.

Knowledge about the effects of new technologies should be produced in collaboration with a wide range of actors. This approach has proven useful in the context of biofuels and with other technologies that impact on the natural environment, i.e. with approaches of adaptive management. Such an approach avoids the dominance of one particular perspective in the shaping of knowledge and thereby increases social control over that technology.

Most importantly the values that motivate policies and other institutional supports for biobased technologies should be clearly explicated so that they are open for public scrutiny. Additionally, policy goals should be formulated in generic terms instead of focussing on a specific technology.

References

- Bachmann, R. and A.C. Inkpen, (2011). Understanding Institutional-based Trust Building Processes in Inter-organizational Relationships. *Organization Studies* 32(2): 281-301.
- Collingridge, D. (1980). *The social control of technology*. London, New York: Frances Pinter.
- Croezen, H.J., G.C. Bergsma, M.B.J. Otten & M.P.J. Valkengoed, v. M.P.J. (2010) Biofuels: indirect land use change and climate impact. CE Delft, Delft
- European Commission. (2006). Communication from the Commission - An EU Strategy for Biofuels.Brussels.
- European Biodiesel Board (2014). What is biodiesel? Retrieved October 30th from <http://www.ebb.eu.org/biodiesel.php>
- European Environment Agency (2006) How much bioenergy can Europe produce without harming the environment? Luxembourg: Office for Official Publications of the European Communities
- Gallagher, E. (ed) (2008) *The Gallagher Review of the indirect effects of biofuels production*. London: UK Renewable Fuels Agency
- Nordmann, Alfred (2010). A forensics of wishing: technology assessment in the age of technoscience. *Poiesis and Praxis* 7 (1-2):5-15.
- Plevin, R. J., M. O'Hare, A. D. Jones, M. S. Torn and H. K. Gibbs (2010). Greenhouse Gas Emissions from Biofuels' Indirect Land Use Change Are Uncertain but May Be Much Greater than Previously Estimated. *Environmental Science and Technology*, 44(21), 8015-8021.
- Searchinger, T., Heimlich, R., Houghton, R. A., Dong, F., Elobeid, A., Fabiosa, J., Tokgoz, S., Hayes, D., & Yu, T. H. (2008). Use of U.S. croplands for biofuels increases greenhouse gases through emissions from land-use change. *Science*, 319(5867), 1238–1240. doi:10.1126/science.1151861.

Van der Laak, W. W. M., Raven, R. P. J. M., & Verbong, G. P. J. (2007). Strategic niche management for biofuels: Analysing past experiments for developing new biofuel policies. *Energy Policy*, 35, 3212–3225.

Van de Poel, I. (2011). Nuclear energy as a social experiment. *Ethics, Policy and Environment*, 14(3), 285–290

The characteristics and dynamics of the Danish energy innovation system in perspective: a patent-based analysis

Laurenço Faria* and Kalle Piirainen
(Technical University of Denmark)
*loufa@dtu.dk

KEYWORDS: Technological innovation systems, Energy sector, Patent analysis

1. Research aim and relevance

Technology has a paradoxical role in the greening of the economy: the technological development has been responsible to increase the environmental impacts dramatically during the industrial revolutions (Georgescu-Roegen, 1971; Commoner et al., 1971), but technological change could also be beneficial if new technologies reduce or neutralize the harmful effects of human economic activities (Freeman, 1984). New technological developments present are influenced by new elements (knowledge, routines, institutions, components) but also share some old ones that supported technologies developed in the past (Dosi, 1982), potentially creating lock-in mechanisms that inhibit radical shifts in the techno-economic paradigms.

This narrative suits well to explain why we perceive strong inertia in the process of greening of the industry, as greener technologies might require radical changes in knowledge, institutions, and demand, calling for a better understanding of the transition process from one paradigm to another (Oltra & Saint-Jean, 2006). One of the biggest challenges for sustainability transitions is to analyze how the dynamics of change unfolds over time and what are its main drivers and obstacles. This task is of special importance for the energy sector, in which the transformations are particularly incremental and new technologies require long periods of gestation and experimentation (Borup et al., 2013). While there is a substantial literature on the characteristics of the energy innovation system as a whole and on the overall effects of policy mechanisms in this system, there is a gap related with in-depth analyzes on the dynamics and patterns of energy-related sustainable innovation (Lee & Lee, 2013). Such gap might be related with the lack of energy innovation indicators that are able to cover long periods of time and contain sufficient information necessary to conduct such in-depth analyzes.

Our paper draws upon these evolutionary and technological innovation systems (TIS) elements to investigate the characteristics and dynamics of the transition process towards greener technologies in the Danish energy innovation system (EIS) in comparison with other Nordic countries, namely Sweden, Norway, and Finland, contributing to the still limited literature on the green innovation dynamics at national levels. Moreover, we aim to analyze the rate and direction of the greening in the energy sector in the Danish context. By comparing the characteristics and dynamics of the EIS across different territorial contexts, we aim to contribute to the understanding of the innovative drivers and barriers which is essential to the improvement of decision makers (Coenen & Díaz López, 2010).

2. Theoretical frameworks and methodological approach

Multiple systemic approaches to innovation have been developed along with evolutionary thinking based on the notion that a range of heterogeneous agents can be grouped according to shared characteristics that affect their innovation activities, patterns of learning, and competence development (Edquist, 1997). National and regional innovation systems are often cited in the literature (e.g. Asheim & Gertler, 2006; Cooke et al., 1997; Freeman, 1988; Lundvall, 1992; Patel & Pavitt, 1997) due to the influence that institutional and market structures within geopolitical borders often exert in innovative activities, encouraging agents operating within such borders to follow specific technological trajectories through, for example, policy enforcement (Patel & Pavitt, 1997) or use of local resources and spillovers by agents (i.e. firms, research organizations, universities) as catalysts in the knowledge creation process (Patel & Vega, 1999). Other relevant boundaries of innovation systems in the literature include sectors (in terms of main products and activities) (Malerba & Nelson, 2011; Malerba, 2002) and technologies (Carlsson & Stankiewicz, 1991).

According to Saint-Jean (2006, p. 63) “(...) environmental innovations are thus said to be part of system innovations. The differentiated development of each sub-system can create bottlenecks that can hinder technological development and diffusion”. Under the technology-sustainability narrative, the systemic innovation perspective has expanded and incorporated elements such as the user practices, policy and cultural

discourses (Geels, Hekkert, & Jacobsson, 2008). New concepts, such as socio-technical systems (STS) were created (Geels, 2004) and old ones were revisited, such as the concept of technological innovation systems (TIS) that, for instance, expanded the previous definition of technological systems (e.g. Carlsson & Stankiewicz, 1991), incorporating the notion of functions and activities within the system as main analytical focus while considering firms as leading organizational units of innovation, supported by other agents (Bergek et al., 2008; Hekkert et al., 2007).

In the eco-innovation context, the TIS framework has been applied to “emergent technologies that have not yet achieved a break-through” (Coenen & Díaz López, 2010, p. 1154), mapping key activities and functions to understand the dynamics of the system over a certain period of time (Hekkert & Negro, 2009; Negro, Suurs, & Hekkert, 2008; Suurs & Hekkert, 2009). Hekkert et al. (2007) suggest the following set of TIS’ functions: Entrepreneurial activities; knowledge development; knowledge diffusion through networks; guidance of search; market formation; resource mobilization; and creation of legitimacy, i.e. counteract resistance to change. While the market diffusion of green technologies is still very incipient, it is possible to have a dynamic picture of the TIS by using indicators that reflect how the functions change over time, and therefore the trajectory of technological change. Patent analysis reveals information about eco-innovation activities whereas other indicators cannot. So far, most firms make no clear distinction between R&D expenditures on eco-innovation and on “traditional” innovation, and innovation surveys are not able to capture the dynamics over time, since they are usually restricted to one or few years and with limited geographic coverage. The level of disaggregation and time coverage of patent data allows one to analyze the evolution of the green technologies - and the transformation of traditional technologies towards lower environmental-harm standards (Hašič & Migotto, 2015). The rate of growth in patenting in a certain technologic field can be used as proxy of its importance and maturity degree (Blind et al., 2009; Chang, 2012; Haupt et al., 2007; Nesta & Patel, 2005), and patent applications are considered a robust indicator of technological competences (Breschi et al., 2003; Chang, 2012). The paper uses data from the OECD REGPAT database (Maraut et al., 2008), which links the patent data with regions according to the addresses of the applicants and inventors. The addresses of the applicants will be used to distinguish the patents associated with the Danish EIS. A remarkable challenge in analysis based on patent data is how to establish the link between patents and technological areas such as energy production. Instead of relying on keywords to identify green patents like most existing studies (e.g. Oltra & Saint-Jean, 2009; Rizzi et al., 2014; Sierzechula et al., 2012; Wesseling et al., 2014), we identified the IPC codes related with several energy-related technologies using the recently developed IPC Green Inventory and the OECD’s list of Environmentally-sound technologies (EST). These classifications use specialists in different fields to classify IPC codes related with “environmentally-sound” technologies at very high disaggregation level (often 7 to 9 digits). With the patents classified by country and technology, we aim to construct a dynamic overview of the development of energy-related technologies and how they respond to changes in the system, particularly changes in the policy framework. Accordingly, the paper analyzes the relative growth and concentration of patenting activity in each technologic group, the main actors involved, and the generation of new knowledge (i.e. new patterns of combinations of IPC codes) and put these elements in perspective with major policy changes at national and international levels. To measure the concentration of the patent activity among the firms in the system, we use a Herfindahl-Hirschman index (Herfindahl, 1950; Hirschman, 1964), as suggested by Malerba & Orsenigo (1997).

3. Findings and expected outcomes

This analysis grounded on patent data enhances our understanding of the transition process in both technological and national innovation systems’ levels and focus on some of the essential functions of innovation systems, including knowledge development and exchange, the mechanisms affecting the guidance of search, and the mobilization of resources (Hekkert & Negro, 2009; Hekkert et al., 2007). Moreover, the methodology offers opportunities for future comparisons between this and other national cases, adding up to the still incipient literature on national EIS (Borup et al., 2008; Jacobsson & Bergek, 2004; Negro et al., 2007). By observing the existence (or not) of patterns of change in agents’ technological strategies (in terms of their patent portfolios), one is able to understand which dimensions stand out as main drivers of innovation (Patel & Pavitt, 1997) and what is the role of main policy events and other institutional changes in influence the development of new technologies in the energy area.

Acknowledgements: The work behind this paper received funding from the Danish Council for Strategic Research/Innovation Fund Denmark through EIS Strategic research alliance for Energy Innovation Systems and their dynamics.

The Entrepreneurial Chinese State. Innovation in China's wind turbine industry

Marius Korsnes
(Norwegian University of Science and Technology)
marius.korsnes@ntnu.no

KEYWORDS: Innovation policy, China, Governance

This paper uses examples from China's wind industry in order to redress how innovation can be viewed in a Chinese context. Theories of innovation have been highly influenced by Western or European cases, but innovation in a Chinese context might look different. The paper therefore asks: How can China's rapid change towards more renewable energy be understood and conceptualised? By comparing and contrasting innovation systems (Lundvall 2010), sustainability transition frameworks (Markard et al. 2012) and actor-network theory (Latour 1987) the paper examines each perspective's strengths and weaknesses in understanding innovation in the context of China's wind industry development. The paper is based on 55 interviews with Chinese and international wind industry stakeholders conducted between 2011 and 2014. The key finding is that innovation understandings where (private) firms are defined as central actors, and where differences between 'niches' and 'landscapes' are stressed, appear unfitting in China's wind turbine industry. Rather, forces moving towards a 'new' regime originate as much from within the existing 'sociotechnical regime' as from within 'niches'. The role of the Chinese government is central, as it does not attempt to maximise control or attain a complete knowledge of the field. Instead, government policy is foresighted and geared towards continued learning as events develop, and entices actors from both within and outside the government to move towards a transition to more renewable energy.

The paper shows that, in the Chinese wind industry, government involvement has both benefits and drawbacks. However, because of an ability to plan ahead and flexibly implementing policy, beneficial effects appear to trump harmful ones when it comes to industry development. Entrepreneurship entails taking on risk and genuine uncertainty (Mazzucato 2013), and Chinese government and industry actors are willing and able to take on such risks. Innovation in a Chinese context therefore implies taking risks and accommodating for learning and experimentation that may lead to innovation. This can be contrasted to an 'over-engineered' European risk management approach. Hence, as we go into more detail studying the way in which the strategies of the various actors unfold, two related points can be made: 1) innovation in a European context is not the same as innovation in a Chinese context, and 2) China is not copying an existing system, but attempting to create something new and independent. Innovation in the wind technology arena can thus be considered a space where experimentation, learning and exchange of knowledge and experiences eventually will lead to innovation.

2C. INNOVATION SYSTEMS AND SUSTAINABILITY TRANSITIONS (I)

Policy Approaches to Facilitating Innovation for Sustainability: A Comparative Analysis of Smart Cities in Japan and the United States

Masaru Yarime
(University of Tokyo)
yarimemasa@gmail.com

KEYWORDS: Smart city, Technological innovation system, Network, Japan, United States

1. Relevance

Smart cities are considered to be one of the key areas in which innovation is expected for increasing energy efficiency while incorporating renewable energy sources. As a smart city integrates a diverse mixture of hardware as well as software in a complex way, diverse approaches would be possible to introducing the concept of smart cities in practice, depending on the economic, social, and environmental conditions. It is not yet examined in details, however, the processes and mechanisms of implementing innovation on smart cities in different national contexts. Policy implications will be of critical importance as urbanization is accelerating particularly in the developing part of the globe.

2. Research Aims and Questions

This research is aimed at examining the processes of implementing innovation on smart cities in different countries, particularly focusing on Japan and the United States. Detailed analysis is conducted on what actors are involved at which stages of innovation, what factors influence the behaviour of the actors, and what impacts are made by policy interventions.

3. Definitions

A smart city is a city that utilizes an advanced technological system for efficient energy supply and applications, incorporating all the behavior of the actors involved, including generators, distributors, technology developers, and consumers, through an intelligent information network.

4. Theoretical Frameworks

The framework of technological innovation system is applied to analyse the processes and mechanisms of implementing innovation on smart cities with the functions identified, including knowledge development and diffusion, guidance of the search, resource mobilization, entrepreneurial experimentation, market formation, legitimation, and development of positive externalities.

5. Empirical Materials

Information on approximately 200 cases of smart cities in Japan and the United States is collected through various sources, including project reports, academic articles, corporate reports, trade journals, and web sites, and interviews are conducted with experts from different stakeholder groups, including academia, firms, industry association, and government organizations.

6. Description of the Methodologies

Projects on smart cities in Japan and the United States are analysed with regard to the actors involved, the technological areas emphasized, and the processes in which the actors collaborate with each other. Network analysis is conducted to identify key stakeholders in smart city innovation and to analyze the relationships between them by utilizing the measurements of betweenness centrality, which illustrates how important the location of an organization is for the other organizations connected with each other in the network. Then the framework of technological innovation system is applied to the processes of implementing innovation in smart cities in Japan and the United States in terms of the functions of the technological innovation system.

7. Expected Outcomes

In Japan the key actors identified from the network analysis are mainly large conglomerates with broad

portfolios, covering both electronics and infrastructure areas, with the large electric utilities relatively invisible.

The situation on the knowledge creation and diffusion process was generally considered to be positive. Smart city projects are regarded as especially important collaborative platforms in which novel technological functionalities could be tried out. While the tightly knit groups involved in the smart city projects are producing valuable knowledge, the sharing of that knowledge is still limited. Within the smart house and appliances sector, knowledge creation has proceeded further and diffusion platforms have been seen as better developed, especially since the Fukushima accident, after which the government started to promote standardization.

The process of the guidance of the search has been performing relatively well in Japan, as there is a shared understanding about the basic concept and acceptance of smart grid, although the emphasis varies to a certain extent between different stakeholders. NEDO has been regarded as the most important actor in facilitating consensus building. As the organization manages the financial resources for many of the demonstration projects on smart grid, it has a significant amount of capacity to influence the focus and direction of the development of smart grid technologies.

With regard to resource mobilization, the financial resources provided by METI and NEDO to smart grid projects has functioned as an important stimulus for smart grid innovation, especially through funding the Smart City projects. After the Fukushima accident, in particular, many of the electric utilities have very low financial capabilities to initiate and implement new technological development. This has directly affected their engagements on smart grid that had already existed. The activities of the electric utilities that are still on-going are mostly funded by government grants, which illustrate the significant role played by this function for keeping the momentum on innovation.

The function of entrepreneurial experimentation has been performing relatively poorly in Japan. While established manufacturing firms are making efforts to tap into new markets, the current monopolistic structure of the electricity market and the uncertainty about future policies and regulations discourage ambitious activities of entrepreneurship. Moreover, the membership in the smart grid projects remains relatively closed, with new entrants very limited, and smart grid tends to be regarded as a field giving advantage to the established industrial giants. The smart house and appliance sector sees more involvement and engagement by smaller firms, in addition to the large electronic companies.

The creation of a market for smart grid technologies in Japan is at this moment considered to face many problems and challenges. While there exists a very limited market, it is still in a very early stage, and the uncertainties surrounding the current environment and future development of the electricity market make potential investors wary. In the smart home and appliances sector, the market has developed further and some demand has already been emerging. Residential developers have played a key role in popularizing various applications for smart home and appliances. The residential developers, however, while actively engaged with the concept of smart home and appliances, only cater to the upper-income groups, with HEMS remaining relatively expensive. The high prevalence and popularity of residential photovoltaics in Japan has also been an important driver for the smart house market.

The creation of legitimacy has not been a serious problem for facilitating innovation on smart grid in Japan. Although knowledge about smart grid is not necessarily shared in the general public, energy efficiency has basically been understood as an area to be supported since the oil crises in the 1970s. Particularly the planned outages by the electric utilities following the Fukushima accident received strong criticisms, as regions of less economic importance had to endure more blackouts. Accordingly, through smart grid technologies that are considered to contribute to reducing energy consumption are socially accepted, without much resistance based on concerns about privacy or health effects. In the smart house and smart appliance sector, the situation has been less problematic, as smart appliances are generally appreciated by consumers for the benefits to be provided by these technologies.

The development of positive externalities has been observed in the evolution of technologies on smart grid in Japan. A crucial area of co-evolutionary development is the fast-developing field of smart home and appliances. The appliance manufacturers who also have interests in the grid equipment market have been the most active stakeholders in the technological innovation system on smart grid. The electric vehicle (EV) has also been an

innovation area of critical importance and will benefit considerably from smart grid innovation. The influence of renewable energy is still relatively small, however, as the electric utilities currently allow only limited amounts of electricity to be connected to the grids, because of the concern about the grid capacities to absorb the fluctuation and interruption of the electricity produced by renewable energy sources, particularly solar power.

In the United States, the most important actors are a research institute, heavy electric manufacturers, and the makers of smart meters.

Overall, the situation of knowledge production and diffusion was good, partly due to the availability of government funding. About the aspect of knowledge creation, there are basically no major obstacles. The level of communication between different stakeholders is reaching an unprecedented level, and results of R&D projects are widely disseminated, much thanks to the hype of smart grid and the plethora of forums that exist to spread information about smart grid innovation.

Some challenges were identified in the creation of societal guidance of smart grid innovation. There is a strong common understanding about the general desirability and the desired values of smart grid among the key players, with the work of the DoE considered important in this regard. One thing that is lacking in the US is an overarching strategy towards an economy with a lesser environmental impact in the energy sector. So far, the smart grid discourse has been growing in importance but mostly within the electric power industry itself. Vendors are mainly marketing equipment towards utilities, and communicating value with end-users of electricity is neglected.

Some areas of the US are still provided electricity by vertically integrated utilities, who have a monopoly on the market. These utilities have by now only a selective interest in smart grid functionalities. Smart grid is pulling actors who had long abandoned the grid as an area for innovation to start paying attention again, and the attention has brought in much more interest from start-up companies. Entrepreneurial activities of the utilities seem to be declining after the initial enthusiasm, and after possibilities for financial support from the government have decreased.

The lack of consumer interest in advanced smart grid functionalities is contributing to the focus on cost savings as the primary value proposition of smart grid in the US. For vendors of smart grid technology, the situation was understood differently. Many vendors have high expectations about the development of the smart grid market in the US, and they see the smart grid concept as a useful vehicle to be able to market sophisticated ITC equipment to the electric power industry. However, high uncertainty about investments because of market fragmentation, and fickleness of regulators are seen as obstacles, and many vendors would invest more in R&D if there existed more guarantees of future markets and more uniform market conditions across the US.

The creation of legitimacy is seen as one of the more troublesome sub-processes. At the level of regulation, the legitimacy of smart grid is perceived to be high and strong, due to strong support from the government. A strong drive for renewable energy lends legitimacy to smart grid efforts, while there is a debate about the timeliness of current efforts to develop smart grid, and especially the cost of investments. At the level of end-users, consumers are seen as most disinterested in the technology, not favoring investments in smart grid functionalities that do not interface with them. The benefits of lower transmission losses and higher quality and reliability of power are not seen as visibly by consumers as is metering technology or electricity production technology.

The financial resource mobilization of the federal government has been an important driver of smart grid innovation, but it is generally considered that this driver will not create a long-term momentum, and that investments by utilities themselves are too low. On the federal level, it was considered that government funding had been sufficient to significantly contribute to grid innovation, although there were criticisms to the short time-span of the ARRA funding with too much focus on non-transformative technology, which is favored by utilities and easier for vendors to produce, rather than the transformative, advanced smart grid applications. On the utility side, consumers are thought to be too averse to costs, which makes it difficult for many utilities to raise funds for smart grid investments.

In Japan the national government gives funding to a lead vendor, who in cooperation with the local government coordinate different stakeholders and aspects of the smart grid project. In the U.S. the federal government gives

fund matching to mainly utilities, which then choose their cooperation partners and manages the project. The formal system failure consists of the electricity market regulation regimes that do not incentivize interaction with consumers, particularly residential users of electricity. Policy support would be important for facilitating a more proactive role to be played by end users in implementing innovation on smart cities.

Structuring signals of transition towards the platform economy: combining horizon scanning and the multi-level perspective

Mikko Dufva*, Heidi Auvinen and Raija Koivisto
(VTT Technical Research Centre of Finland Ltd)

* mikko.dufva@vtt.fi

KEYWORDS: Horizon scanning, Socio-technical transition, Multi-level perspective, Platform economy, Foresight

1. Relevance

The global economy is undergoing a major structural transformation from linear production and consumption of products and services towards a networked collaboration-based system known as the platform economy. In addition to widely known examples of platforms, such as Airbnb and Uber, there is a multitude of emerging platform companies and cooperatives across sectors. While many platforms connect consumers to one another and enable them to be producers and service providers (peer-to-peer and sharing economy functions), some platforms focus on business-to-business or citizen-government interaction. Platforms are also entering highly regulated fields such as finance and health care.

The socio-technical transition towards the platform economy poses multiple challenges for research and innovation policy. On the one hand the objective is to grasp opportunities: to identify and foster new ways of working and support emerging businesses. On the other hand there is a need to manage and mitigate the adverse effects of disruptions caused by the shift to platforms, such as the expected fast decline of some existing industries and professions or possible threats to privacy. Because of the emerging nature and rapid progression of the platform phenomenon it is vital to detect as early as possible the next disruption, and more importantly, to anticipate what it means for business and society; this is where horizon scanning can help.

2. Research aim(s) and question(s)

Horizon scanning aims to identify and to make sense of the relevant signals from all the noise surrounding an emerging phenomenon. Our main research question is how to identify and structure key signals of a socio-technical transition in order to provide timely insights to support research and innovation policy. The aim is thus to provide an understanding of how signals are linked and positioned in order to enable sensemaking and ultimately the design of viable policy options. On the methodological side our aim is to combine the multi-level perspective (MLP) framework (Geels, 2002) and horizon scanning. Our key assumption is that the emerging platform economy can be studied as a regime-level transition process. We explore how horizon scanning of signals of different type can be structured using the multi-level perspective, with the aim to build understanding of e.g. landscape-level trends, regime-level change carriers and barriers and niche-level innovations.

3. Definitions

The platform economy can be defined as the value creation system consisting of shared social and technological structures (platforms) that connect multiple producers of services, products and social value (Autio & Thomas, 2013; Evans et al., 2011; Thomas et al. 2014). Its main driver is rapidly progressing digitalization, which enables the collection, analysing and sharing of information among multiple actors globally (Watanabe et al., 2015ab; Yoo et al. 2012). The main change in platform economy is from a linear pipe-model of production of products and services to a networked platform-model, where the distinction between the producer and consumer is blurred (Choudary, 2015).

A widely cited definition of horizon scanning is “the systematic examination of potential threats, opportunities and likely future developments including but not restricted to those at the margins of current thinking and planning. Horizon scanning may explore novel and unexpected issues as well as persistent issues or trends” (Chief Scientists Advisers, 2004; see Miles and Saritas, 2012 for a detailed analysis of the definition). Horizon scanning is based on the work on weak signals by Ansoff (1975), although it became more widely used after the millennium (Schultz, 2006; Ilmola and Kuusi, 2013). It offers a set of tools and approaches for collecting signals of current or imminent changes and emerging issues (Könnölä et al. 2012).

Socio-technical transitions are transformations of the structure, institutions and ways of working in a society, driven by the advent of some new technology. A popular framework for studying these transitions is the multi-level perspective, which consists of three levels: landscape, regime and niche (Geels 2002; Elzen et al. 2004;

Geels 2011). Landscape refers to relatively stable, slow-changing external factors, regime to the semi-coherent set of rules, routines and practices carried out by different actors, and niche to experiments and initiatives in special application areas insulated from established markets (Raven and Verbong, 2007; Foxon et al. 2010; Geels 2002).

4. Theoretical Frameworks

In this paper we aim to combine two lineages of theoretical work. The first is the literature on socio-technical transitions and especially the multi-level perspective framework. The second is the literature on weak signals and horizon scanning, discussed mainly in the fields of foresight and futures research. The multi-level perspective will act as the structure to support the positioning and sensemaking of the signals detected in horizon scanning.

5. Empirical materials

The research is based on work conducted in on-going research project Platform Value Now, funded by the Strategic Research Council at the Academy of Finland under grant agreement n:o 293446 – Platform Value Now: Value capturing in the fast emerging platform ecosystems. One part of the Platform Value Now project is the horizon scanning related to emerging platforms and the impacts of moving towards a platform economy. This includes the scanning of scientific articles, newspaper articles, blogs and social media as well as conducting expert interviews and holding stakeholder workshops. The empirical material thus consists of signals collected from various media and the scientific community and of opinions and views of experts and stakeholders.

6. Description of the methodologies

The methodology can be divided into three phases. The first phase includes identification and collection of key signals from various sources. These are then categorised and summarised. The second phase consists of grouping, positioning and synthesizing of the signals. In addition, the levels in the multi-level perspective framework are used to help analyse the linkages and impacts related to the signals. The third phase is to clarify the overall developments, highlight key impacts, and to suggest policy-relevant actions to mitigate adverse impacts and foster desirable developments.

7. Expected outcomes

There are two main outcomes from the research. The first is a structured description of key developments in certain areas of platform economy. Examples of the focus areas include work and employment, industrial internet and internet of things, and blockchain technology. The description of key developments, in addition to suggestion of what to do about them will support the policy making process. The second, more research oriented outcome is the combining of horizon scanning and the multi-level perspective. Positioning weak signals and potential future developments to the framework of socio-technical transitions will help to improve the sensemaking process by connecting it to the larger context.

References

- Ansoff, H. I. (1975) 'Managing strategic surprise by response to weak signals', *California Management Review*, XVIII, 21–33.
- Autio, E., Thomas, L. (2013). Innovation Ecosystems: Implications for Innovation Management. In M., Dodgson, N. Phillips, D. M. Gann (toim.), *The Oxford Handbook of Innovation Management*, Oxford University Press, 204–228.
- Chief Scientists Advisers (2004). UK Chief Scientists Advisers Committee, 09/04, cited from p. 37 of Government Office for Science (2011). *Sharing Experience: Improving engagement across SAC Secretariats*. Report of a series of workshops designed to facilitate greater engagement across the Scientific Advisory Committee community.
- Choudary, S. P. (2015). Platform Scale: How an Emerging Business Model Helps Startups Build Large Empires with Minimum Investment. *Platform Thinking Labs*.
- Elzen, B., Geels, F.W. & Green, K., (2004). *System innovation and the transition to sustainability: theory, evidence and policy*, Edward Elgar Publishing.
- Evans, D. S., Schmalensee, R., Noel, M. D., Chang, H. H., Garcia-Swartz, D. D. (2011). *Platform economics: Essays on multi-sided businesses*. David S. Evans, ed., Competition Policy International.
- Foxon, T.J., Hammond, G.P. & Pearson, P.J.G., (2010). Developing transition pathways for a low carbon electricity system in the UK. *Technological Forecasting and Social Change*, 77(8), pp.1203–1213.
- Geels, F.W. (2002). Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research policy*, 31(8), 1257–1274.
- Geels, F.W., (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions*, 1(1), pp.24–40.
- Ilmola, L. & Kuusi, O. (2013). Information filters as one of the means of managing strategic fit in a complex environment, *Foresight*, 15(2), 132–151.
- Könnölä, T., Salo, A., Cagnin, C., Carabias, V. & Vilkkumaa, E. (2012). Facing the future: Scanning, synthesizing and sense-making in horizon scanning. *Science and Public Policy*, 39(2), 222–231.
- Miles, I. & Saritas, O. (2012). The depth of the horizon: searching, scanning and widening horizons. *Foresight*, 14(6), 530–545.
- Raven, R. & Verbong, G., (2007). Multi-regime interactions in the Dutch energy sector: The case of combined heat and power technologies in the Netherlands 1970–2000. *Technology Analysis & Strategic Management*, 19(4), pp.491–507.
- Schultz, W. L. (2006) 'The cultural contradictions of managing change: Using horizon scanning in an evidence-based policy context', *Foresight*, 8: 3–12.
- Thomas, L. D., Autio, E., Gann, D. M. (2014). Architectural leverage: putting platforms in context. *The Academy of Management Perspectives*, 28(2), 198–219.
- Watanabe, C., Naveed, K., Neittaanmäki, P. (2015a). Dependency on un-captured GDP as a source of resilience beyond economic value in countries with advanced ICT Infrastructure – similarity and disparities between Finland and Singapore. *Technology in Society*, 41(2), 104–122.

Watanabe, C., Naveed, K., Zhao, W. (2015b). New paradigm of ICT productivity—Increasing role of un-captured GDP and growing anger of consumers. *Technology in Society*, 41, 21-44.

Yoo, Y., Boland Jr., R. J., Lyytinen, K., Majchrzak, A. (2012). Organizing for innovation in the digitized world. *Organization Science*, 23(5), 1398-1408.

Perceptions of problems and solutions in innovation systems: The influence of institutional logics in the empirical domain of renovating houses energy-efficiently

Alco Kieft*(Utrecht University), Robert Harmsen(Utrecht University, Energy & Resources, Copernicus Institute of Sustainable Development) and Marko Hekkert(Utrecht University)

* a.c.kieft@uu.nl

KEYWORDS: Innovation systems, Systemic problems, Conflicting data, Perception of problems and solutions, Institutional logics

1. Relevance

Our paper tries to make a contribution to solving difficulties that analysts often encounter during the process of problem identification and solution formulation in innovation systems. In practice, innovation systems analysts often find conflicting perceptions on problems and solutions in their data (often interviews). If such conflicting data is encountered, it becomes difficult for the analyst to identify what the problems are and what the best fitting solutions are that may alleviate these problems. The choices that the analyst then makes (either choosing for the opinions he/she finds more ‘true’ or neglecting the conflicting data) influences the policy recommendations made based on the analysis. The main argument in our paper is that such difficulties come forth from the implicit assumption in innovation systems literature that problems are ‘out there’ and part of objective reality. We use the concept of institutional logics to introduce an alternative subjective perspective on problems and solutions in innovation systems. In a subjective view, no problems and solutions are identified, but instead perceptions on problems and perceptions. Our analysis exemplifies how ideal-type institutional logics may provide a tool for analysts to understand the origin of the conflicting data on problems and solutions. We also explain how policy recommendations can still be given based on a problem analysis that takes a subjective view, and how an analyst can use the additional analysis of institutional logics as means to formulate a coherent intervention strategy.

2. Research aim(s) and question(s)

During data collection for an innovation systems analysis, analysts are commonly confronted with varying, if not conflicting, opinions on what the problems and solutions are. For example, one stakeholder may perceive few leading companies as a problem, while another stakeholder may perceive the same situation as desirable because it makes coordination more efficient; or one actor may propose a subsidy to alleviate a lack of financial resources, while another may opt for a tax-reduction. Current innovation systems literature does not provide any guidelines on how an analyst can cope with such conflicting opinions, necessitating the analyst to find a solution her/himself.

To deal with conflicting data on problems and solutions, the analyst currently has two options: (1) choose which opinions are ‘true’ or (2) list all mentioned problems and all possible solutions, even though some of them contradict. In our view, the first option does not do justice to the collected data, which may lead to wrong conclusions; and the second option may lead to incoherent intervention strategies. The starting point of this paper is that these difficulties arise from the implicit assumption in innovation systems literature that problems are ‘out there’ and that it is thus possible to reveal the objective reality of what they are. The solution problems with which analysts are confronted may lie in an alternative subjective view on problems and solutions in innovation systems.

This paper makes use of the concept of institutional logics (Thornton et al. 2012), which is based on the idea that available cultural knowledge to social actors is comprised within different institutional logics (Thornton et al., 2008). Since actors make sense of reality depending on the prevailing institutional logics, they may perceive different problems and solutions when they adhere to different institutional logics. We explore the merits of revealing ideal-type logics as part of a problem analysis in innovation systems, by exploring how they influence the perception on problems and solutions in the innovation system of renovating houses energy-efficiently in the Netherlands.

3. Definitions & 4. Theoretical frameworks

The innovation systems approach offers a framework to identify interventions that can contribute to the generation, diffusion and utilization of innovations. Interventions in the innovation systems framework are targeted at improving system performance through alleviating systemic problems (Wieczorek and Hekkert, 2012). Unsatisfactory performance of the system is caused by problems in the system structure and the

framework prescribes that problems are related to the structural elements that make up the system structure (Klein-Woolthuis et al. 2005; Jacobsson and Bergek, 2011).

The institutional logics concept is based on the idea that available cultural knowledge to social actors is comprised within different institutional logics (Thornton et al., 2012). ‘How actors make sense of and act upon reality is contingent on prevailing institutional logics’ (Fuenfschilling & Truffer, 2014:774). Actors use these logics in the process of ‘sensemaking, problem solving, decision making, and coordination’ (Thornton et al., 2012). According to the institutional logics concept, actors focus their attention only on the problems and solutions that are consistent with the logics they operate under. Logics thus determine “what answers and solutions are available” (Thornton and Ocasio, 1999, p806).

We make use of the ‘ideal-type’ logics concept. These may be considered stereotypes, because there often exists a distance between empirical reality and the formulated ideal-type logics. Although ideal-type logics are usually formulated using empirical data, ‘ideal types are not for describing an organizational field, but instead are theoretical models for comparing the effects of various meanings in a location with a definable boundary’ (Thornton and Ocasio, 2008, p110). After the ideal-types have been identified, they are compared to actual empirical reality, thereby coming to a conclusion of the extent to which the ideal-type logics are institutionalized in practice.

5. Empirical materials

In short, to formulate the ideal-type logics that influence the innovation system of renovating houses energy-efficiently in the Netherlands, we used our previous experience with the domain, preliminary interviews with practitioners, professional magazine articles, websites of initiatives related to renovating houses, and documents about how to approach house renovation. To identify problem perceptions on problems and solutions in the empirical domain of our case, we interviewed people that had been recommended by the initial interviewees and worked from there (snowball sampling). Professional magazine articles also contain interviews or highlight workshops in which perceived problems and possible solutions are mentioned. We had access to articles from two professional magazines .

6. Description of the methodologies

A short version of our methods for formulating the ideal-type logics is that conflicting data encountered in our initial data (see first paragraph of section 5) pointed at the varying contents of two conflicting ideal-type institutional logics. This led to the formulation of two ideal-type logics that conflicting on multiple characteristics.

After transcribing the interviews from our second set our data (see second paragraph of section 5) into text, textual fragments from all data sources were concurrently analyzed for perceptions of problems and solutions for which a process of open coding (Strauss and Corbin, 1990) and focused coding (Charmaz, 2006) was used. The next step consisted of relating the identified perceptions on problems and solutions to the ideal-type institutional logics formulated earlier, and to the concepts from the innovation systems framework. First, the characteristics of the earlier formulated ideal-type logics provided a coding scheme to which the problem and solution perceptions were linked. The classification of structural elements by Wieczorek and Hekkert (2012): Actors, Interactions, Institutions, Infrastructure and Technology, formed a second coding scheme through which the identified problems and solutions were linked to the innovation systems framework.

The final analysis step consisted of creating a historical narrative that discusses the extent to which both ideal-type logics are institutionalized in practice, and how this has changed over time. For this narrative we traced historical events that signaled a change in the extent of institutionalization of the ideal-type logics in the field, and drew on our understanding of the context of the empirical domain that had formed during the previous research steps.

7. Outcomes

The results consist of three parts. The first part discusses the two formulated ideal-type logics. The subsequent part presents multiple situations that are perceived as problematic from the viewpoint of one logic, but not from the other. This part also presents multiple problematic situations that are shared by both logics, but for which the perceived solution differs. Thirdly, a historical narrative that describes to what extent both ideal-type logics are institutionalized in practice. We end with a discussion of the implications of taking a subjective view on problems and solutions for analysts and intervenors (e.g. policy makers), in which we pose that making policy recommendations based on a subjective approach is also possible and sometimes desirable. A subjective view

may also contribute to formulating more coherent intervention strategies. Because of the space restrictions, we could not present the formulated ideal-type logics, and how they influence the identified perceptions on problems and solutions here. We will be more than happy to present them at the conference.

References

- Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative research*. Sage Publications Ltd, London.
- Fuenfschilling, L., & Truffer, B. (2014). The structuration of socio-technical regimes Conceptual foundations from institutional theory. *Research Policy*, 43(4), 772-791.
- Jacobsson, S., & Bergek, A. (2011). Innovation system analyses and sustainability transitions: Contributions and suggestions for research. *Environmental Innovation and Societal Transitions*, 1(1), 41-57.
- Jacobsson, T., & Jacobsson, S. (2014). Conceptual confusion - an analysis of the meaning of concepts in technological innovation systems and sociological functionalism. *Technology Analysis and Strategic Management*, 26(7), 811-823. doi:10.1080/09537325.2014.900171
- Klein Woolthuis, R., Lankhuizen, M., & Gilsing, V. (2005). A system failure framework for innovation policy design. *Technovation*, 25(6), 609-619. doi:10.1016/j.technovation.2003.11.002
- Strauss, A., & Corbin, J. (1990). *Basics of qualitative research* (Vol. 15). Newbury Park, CA: Sage.
- Thornton, P. H., & Ocasio, W. (1999). Institutional logics and the historical contingency of power in organizations: Executive succession in the higher education publishing industry, 1958–1990. *American journal of Sociology*, 105(3), 801-843.
- Thornton, P. H., Ocasio, W., & Lounsbury, M. (2012). The institutional logics perspective. John Wiley & Sons, Inc.. Thornton, Patricia, and William Ocasio. 1999. 'Institutional Logics and the Historical Contingency of Power in Organizations: Executive Succession in the Higher Education Publishing Industry, 1958–1990.' *American Journal of Sociology* 105 (3): 801–843
- Thornton, P. H., & Ocasio, W. (2008). Institutional logics. *The Sage handbook of organizational institutionalism*, 840, 99-128.
- Wieczorek, A. J., & Hekkert, M. P. (2012). Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars. *Science and Public Policy*, 39(1), 74-87. doi:10.1093/scipol/scr008

Cluster strategies for the North Sea the offshore wind service sector. A sectoral innovation system foresight.

Per Dannemand Andersen* and Kalle A. Piirainen

(DTU Management Engineering, Technology and Innovation Management division)

*pean@dtu.dk

KEYWORDS: Foresight, Offshore wind service, Technological innovation system, Clusters

Relevance and research aim

As Europe is working its way towards a low carbon future there are high expectations of the role of offshore wind, and the installed capacity is projected to increase significantly towards 2020 and beyond (EWEA 2014). However, offshore wind energy is relatively expensive, and the industry has outlined an ambitious goal of reducing the cost of offshore wind by 40% from today's average LCoE (Levelized Cost of Energy) by 2020. Services for project development installation, operation and maintenance (O&M) contribute up to 46% of LCoE (capital and operating expenditure). O&M services' contribution alone is estimated between 25 and 28% (Green & Vasilakos 2011). Hence, the services associated with offshore wind farms hold a significant potential for cost reduction. Furthermore, the North Sea is currently the most important site for offshore wind installations, and industry clusters based on OWS are emerging in regions around the North Sea.

Recently, several studies departing from the Technology Innovation Systems (TIS) approach have analysed the North Sea offshore wind innovation system (Rodrigues et al. 2015; Wieczorek et al. 2013; Jacobsson & Karltorp 2013). Among the conclusions of these studies is that there is a need for an orchestrated policy effort in order to strengthen the development and functioning of the European offshore wind innovation system (Wieczorek et al. 2013). This paper focuses on this knowledge gap, by presenting a sectoral innovation foresight study, which contributes with a range of recommendation for supporting the on-going development of offshore wind service sector clusters around the North Sea.

Theoretical framework

The paper departs from the concept of innovation system foresight (Andersen & Andersen 2014; Andersen et al. 2014). The nexus between foresight and innovation systems has been explored by several studies (Alkemade et al. 2007; Cagnin et al. 2012; Martin & Johnston 1999; Markard et al. 2009). The innovation system foresight takes a further integration of the two fields of research.

First, most of the studies that focus on how foresight can contribute to innovation system policies adopt a predictive understanding of the future. A Swiss study notes that there is a strong need for assessing future development paths in innovation in order to develop effective innovation policy strategies (Markard et al. 2009). However predicting is only one of three generic approaches to the future. The other being an explorative approach and anticipative or normative approach (Börjeson et al. 2006). Innovation system foresight emphasises such other approaches to the future. Second, mirroring the development in innovation studies, foresight seems to be increasingly systems oriented, as it is gradually, albeit not always explicitly, implementing the systemic, contextual and evolutionary understanding of innovation that is dominant in the academic field of innovation studies (Dosi 1988; Martin 2014). There are several implications of this development in both innovation studies and foresight. In particular, it has been increasingly recognised that foresight is highly context dependent (Cariola & Rolfo 2004). Therefore, foresight must be able to systematically and coherently include context to conclude anything sensible about innovation and adequate innovation policies. Despite its importance, such work is currently limited (Schoen et al. 2011). Third, foresight exercises often do not take sufficient notice of the demand for knowledge, existing competences, and reality and wishes of firms, policy makers and other key stakeholders (Smits et al. 2010). The lack of a (demonstrable) impact of foresight has led to an increased focus on the demand side of the innovation process within foresight (Smits & Kuhlmann 2004). The rationale is that more seriously including demand and key stakeholders will increase the impact (Georghiou & Cassingena Harper 2011). Innovation systems foresight provides a platform for a wider inclusion of stakeholders.

In this context we define innovation systems foresight as systemic, systematic, participatory, future-intelligence-gathering and medium-to-long-term vision-building process aimed at present-day decisions and mobilising joint actions to improve innovation system performance with the ultimate goal of improving desirable socio-economic

performance (Andersen & Andersen 2014).

The work is of course also based on concepts such as regional innovation systems (Asheim & Gertler 2005), the multilevel perspective (Geels 2005) and smart specialisation (Foray et al. 2012). However it is not the intention to go deeper in to that discussion.

Empirical material and methodology

The paper draws from a recently concluded project European Clusters for Offshore Wind Servicing (EcoWindS, 2012-2015) with the overall aim of project to increase the innovation capacity of the European offshore wind servicing (OWS) sector by establishing cross-regional cooperation and intensifying the relationship between research and the offshore wind industry. Furthermore, the aim of the project was to pave the way for new research and knowledge of how the costs of offshore wind energy can be driven down and partly to contribute to the growth of the many small and medium sized companies in OWS and hence strengthen European competitiveness in the market for offshore wind.

The project can be characterized as a generic sectoral innovation system foresight process (Andersen et al. 2014) that was adapted to the actual case. The process had three phases, each of which contained sub-phases. The planning phase comprised preparation and organisation of the foresight exercise. The main phase was the most comprehensive, as well as the most time-consuming and labour-intensive part of the foresight process. It is in this phase that sustainable knowledge, visions and future possibilities were developed and priorities set among the formulated possibilities on the basis of well-described criteria. The main phase was divided into four sub-phases: mapping, foresighting, prioritising and planning. The follow-up phase comprised two sub-phases: dissemination and learning.

The mapping followed the guidelines for analysing innovation systems (Hekkert et al. 2011; Wieczorek et al. 2013). Based on the mapping of regional resources, the project set out to establish and prioritise goals for the TIS and set a roadmap for achieving them. The roadmapping method is described in more detail elsewhere (c.f. Piirainen 2014). These concurrent activities constitute the foresighting, prioritising and planning stages.

Implication for policy

The foremost contribution of the research is to policy. The outcome of the study is a roadmap that presents a set of concrete actions at multiple levels to support the development of the sector. The actions are: 1) Establish a long lasting joint initiative for knowledge sharing and innovation between regions, 2) Develop a value proposition for OWS as an industry in itself, 3) Develop OWS specific mission-oriented research, development and innovation program, 4) Drive for international OWS specific standards, 5) Develop OWS specific skills and training programs across regions, 6) Develop an OWS Industry Database, 7) Establish OWS Specific Test Sites and Research Infrastructure, 8) Drive regulatory harmonization on Occupational Health & Safety. These actions and more detailed recommendations are built on the analysis within the project and illuminate development prospects of offshore wind services, and by extension offshore wind power in general. This is relevant for discussion both on research, development and innovation, as well as energy policy. In effect the findings will provide an input for a concerted effort to both support offshore wind development and support the emerging clusters of offshore wind services around the North Sea.

Additionally the research addresses the added value of the innovation systems foresight perspective, and in particular aspects of the process in terms of stakeholder interaction, effectively broadening the understanding of the effectiveness of foresight and planning of future foresight exercises.

Acknowledgement

The work behind this paper has been primarily performed within the project 'European Clusters for Offshore Wind Servicing' (ECOWindS) funded by EU's FP7 programme (FP7-REGIONS-2012-2013-1, Project ID 320042). The academic part of the paper was furthermore developed within the project 'Strategic Research Alliance for Energy Innovation Systems and their Dynamics' (EIS) funded by the Danish Council for Strategic Research. The authors would like to thank partners from both projects for their contributions.

References

- Alkemade, F., Kleinschmidt, C. & Hekkert, M., 2007. Analysing emerging innovation systems: a functions approach to foresight. *International Journal of Foresight and Innovation Policy*, 3(2), pp.139–168.
- Andersen, A.D. & Andersen, P.D., 2014. Innovation system foresight. *Technological Forecasting and Social Change*, 88, pp.276–286.
- Andersen, P.D. et al., 2014. Sectoral innovation system foresight in practice: Nordic facilities management foresight. *Futures*, 61, pp.33–44.
- Asheim, B.T. & Gertler, M., 2005. The geography of innovation: regional innovation systems. In J. Fagerberg, D. Mowery, & R. Nelson., eds. *The Oxford handbook of innovation*. Oxford University Press, USA.
- Börjeson, L. et al., 2006. Scenario types and techniques: Towards a user's guide. *Futures*, 38(7), pp.723–739.
- Cagnin, C., Amanatidou, E. & Keenan, M., 2012. Orienting European innovation systems towards grand challenges and the roles that FTA can play. *Science and Public Policy*, 39(2), pp.140–152.
- Cariola, M. & Rolfo, S., 2004. Evolution in the rationales of foresight in Europe. *Futures*, 36(10), pp.1063–1075.
- Dosi, G., 1988. Sources, procedures, and microeconomic effects of innovation. *Journal of economic literature*, 26(3), pp.1120–1171.
- EWEA, 2014. *The European offshore wind industry - key trends and statistics 2013*, Brussels.
- Foray, D. et al., 2012. *Guide to Research and Innovation Strategies for Smart Specialization (RIS3)*.
- Geels, F.W., 2005. Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective. *Technological Forecasting and Social Change*, 72(6), pp.681–696.
- Georgiou, L. & Cassingena Harper, J., 2011. From priority-setting to articulation of demand: Foresight for research and innovation policy and strategy. *Futures*, 43(3), pp.243–251.
- Green, R. & Vasilakos, N., 2011. The economics of offshore wind. *Energy Policy*, 39(2), pp.496–502.
- Hekkert, M. et al., 2011. *Technological Innovation System Analysis: A manual for analyst*, Utrecht, NL.
- Jacobsson, S. & Karltorp, K., 2013. Mechanisms blocking the dynamics of the European offshore wind energy innovation system – Challenges for policy intervention. *Energy Policy*, 2010(June 2010), pp.1–14.
- Markard, J., Stadelmann, M. & Truffer, B., 2009. Prospective analysis of technological innovation systems: Identifying technological and organizational development options for biogas in Switzerland. *Research Policy*, 38(4), pp.655–667.
- Martin, B.R., 2014. *R & D Policy Instruments – a Critical Review of What We Do and Don't Know*, Aalborg.
- Martin, B.R. & Johnston, R., 1999. Technology Foresight for Wiring Up the National Innovation System. *Technological Forecasting and Social Change*, 60(1), pp.37–54.
- Piirainen, K.A., 2014. The GRIP method for collaborative roadmapping workshops. In 5th International Conference on Future-Oriented Technology Analysis (FTA) - Engage today to shape tomorrow. Brussels, BE: European Commission.
- Rodrigues, S. et al., 2015. Trends of offshore wind projects. *Renewable and Sustainable Energy Reviews*, 49, pp.1114–1135.
- Schoen, A. et al., 2011. Tailoring Foresight to field specificities. *Futures*, 43(3), pp.232–242.
- Smits, R. et al., 2010. The Role of Technology Assessment in Systemic Innovation Policy. In R. E. Smits, S. Kuhlmann, & P. Shapira, eds. *The Theory and Practice of Innovation Policy: An International Research Handbook*.
- Smits, R. & Kuhlmann, S., 2004. The rise of systemic instruments in innovation policy. *International Journal of Foresight and Innovation Policy*, 1(1/2), p.4.
- Wieczorek, A.J. et al., 2013. A review of the European offshore wind innovation system. *Renewable and Sustainable Energy Reviews*, 26, pp.294–306.

2D. TRACK TEAM 2: INNOVATION PARADIGMS IN THE BIOECONOMY (II)

Value chain structures that define second generation bio-refineries in Europe

Jay Gregg*(Technical University of Denmark), Simon Bolwig(Technical University of Denmark), Teis Hansen(Lund University), Ola Solér(Technical University of Denmark), Sara Ben Amer-Allam(Technical University of Denmark), Júlia Pladevall Viladecans(Technical University of Denmark), Lars Coenen(Lund University), Antje Klitkou(Nordic Institute for Studies in Innovation) and Arne Fevolden(Nordic Institute for Studies in Innovation)

* jsgr@dtu.dk

KEYWORDS: Global Value Chain, 2nd generation bio-refinery, Ethanol, Economies of scope

1. Relevance

Literature on 2nd generation biomass refining highlights ways of reducing cost: 1. enzyme cost reduction; 2. reducing energy consumption for pretreatment; 3. securing feedstock provision, by increasing residue harvest rates, and enabling feedstock variability; 4. reduction of risk in infrastructure investments.

2. Research aim and questions

We hypothesize that development of 2nd generation bio-refineries is structured by: 1) the nature of the feedstock and resource availability; 2) the industrial actors (competences, existing capital stock/investments, incentives, objectives); and 3) coordination between various actors in the value chain. From this perspective, we seek to identify the barriers to greater diffusion of cellulosic biomass refining, and influence (failure) of current policies to address these barriers. Our claim is that these barriers could be addressed more effectively by considering economies of scope in the national and EU policies that intend to promote greater utilization of second generation bio-refining for fuel and other co-products.

3. Definitions

Second generation bio-refining is the process of breaking down the ligno-cellulosic structure of biomass to enable its enzymatic fermentation into end use products. A bio-refinery is a physical production plant where biomass is converted into end use products such as ethanol fuel, cellulose, and niche chemicals.

4. Theoretical Frameworks

To address this hypothesis and demonstrate our claim, we apply Global Value Chain (GVC) analysis. GVC analysis emerged in the early 1990s as a novel methodological tool for understanding the dynamics of economic globalization, international trade as well as particular industries such as automobile manufacturing (Sturgeon, et al. 2008). GVC is based on the analysis of discrete value chains where input supply, production, trade and consumption or disposal are explicitly and coherently linked. In GVC analysis, the concept of upgrading is used to identify the possibilities for producers to ‘move up the value chain’, either by shifting to more rewarding functional positions, or by making products that have more value-added invested in them or that provide higher returns. The upgrading process is examined through the lenses of how knowledge and information flow within value chains (Gereffi, et al., 2005; Bolwig, et al., 2010) and displays similarities with innovation system approaches. Recent literature points out that external actors such as governments, multilateral institutions, and non-governmental organizations (NGOs) can significantly influence GVC governance (Bolwig, et al., 2010; Ponte & Sturgeon, 2014), especially in emerging industries like those for renewables, thus creating multipolar chains (Ponte, 2014).

5. Empirical Materials

We conducted a survey of the policy landscapes, at both the EU and national levels. We also conducted interviews of firms that use 2nd generation refining technology within Denmark, Sweden, Norway, Spain and Italy- countries where pilot scale and production scale plants exist. The plants differ in terms of resources, technologies, policy landscape, and actors. Thus the case studies cover many different perspectives for how value chains form and function with respect to 2nd generation refining.

6. Description of the Methodologies

A survey was conducted of six different firms across Europe: Abengoa (Spain), Inbicon (Denmark), Örnsköldsvik (Sweden), Weyland (Norway), Borregaard (Norway), and Crescentino (Italy). The survey collected information on: the position of the studied value chain actors in the global market, in terms of technological advantage, presence in different markets; the feedstock supply; firm characteristics (size, ownership, recent developments, etc.); innovations (major achievements), their characteristics (disruptive or incremental) and the factors that drive them (e.g. public research and development funding); sources of finance for R&D and construction of larger plants; domestic market characteristics/ creating and the role of policy; and value added in different value chain segments (prices, costs, etc.).

7. Expected outcomes

Policies to promote 2nd generation bio-refining, and specifically, the production of cellulosic ethanol, tend to focus on technological innovation (e.g., research to reduce the price of enzymes), and targets/ mandates for ethanol production (renewable energy targets, tax incentives); i.e. they tend to focus on economies of scale. Yet the barriers to economies of scale are more than just technological. From a global value chain perspective, achieving economies of scale and scope, and thus reducing price requires the coordination of many actors. If policy, which generally focuses on subsidies and other incentives for technological development, were to consider economies of scope rather than just scale, the price of cellulosic ethanol would be reduced more efficiently, and it would better promote greater innovation within the bio-economy.

References

- Bolwig, S., Ponte, S., Du Toit, A., Riisgaard, L., & Halberg, N. (2010). Integrating Poverty and Environmental Concerns into Value-Chain Analysis: A Conceptual Framework. *Development Policy Review*, 28(2), 173-194.
- Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of international political economy*, 12(1), 78-104.
- Ponte, S. 2014. The evolutionary dynamics of biofuel value chains: from unipolar and government driven to multipolar governance. *Environment and Planning A*, 46, 353-372.
- Ponte, S., & Sturgeon, T. (2014). Explaining governance in global value chains: A modular theory-building effort. *Review of International Political Economy*, 21(1), 195-223.
- Sturgeon, T., Van Biesebroeck, J., & Gereffi, G. (2008). Value chains, networks and clusters: reframing the global automotive industry. *Journal of economic geography*, lbn007.

Governance in transitions: directionality and heterogeneity towards a bioeconomy

Lisa Scordato*(NIFU), Markus Bugge(NIFU) and Arne Fevolden(TIK, University of Oslo)

* lisa.scordato@nifu.no

KEYWORDS: Governance, Directionality, Institutional logics, Transition, Bioeconomy

1. Relevance

In recent years, there has been an increasing interest in how grand societal challenges can be met by research and innovation policies. Differing from historical examples of targeted and mission-oriented science, technology and innovation policies, challenge driven innovation is characterized by fundamental uncertainties regarding the driving forces and the outcomes of socio-technical reconfiguration processes. Associated with this, challenge driven innovation implies a high degree of uncertainty regarding what kinds of stakeholders, processes and knowledge that is required in order to address societal challenges in appropriate ways.

One of the pressing societal challenges today relates to climate change and the need to replace fossil fuels with renewable energies and biological resources. This has resulted in the development of biofuels such as bioethanol, biodiesel and biogas; bio-products such as bio-plastics, bio-chemicals and bio-pharmaceuticals; and bioenergy such as electricity and district heating generated at biogas or combustion plants. The magnitude and diversity of these initiatives has led scholars, commentators and policy makers to talk about a 'bioeconomy' and subsequently a call for a more comprehensive policy framework to support and direct this sector of the economy. The bioeconomy concept has been embraced by many governments around the world with the view to respond to societal challenges (Staffas, Gustavsson et al. 2013, German Bioeconomy Council 2015).

Nevertheless, it remains unclear what the bioeconomy is and how it can contribute to a transition to a low-carbon society. It has been pointed out in the literature that there is a need for more analytical and empirical efforts in the study of governance of change in socio-technical systems (Borrás and Edler 2014) and that there is a need to improve the understanding of the politics and policies of sustainability transitions (Markard, Raven et al. 2012). In this paper, we wish to address this knowledge gap by focusing on the roles of governance in transition. The study seeks to generate an improved understanding of to what extent and how governance manoeuvres and directs transition processes. In more detail, the study focuses upon the development process of a national policy strategy for the bioeconomy in Norway, in which a public inquiry process has been carried out seeking to inform the direction of and contents for the policy strategy.

2. Aims & Research questions

The study aims to generate new knowledge on the roles of governance in such processes of transition and on how directionality for socio-technical transition is arrived at across the heterogeneous landscape of stakeholders and interests involved in shaping the new bioeconomic regime(s). The research questions guiding the study can be formulated as follows:

- 1) How is the new bioeconomic regime shaped?
 - a. What actors (representing existing regimes and new niches) are involved in the shaping of the new regime?
 - b. What are their policy positions on the bioeconomy?
- 2) What are the predominant institutional logics involved in the formation of this sector, and how do they possibly support or hamper transition?

3. Theoretical framework and definitions

A prominent approach to address societal transformation has been transition theory (Kemp, Schot et al. 1998, Geels 2002), which represents a multi-level perspective (MLP) to understand long-term socio-technical change. Transformative change is often seen to comprise radical, long-term alterations in both production and consumption that significantly modify the functioning of society (Grin, Rotmans et al. 2010). This literature has come to constitute an important supplement to conceptualize research and innovation policies, extending existing theory on systems of innovation towards transformative and societal change.

In addition to the multi-level perspective serving as an overarching framework for the analysis, the discourses on the emerging bioeconomy will be studied with a focus on so-called institutional logics (Thornton and Ocasio 2008). This perspective will be applied to analyse what institutional logics exist among all the inquiries to the national policy strategy and identify potential conflicts and tensions between them. A recent contribution of Fuenfschilling and Truffer (2014) offers a conceptual foundation for assessing structures and degrees of structuration within socio-technical systems by drawing on concepts of institutional theory. Notably, following

the previous work on the institutional nature of the regime (Geels and Schot 2007) their framework argues that structuration can be conceptualised as a process of institutionalisation and that the strength of a regime can be assessed by identifying the degree of institutionalization of its core elements. In addition, they use the institutional logics concept by Thornton and Ocasio (2008) to analyse the specific content and coherence of structures in a socio-technical system.

Related to the notions of structuration and institutionalization is the concept of legitimacy (Markard, Wirth et al. 2016). Several scholars make it clear that establishing legitimacy is essential for both novel and established technologies in the sense that they require a financial, human and material resources as well as regulatory support (Hekkert, Suurs et al. 2007, Bergek, Jacobsson et al. 2008). This study will consider how legitimacy for a technology is “formed through conscious actions by various organizations and individuals in socio-technical process of legitimation, which incorporates cognitive, normative as well as regulative aspects” (Bergek, Jacobsson et al. 2008, p.581). Moreover, the level of legitimacy may also be eroded because of changing societal values and preferences (Geels and Verhees 2011). In our case, the public inquiry offers an interesting opportunity to study legitimacy dynamics of institutions who have a stake in forming the early phases of the transition towards a bioeconomy.

4. Empirical data, methodology and analysis

Empirically, our main data source for the discourse analysis is the national public inquiry process for a national bioeconomy strategy in Norway. The process was initiated by the ministry of Trade, Industry and Fisheries and the Ministry of Food and Agriculture in 2015. The inquiry was launched with the aim “to identify overall priorities for a national strategy within the field and formulate goals and instruments in a long term perspective”. Parties were invited to submit their opinions by sending in written submissions. In addition, a public hearing conference was held in June 2015 in Oslo. The submissions and the presentations from the public hearing were then collected and made available online by the government. The hearing material comprise 41 written submissions made by equally many different actors representing private companies, industry associations, universities and university colleges, research institutes, interest organisations and local and regional municipalities and NGOs.

Methodologically, the paper is based on discourse analysis using a qualitative data analysis software (NVIVO). A coding system was created (a priori and underway) to systematize the text material. First, the submissions were categorised by actor groups and sectors. Second, the selected text paragraphs were coded according to predefined categories. In this way, the material was systematically analysed allowing us to identify emerging discursive patterns. The different discourses were then grouped into ideal institutional logic types. The dimensions of the institutional logics were guided by diagnostic questions referring to cognitive (“understanding and purpose”) and, normative (“major design principles) and regulatory (“socio-technical materialisation) processes of legitimation (Markard et al. 2016).

The analysis will constitute a bottom-up and iterative process of identification, interpretation and categorization of a) actors and regimes b) their statements and advice, and c) their motivations and institutional logics. In sum, the analysis will illustrate the richness and nuances of the heterogeneity among the stakeholders involved.

5. Expected outcomes

We expect that the analysis will generate an improved understanding of the potential transition trajectories towards the emerging bioeconomy. The study aims to contribute to the literature in two ways; first, in terms of illustrating the diversity of actors, interests and logics involved in the formation of a new socio-technical regime, and the intrinsic tensions among these; second, in terms of exemplifying the open-ended and uncertain nature of such processes regarding future outcomes and bioeconomy regime(s). In this way, the paper addresses the dynamics and balance between existing and future regimes as well as the coordination of heterogeneous interests in such transitions processes.

REFERENCES

- Bergek, A., et al. (2008). "Analyzing the functional dynamics of technological innovation systems: A scheme of analysis." *Research Policy* 37(3): 407-429.
- Bergek, A., et al. (2008). "'Legitimation' and 'development of positive externalities': two key processes in the formation phase of technological innovation systems." *Technology Analysis & Strategic Management* 20(5): 575-592.
- Borrás, S. and J. Edler (2014). *The governance of change in socio-technical and innovation systems: three pillars for a conceptual framework. The Governance of Socio-Technical Systems*. S. Borrás and J. Edler. Cheltenham, UK Northampton, MA, USA, Edward Elgar.
- Geels, F. W. (2002). "Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study." *Research Policy* 31(8-9): 1257-1274.
- Geels, F. W. and J. Schot (2007). "Typology of sociotechnical transition pathways." *Research Policy* 36(3): 399-417.
- Geels, F. W. and B. Verhees (2011). "Cultural legitimacy and framing struggles in innovation journeys: A cultural-performative perspective and a case study of

Dutch nuclear energy (1945-1986)." *Technological Forecasting and Social Change* 78(6): 910-930.

German Bioeconomy Council (2015). *Synopsis of National Strategies around the World*. Berlin.

Grin, J., et al. (2010). *Transitions to sustainable development*. New York, Routledge.

Hekkert, M. P., et al. (2007). "Functions of innovation systems: A new approach for analysing technological change." *Technological Forecasting and Social Change* 74(4): 413-432.

Kemp, R., et al. (1998). "Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management." *Technology Analysis & Strategic Management* 10(2): 175-198.

Markard, J., et al. (2012). "Sustainability transitions: An emerging field of research and its prospects." *Research Policy* 41(6): 955-967.

Markard, J., et al. (2016). "Institutional dynamics and technology legitimacy - A framework and a case study on biogas technology." *Research Policy* 45(1): 330-344.

Staffas, L., et al. (2013). "Strategies and Policies for the Bioeconomy and Bio-Based Economy: An Analysis of Official National Approaches." *Sustainability* 5: 2751-2769.

Thornton, P. H. and W. Ocasio (2008). *Institutional logics. Organizational Institutionalism*. R. Greenwood, C. Oliver, K. Sahlin and R. Suddaby. London, Sage Publications: 99-129.

Absorptive Capacity and Industrial Symbiosis – Experiences from the Danish Green Industrial Symbiosis SME Program 2013-2015

Andreas Schmiegelow* and Maj Munch Andersen
(Technical University of Denmark)
*anschm@dtu.dk

KEYWORDS: Industrial symbiosis, Dynamic capabilities, Organizational learning, Absorptive capacity, SME

Research question, hypothesis and relevance:

Industrial Symbiosis (henceforward IS) may be understood as the mutually advantageous utilization of residues and by-products between traditionally separate industrial entities (M. R. Chertow, 2000: 313). Despite not being a new phenomenon (M. Chertow & Park, 2016), IS has recently risen to the vanguard of political appraisal (Laybourn & Lombardi, 2012; Wang, Deutz, & Gibbs, 2015). With appeal to the comforting prosaic idea that one company's 'trash' could in fact be another one's 'treasure', IS is endorsed as a tool for systemic innovation vital for green growth (OECD 2010 in Lombardi & Laybourn, 2012: 28). A game-changer for sustainable development (WWF 2010 in Laybourn & Lombardi, 2012: 10) with the ability to put circular economy thinking into practice and promote recirculation of industrial residues and by-products and effectively optimize companies' resource consumption (EC, 2011, 2015).

By analyses of data collected among participants in the recently ended Danish Green Industrial Symbiosis SME Program (the 'GIS-program') this paper aims to provide some nuances to the apparent sanguine political belief in IS as a ubiquitously applicable engine for green growth and eco-innovation.

Specifically, this paper dives into the question of why an evaluation report conducted by the Danish Business Authority as the GIS-program ended, showed that only approximately 10 pct. of the 174 IS opportunities found during the program was implemented. A result that ostensibly stands in opposition to the general appraisal of IS, as well as to conclusions drawn from similar 'facilitated' IS policy initiatives (Laybourn & Morrissey, 2009; Paquin & Howard-Grenville, 2012).

The literature on IS has evolved significantly in recent years highlighting several factors that may affect the formation of IS. These include e.g. environmental and economic benefits (M. R. Chertow, 2007; Van Berkel, 2010); incentivizing policies and regulation (Salmi, Hukkinen, Heino, Pajunen, & Wierink, 2012); and social embeddedness among IS partners (Ashton & Bain, 2012).

One line of research considers the epistemological component in IS, because as argued, for IS to succeed large amounts of data and knowledge need be collected, processes and shared between IS partners (Davis, Nikolic, & Dijkema, 2010). Knowledge barriers for IS include companies' lack of knowledge on waste utilization opportunities (M. R. Chertow, 2007), inadequate knowledge about waste stream compositions to evaluate IS opportunities (Allen, 2004) and lack of appropriate ICT-tools to ease transfer of knowledge between potential IS partners (Grant, Seager, Massard, & Nies, 2010; Trokanas, Cecelja, & Raafat, 2014). However, despite general appreciation of the epistemological component in IS, little attention has been given to factors that influence the actual attainment of knowledge on IS opportunities in companies and the concomitant commercial application of this knowledge. In that sense, the epistemological component in IS has mostly been treated an issue of information deficit that need to be corrected for IS to proliferate.

We, however, hypothesize, based on insights from the literature on dynamic capabilities and organizational learning, that part of the answer to the issue of the epistemological shortfall in IS resides elsewhere. We propose that the reason why IS does indeed not proliferate ubiquitously is not only because the knowledge needed to make it so is unavailable, but also because companies, and especially SMEs, lack the capacity to attain and utilize it. SMEs' having such lack is not a novel insight (Gray, 2006; Muscio, 2007), however, one that hasn't been given much attention in the context of IS (cf. Boons & Spekink, 2012). In this paper, we will thus attempt to fill what we see as an important gap in the IS literature and, based on data from the GIS-program, test the extent to which there is a connection between companies' capacity to attain and utilize knowledge and the implementation of IS and if so, how this connection might be understood. With the increased attention to IS

among policy makers, we regard a filling of this gap to be a relevant contribution, not least in regard to the development of a sustainable bio-economy in which IS may be considered a central component (see e.g. Lopes, 2015)

Theoretical framework

When considering companies' abilities to attain and utilize knowledge, 'absorptive capacity' stands as a central concept, and since Cohen & Levinthal defined it as 'the firm's ability to identify, assimilate and exploit knowledge from the environment' (Wesley M Cohen & Levinthal, 1989:569-70) it has gained widespread recognition (see Van Den Bosch, Van Wijk, & Volberda, 2003). This is not least due to its ability to incorporate dynamic capabilities (i.e. organizations' ability to adapt) (Teece, Pisano, & Shuen, 1997) and organizational learning (i.e. organizations' encoding, storing, and retrieving of knowledge) (Levitt & March, 1988) perspectives (cf. Easterby-Smith, Graca, Antonacopoulou, & Ferdinand, 2005).

Since Cohen & Levinthal's initial definition, several modifications have evolved one of which is Zahra & George's (2002), who on basis of the contention that companies need to transfigure external knowledge before they can utilize it, expand Cohen & Levinthal's three components of absorptive capacity (identify, assimilate, exploit) to four (acquire, assimilate, transform, exploit). As the transformation or modelling of knowledge may be considered particular pivotal in the case of IS (Trokanas, Cecelja, & Raafat, 2014), we will in this paper follow Zahra & George's (2002) conception.

Despite being a pervasively applied concept (Lane, Salk, & Lyles, 2001), organizations absorptive capacity has mostly been measured by the use of R&D proxies (patents, expenditures, personnel, etc.) (Flatten, Engelen, Zahra, & Brettel, 2011). Such approach, however, ignores the multi-dimensionality of the construct (acquire, assimilate, transform, exploit) (Flatten et al., 2011) and is less relevant in the context of SME's where formal R&D activities are often limited (Muscio, 2007), implicitly rather than explicitly conveyed (Lundvall & Johnson, 1994) and innovation happens in a DUI- rather than STI-mode (Jensen, Johnson, Lorenz, & Lundvall, 2007).

Accordingly, in order to measure the absorptive capacity of participants in the GIS-program we need a measure that considers the multiple dimensions of such capacity, however, is applicable in a SME setting. Therefore, we apply Flatten et al.'s (2001) literature-based item-pool framework that considers all components in Zahra & George's (2002) absorptive capacity conception, however, modify it so that it is sensitive to SMEs' particular organizational setup thus leave out or alter a number of items in the framework that assume a hierarchical organizational structure with various management levels.

Methodology and expected outcomes

The paper's data sample is gathered from a database developed by the Danish Business Authority during the GIS-program as well as collected among companies participating in the program through a survey using Likert-scales on the various selected/altered items from Flatten et al.'s framework (2011). Other relevant data that may explain the lack of implementation of IS is gathered as well (see e.g. above mentioned factors) through semi-structured interviews. This data is important in order to account for non-absorptive capacity factors that may have influenced the implementation of IS. Here it is worth remarking that one of the authors has been heavily involved in the GIS-program, thus have a unique access to the participating companies and inside information.

The expected outcome of the paper is a deeper theoretical and empirical clarification of the IS concept and its epistemological component. Empirically, we expect to conclude that there is a significant connection between absorptive capacity and IS, so that the companies where IS has been implemented show a higher level of absorptive capacity compared to those where it has not. As mentioned, since IS may be considered a central component in a bio-economy (see e.g. Lopes, 2015) we consider these outcomes to be highly relevant in a bio-economy policy perspective.

References

- Allen, D. T. (2004). An industrial ecology: material flows and engineering design. *Sustainable Development in Practice: Case Studies for Engineers and Scientists*, 283.
- Ashton, W. S., & Bain, A. C. (2012). Assessing the "Short Mental Distance" in Eco-Industrial Networks. *Journal of Industrial Ecology*, 16(1), 70-82. doi:10.1111/j.1530-9290.2011.00453.x
- Boons, F., & Spekkink, W. (2012). Levels of Institutional Capacity and Actor Expectations about Industrial Symbiosis. *Journal of Industrial Ecology*, 16(1), 61-69. doi:10.1111/j.1530-9290.2011.00432.x
- Chertow, M., & Park, J. (2016). Scholarship and Practice in Industrial Symbiosis: 1989–2014. In R. Clift & A. Druckman (Eds.), *Taking Stock of Industrial Ecology* (pp. 87-116). Cham: Springer International Publishing.

- Chertow, M. R. (2000). Industrial symbiosis: literature and taxonomy. *Annual review of energy and the environment*, 25(1), 313-337. Retrieved from <http://www.annualreviews.org/doi/pdf/10.1146/annurev.energy.25.1.313>
- Chertow, M. R. (2007). "Uncovering" industrial symbiosis. *Journal of Industrial Ecology*, 11(1), 11-30.
- Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: the two faces of R & D. *The economic journal*, 99(397), 569-596.
- Cohen, W. M., & Levinthal, D. A. (1990). Absorptive-Capacity - a New Perspective on Learning and Innovation. *Administrative science quarterly*, 35(1), 128-152. doi:10.2307/2393553
- Davis, C., Nikolic, I., & Dijkema, G. P. J. (2010). Industrial Ecology 2.0. *Journal of Industrial Ecology*, 14(5), 707-726. doi:10.1111/j.1530-9290.2010.00281.x
- Easterby-Smith, M., Graca, M., Antonacopoulou, E., & Ferdinand, J. (2005). Absorptive capacity in practice: an empirical examination of Zahra and George's model. Paper presented at the European conference on organizational knowledge, learning and capabilities.
- EC. (2011). Roadmap to a Resource Efficient Europe. COM (2011), 571.
- EC. (2015). Closing the loop - An EU action plan for the Circular Economy. European Commission.
- Flatten, T. C., Engelen, A., Zahra, S. A., & Brettel, M. (2011). A measure of absorptive capacity: Scale development and validation. *European Management Journal*, 29(2), 98-116. doi:<http://dx.doi.org/10.1016/j.emj.2010.11.002>
- Grant, G. B., Seager, T. P., Massard, G., & Nies, L. (2010). Information and communication technology for industrial symbiosis. *Journal of Industrial Ecology*, 14(5), 740-753. doi:10.1111/j.1530-9290.2010.00273.x
- Gray, C. (2006). Absorptive capacity, knowledge management and innovation in entrepreneurial small firms. *International Journal of Entrepreneurial Behavior & Research*, 12(6), 345-360.
- Jensen, M. B., Johnson, B., Lorenz, E., & Lundvall, B. Å. (2007). Forms of knowledge and modes of innovation. *Research policy*, 36(5), 680-693.
- Lane, P. J., Salk, J. E., & Lyles, M. A. (2001). Absorptive capacity, learning, and performance in international joint ventures. *Strategic management journal*, 22(12), 1139-1161.
- Laybourn, P., & Lombardi, D. R. (2012). Industrial Symbiosis in European Policy. *Journal of Industrial Ecology*, 16(1), 11-12. doi:10.1111/j.1530-9290.2011.00451.x
- Laybourn, P., & Morrissey, M. (2009). National Industrial Symbiosis Programme: The pathway to a low carbon sustainable economy: International Synergies Limited.
- Levitt, B., & March, J. G. (1988). Organizational learning. *Annual review of sociology*, 319-340.
- Lombardi, D. R., & Laybourn, P. (2012). Redefining Industrial Symbiosis. *Journal of Industrial Ecology*, 16(1), 28-37. doi:10.1111/j.1530-9290.2011.00444.x
- Lopes, M. S. G. (2015). Engineering biological systems toward a sustainable bioeconomy. *Journal of Industrial Microbiology & Biotechnology*, 42(6), 813-838. doi:10.1007/s10295-015-1606-9
- Lundvall, B.-Å., & Johnson, B. (1994). The learning economy. *Journal of industry studies*, 1(2), 23-42.
- Muscio, A. (2007). The impact of absorptive capacity on SMEs' collaboration. *Economics of Innovation and New Technology*, 16(8), 653-668.
- Paquin, R. L., & Howard-Grenville, J. (2012). The Evolution of Facilitated Industrial Symbiosis. *Journal of Industrial Ecology*, 16(1), 83-93. doi:10.1111/j.1530-9290.2011.00437.x
- Salmi, O., Hukkinen, J., Heino, J., Pajunen, N., & Wierink, M. (2012). Governing the Interplay between Industrial Ecosystems and Environmental Regulation. *Journal of Industrial Ecology*, 16(1), 119-128. doi:10.1111/j.1530-9290.2011.00403.x
- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic management journal*, 18(7), 509-533.
- Trokanas, N., Cecelja, F., & Raafat, T. (2014). Semantic input/output matching for waste processing in industrial symbiosis. *Computers & Chemical Engineering*, 66, 259-268. doi:<http://dx.doi.org/10.1016/j.compchemeng.2014.02.010>
- Van Berkel, R. (2010). Quantifying sustainability benefits of industrial symbioses. *Journal of Industrial Ecology*, 14(3), 371-373.
- Van Den Bosch, F. A., Van Wijk, R., & Volberda, H. W. (2003). Absorptive capacity: antecedents, models and outcomes.
- Wang, Q., Deutz, P., & Gibbs, D. (2015). UK-China collaboration for industrial symbiosis: a multi-level approach to policy transfer analysis. *International Perspectives on Industrial Ecology*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar, 89-107.
- Zahra, S. A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review*, 27(2), 185-203.

Natural resource diversity and Knowledge idiosyncrasies. Implications for resource intensive development paths and sustainability transitions

Allan Dahl Andersen* and Olav Wicken

(Center for Technology, Innovation and Culture (TIK), Oslo University, Norway)

*allanda@tik.uio.no

KEYWORDS: Natural resources, Knowledge bases, Bioeconomy, Industrial development

The production and processing of natural resources are playing an increasingly important role in the global economy. First, the world witnessed a commodity super cycle in the 2000s that presented natural resource rich countries with new opportunities for innovation and development. Although the actual developmental impact is contested, the discussion of how to develop through expansion of natural resource intensive industries (NRIIs) rages on (AEO, 2013). Second, unsustainable practices in our management of natural resources have played an important part in global warming. Changing these practices in NRIIs is an important part of climate change mitigation strategies and part of a shift to a bioeconomy (Rockström et al., 2009). Innovation is central for addressing both these challenges. Still, due to a broad manufacturing and high-tech bias in innovation studies (Castellacci, 2008; Martin, 2013) we know surprisingly little about innovation and change in NRIIs (Andersen et al., 2015).

However, determined to nuance the dominance of the ‘resource curse thesis’, a new wave of thinking about natural resource intensive development paths has recently emerged (see e.g. Dantas, 2011; Marín et al., 2015; Morris et al., 2012b; Smith, 2007; Ville & Wicken, 2012). A preliminary insight that materialises from this research is that innovation in NRIIs very often face specific geological and agro-ecological conditions, which vary from context to context. This suggests that knowledge produced in a specific location might not always be useful to every other location. We will refer to this feature as ‘natural resource knowledge idiosyncrasy’ (NRKI). The existence of NRKI constitutes an anomaly in front of our current understanding of innovation and development that is roughly seen as a three-stage catching-up process. It begins with the copy, replication, and reverse engineering of existing technologies developed by lead firms in high-income countries. Subsequently firms in low-income countries move on to creative imitation (i.e. making minor improvements to the original technology), and lastly they become innovators of novel items and reach the global knowledge frontier (Hobday et al., 2004; Lall, 1987; Mathews, 2002). We argue that the latter understanding is valid for manufacturing industries but inappropriate for NRIIs. In NRIIs the first step often requires innovation in the local context rather than imitation because the relevant knowledge bases are in situ rather than global as is the case in manufacturing. NRKI further implies that the ideal organization and functioning of innovation systems related to natural resources differ from what we know from manufacturing.

However, our knowledge about how geological and agro-ecological conditions affect innovation is still limited. We attempt to narrow this gap in our knowledge by exploring the following questions:

1. To what extent does NRKI exist across different NRIIs?
2. How does NRKI influence innovation in NRIIs?
3. What are the implications of the latter for policy and research?

To inform our inquiries we review a selection of case studies that individually make different contributions to our understanding of NRKI. We select cases to cover all categories of NRIIs including soft, hard, and energy resources (Morris et al., 2012a) to strengthen analytical generalization of our results.

We find that NRKI exists in most NRIIs but that it differs in strength. NRKI can be defined as an outcome of interactions between resource specificity, local environment (ecology and geology), and local climate. We conclude that NRKI constitutes the in situ knowledge base needed achieve high productivity and sustainability in production and processing of natural resources. This implies that NRKI is a key for achieving a sustainability transition in natural resources and thus a shift to a bioeconomy. Indeed, ecologists argue for mobilizing ‘the power of NRKI’ by using in situ eco-services as production inputs rather than pesticides and chemical fertilizers (Tittonell et al., 2016).

We furthermore conclude that NRKI can be a window of opportunity for local capital goods firms in developing countries to enter global value chains dominated by foreign lead firms whose strategies concentrate on generic solutions with global markets rather than the local niche markets for NRKI. The strategic management of NRKI thus seems an important element of natural resource intensive development paths.

Reference list

- AEO. (2013). African Economic Outlook 2013 - Structural Transformation and Natural Resources. African Development Bank, Organisation for Economic Co-operation and Development, United Nations Development Programme, Economic Commission for Africa.
- Andersen, A. D., Johnson, B., Marin, A., Kaplan, D., Lundvall, B.-Å., Stubrin, L., & Kaplinsky, R. (2015). Natural resources, Innovation and Development. Globelics Thematic Review. Aalborg University Press.
- Castellacci, F. (2008). Technological paradigms, regimes and trajectories: Manufacturing and service industries in a new taxonomy of sectoral patterns of innovation. *Research Policy*, 37(6-7), 978–994.
- Dantas, E. (2011). The evolution of the knowledge accumulation function in the formation of the Brazilian biofuels innovation system. *International Journal of Technology and Globalisation*, 5(3-4), 327–340.
- Hobday, M., Rush, H., & Bessant, J. (2004). Approaching the innovation frontier in Korea: the transition phase to leadership. *Research Policy*, 33(10), 1433–1457.
- Lall, S. (1987). *Learning to industrialize : the acquisition of technological capability by India*. London: Macmillan.
- Marin, A., Navas-Aleman, L., & Perez, C. (2015). Natural Resource Industries as a Platform for the Development of Knowledge Intensive Industries. *Tijdschrift Voor Economische En Sociale Geografie*, 106(2), 154–168.
- Martin, B. (2013). Innovation Studies: An emergin agenda. In J. Fagerberg, B. R. Martin, & E. S. Andersen (Eds.), *Innovation Studies. Evolution and future challenges*.
- Mathews, J. A. (2002). Competitive Advantages of the Latecomer Firm : A Resource-Based Account of Industrial. *Asia Pacific Journal of Management*, 19(4), 467–488.
- Morris, M., Kaplinsky, R., & Kaplan, D. (2012a). “One thing leads to another” - Commodities, linkages and industrial development. *Resources Policy*, 37, 408–416.
- Morris, M., Kaplinsky, R., & Kaplan, D. (2012b). One Thing Leads To Another: Promoting Industrialisation by Making the Most of the Commodity Boom in Sub-Saharan Africa. Open access.
- Rockström, J., Steffen, W., & Noone, K. (2009). Planetary boundaries: exploring the safe operating space for humanity. *Ecology and Society*.
- Smith, K. (2007). Innovation and growth in resource-based economies. *CEDA Growth*, (58), 50–57.
- Tittonell, P., Klerkx, L., Baudron, F., Félix, G. F., Ruggia, A., Apeldoorn, D. van, ... Rossing, W. A. H. (2016). Ecological Intensifi cation: Local Innovation to Address Global Challenges. *Sustainable Agriculture Reviews*, 19, 1–34.
- Ville, S., & Wicken, O. (2012). The dynamics of resource-based economic development: Evidence from Australia and Norway. *Industrial and Corporate Change*, 22(5).

2E. REGIONAL INNOVATION SYSTEMS AND INNOVATION POLICY

Innovation Policies for a Creative Economy: Challenging the dominance of STI and “Research”

Bruce Tether and **Mickael Benaim***
(Manchester Institute of Innovation Research)
*bruce.tether@manchester.ac.uk

KEYWORDS: Creative Economy, Innovation Policies, Theoretical framework

Relevance

The present contribution addresses two main issues: the relationship between innovation theory and innovation policies and the particular relationships between innovation policy and research policy. The idea that new knowledge, especially as developed through science and R&D, is the driving force for growth is widely accepted and supported through various “innovation policies”. The paradox here is that “innovation” has become a broad concept in both academic and policy circles, but “innovation policies” tend to be much more narrowly conceived, focusing on “science”, “scientific research”, and R&D, and justified, implicitly or explicitly, by “market failure” arguments (Edquist, 2014). In this sense the 25 years or so of “innovation systems” thinking has largely failed to substantially change innovation policy. Taking as an example of the recent OECD’s “review of innovation policies” for France (OECD, 2014) the reader would encounter the word “research” no fewer than 1,534 times (i.e. over five times per page on average); “R&D” 353 times, “science” or “scientific” 300 times; more frequently than “entrepreneur” (252 times) or “creative”, which appears just 7 times. And while page 30 asserts that “Design and marketing form an integral part of innovation activities” there is very little discussion on these topics, despite a substantial literature underlying their importance for innovation and growth (e.g. Design Council, 2011; EDLB, 2012).

Research aim

We argue that the mainstream of innovation policy-making is excessively narrow, and that the scope and understanding of innovation (policies) should be broadened, at least partially in order to prepare a country for an uncertain future which itself is both a product of innovation, and in which the nature of innovation is changing (e.g. WEF, 2016). Central to this is the ability to identify activities that may become widespread in the future.

Definitions and theoretical framework

So why does the “creative economy” or “creative industries” matter for innovation (policy)? Recent contributions have pointed a growing number of policy initiatives targeting creative industries (Bakhshi et al. 2015), but only a few have directly targeted their innovations (Benaim et al. 2014). Yet the creative industries are evidently highly innovative (Miles and Green, 2010; Jones et al. 2015), even if they engage in little if any “research” (at least as defined by the Frascati Manual – OECD, 2015). Part of this innovativeness comes from the ability to draw on the imagination, to be agile, and to generate new forms of expression, which inter-relate with technologies, both established and new. Extant innovation policies are well suited to supporting “high-tech”, “science-based” and other “research-based” activities, but less suited to “research-less” activities: creative activities could be “lead users” for such policies. Second, and perhaps more importantly, because the organisation of creative activities is primarily through projects (as opposed to being organised to produce ‘products’ or provide ‘services’), which involve networks of firms and individuals (Hesmondhagh and Baker, 2010), including freelancers, and are mediated by advanced communication technologies. This form of organisation, in which the firm as an entity becomes less important, may be prototypical of an emerging form of (industrial) organisation that will become much more widespread in the future.

Methodology

In relation to this we argue that a key but neglected role of innovation policy is to place bets and to prepare for possible futures. We know from history that each “industrial revolution” has been accompanied by an organisational revolution. The prize for getting it right – i.e., identifying and preparing for technologies and forms of organisations that will become widespread - is huge. Thus we propose a conceptual framework that captures the economic activities under three dimensions: their innovation forms (from progressive to expressive); their economic orientation (from market oriented to non-profit oriented) and a time dimension (past oriented to future oriented).

Expected outcomes

This framework offers a renewed vision on innovation policies by coupling a dynamic dialogue amongst activities, their forms of innovation and organisational changes. To this respect, our contribution will challenge some current areas of innovation policies whilst proposing new areas for actions. The linear model and the restrictive definitions of innovation remain in the mind of many policy makers. To challenge more effectively this bias, we propose a framework that is as accessible, and thus, more likely to impact innovation policies.

Reference

- Bakhshi, H., Cunningham, S. and J. Mateos-Garcia (2015) Public Policy for the Creative Industries. in C. Jones, M. Lorenzen and J. Sapsed (eds) *The Oxford Handbook of Creative Industries*. Oxford University Press.
- Benaïm, M., Miles, I. and B. Tether (2014) A Review of Policies for the Cultural and Creative Industries, in the context of Innovation and Smart Growth. A Cre8tv Project Deliverable, DEL: 6.1.1(R). Online
- Design Council (2011) Design for Innovation. Fact, figures and practical plans for growth. December 2011. Online.
- Edquist, C. (2014) Striving towards a holistic innovation policy in European countries. But linearity still prevails! *STI Policy Review*, 5 (2), 1-19. Online
- European Design Leadership Board (2012) Design for Growth & Prosperity. Report and recommendations of the EDLB. Online.
- Hesmondhalgh, D. and S. Baker (2010) 'A very complicated version of freedom': Conditions and experiences of creative labour in three cultural industries. *Poetics*, 38, 4-20. Online
- Jones, C., Lorenzen, M. and J. Sapsed (2015) Creative industries: a typology of change. in *The Oxford Handbook of Creative Industries*. Oxford University Press.
- Miles, I. and L. Green (2010) Innovation and Creative Services in F. Gallouj, F. Djellal and C. Gallouj (eds) *The Handbook of Innovation and Services*. Cheltenham, Edward Elgar.
- OECD (2015) Frascati Manual 2015. Guidelines for Collecting and Reporting Data on Research and Experimental Development. OECD, Paris. Online
- OECD (2014) Review of Innovation Policy: France 2014. OECD, Paris. Online
- World Economic Forum (2016) Mastering the Fourth Industrial Revolution. World Economic Forum Annual Meeting 2016. Online

Formal and informal institutions as drivers of regional economic diversification

Nicola Cortinovis(Utrecht), Jing Xiao(CIRCLE), **Ron Boschma***(Utrecht) and Frank van Oort(Utrecht)
*ron.boschma@circle.lu.se

Keywords: -

Towards a Dynamic Perspective on Leadership in Regional Innovation Systems

Johan Miörner
(CIRCLE)
johan.miorner@circle.lu.se

KEYWORDS: Leadership, Innovation policy, Policy networks, Regional innovation systems

1. Relevance and aim

There is a widespread agreement in the literature on regional innovation policy that interactive modes of state intervention and associational governance (Cooke and Morgan, 1998; Nauwelaers and Wintjes, 2003) are more effective than traditional top-down strategies. Successful policies are seen as the result of collaborative efforts between a variety of actors in Regional Innovation Systems (RIS). Regional governments play a key role in creating favourable conditions for collaboration between different stakeholders in a RIS by mediating in regional policy networks (Tödtling and Trippel, 2005). These insights have led to the idea of including regional stakeholders in policy processes through multi-actor governance is a feature of influential innovation policy approaches such as the Smart Specialisation concept (Foray, 2015) and Constructing Regional Advantage (Asheim et al., 2011a).

In this paper, multi-actor governance in RIS is analyzed by studying leadership in and through policy networks. Studies of policy networks have described leadership to be shared among a number of RIS actors, but with certain individuals playing particularly critical roles. They have however largely been concerned with leadership in the emergence policy networks, disregarding that the role of leadership might change over time. Furthermore, the literature provides few insights into how policy networks can possess leadership capabilities in a RIS, i.e., how policy networks can contribute to the coordination of the system.

2. Contribution

This paper seeks to make a contribution to close the gaps outlined above by analyzing both conceptually and empirically the role of leadership in and through policy networks. First, we suggest a conceptual framework that provides a more dynamic view of leadership in policy networks by exploring the role of leadership in different phases of the development of a policy network. Second, we analyse conceptually how regional leadership in terms of setting strategic goals, and coordinating and mobilizing actors and resources, is exercised through policy networks in a RIS.

3. Policy networks and leadership

The literature on regional leadership has been concerned with examining leadership through the studies of networks, in particular policy networks (Klijn et al., 1995; Kickert et al., 1997) and collaborative governance bodies (Ansell and Gash, 2008). These are suitable for analysing the relationships, in terms of power, trust, influence, coordination and collaboration, between public, semi-public and private actors. Here, some actors are considered as leading other actors, by mediating or building trust in policy networks, or by facilitative leadership in collaborative governance bodies. This approach to study regional governance is drawing on the latest conceptual developments within various strands of literature dealing with place-based leadership (Beer and Clower, 2014; Sotarauta, 2014; Pearce and Conger, 2002; Sotarauta, 2005; Carson et al., 2007). For example, Sotarauta (2005) argues that with increasing complexity, regional development becomes more dependent on key actors to lead and manage regional networks. The ability of leaders to make brave and fast decisions has shown to be crucial in opening up new opportunities and develop new paths, and this ability is possessed and exercised by key actors in regional development efforts.

In this paper, regional leadership is defined as the capacity to coordinate actors, activities and resources within and across the subsystems of a RIS. In other words, there is a systemic aspect to leadership in RISs. Sotarauta (2005) argues that with increasing complexity, regional development becomes more dependent on key actors to lead and manage regional networks. The ability of leaders to make brave and fast decisions has shown to be crucial in opening up new opportunities and develop new paths, and this ability is possessed and exercised by key actors in regional development efforts. Hence, key actors who facilitate and coordinate the use of resources across institutional and organizational boundaries are crucial in order to get them to work together, mobilize resources and create visions for the potential achievements of collaborative governance. It could however also be

that constellations of actors play a leading role in processes of coordination and mobilization of resources, representing a form of leadership in the RIS through these constellations. Thus, individual agency is balanced against the structural dimension of a network.

This implies that leadership in a RIS is an interdependent process where the capabilities of individuals and coalitions are exercised in order to achieve collective or separate goals (Sotarauta, 2010) by mobilizing and coordinating resources toward specific tasks.

4. Conceptual framework

The conceptual framework suggests a model for analyzing task-oriented policy networks consisting of four phases with different characteristics: identification of tasks, establishment of networks, production of outcomes and re-organization of networks.

For each phase, the role of leadership is outlined guided by insights from previous studies. We distinguish between three types of actors: policy generalists, persons of substance and persons of process understanding (Sotarauta, 2010). Particular attention is paid to the third phase, production of outcomes, as it is during this phase the policy network can become institutionalized as an actor in the RIS. Thus, the conceptual framework captures both the role of leadership in the different phases of policy networks and how these networks can be used to mobilize and coordinate resources, leading to concrete outcomes, in the RIS.

5. Empirical case

The empirical part of the paper focuses on two policy networks in the region of Scania (Sweden). We analyse leadership in and through the Soundingboard for Innovation in Skåne (SIS) and Skåne Research and Innovation Council (FIRS). Both have been established in the years 2009 and 2010, with the explicit ambition of building leadership capacity in the RIS and coordinate stakeholders' efforts in innovation activities. The role of leadership, in terms of individual agency and the role played by key actors, in different phases of development will be analysed. Furthermore, the outcomes of the policy networks will be analysed as a way of studying the leadership exercised in the RIS through the network.

7. Findings

The identification of tasks was resource intensive and demanded much in terms of the engagement of key actors. Region Skåne mobilized regional resources and conducted a series of analyses evaluating different aspects of the RIS. In these, persons of substance were involved through the provision of data and other inputs, but responsibility remained the property of policy generalists at Region Skåne throughout the whole process. The importance of leadership decreased during the identification process, as strategic awareness and collective belief formation increased and stakeholders started to get a sense of urgency for the matter.

Furthermore it is indicated that in FIRS, where the initiative came from a non-policy actor, leadership plays a much more pronounced role. This is especially true in the establishment of the policy network as it became a primary concern for network leaders to build both internal and external legitimacy. If the network is not established by a strong policy organization, one of the primary concerns of network leaders in building legitimacy is to anchor the network in the prevailing political setting. In the case of both networks, this process was aided by a high degree of strategic awareness among key stakeholders, having an impact also on policy makers.

The analysis also shows that the identification of evidence-based tasks have been crucial to setting the direction for the development of policy networks. Clear tasks with region-wide support from various stakeholders have appeared to be closely linked to the subsequent outcomes of the policy networks. The types of outcomes have however varied between the two networks.

Our analysis of outcomes indicates that leadership has been exercised through SIS and FIRS Scania's RIS. The regional innovation strategy developed by FIRS sets a broad direction for regional actors in terms of innovation activities. FIRS took the role of leading this 'direction setting process' in a way that gave legitimacy to the final output. The same holds true for the creation of a quick response action group through which FIRS has a mandate to coordinate regional resources and actors to cope with negative regional events. SIS sought to improve the coordination of innovation support organizations. This has occurred, however, only to some degree as SIS functioned more as a forum for discussion than as a coordinating actor in the region.

8. Conclusion

This paper investigates the role of leadership in policy networks and provides insights to how leadership can be exercised through these networks in a RIS. The results show that the role of leadership in policy networks is varying during the course of development. In some phases the role of leadership is more pronounced than in others. This is also true for the type of actors having leadership functions. The role of policy generalists, persons of substance and persons of process understanding is varying both with regard to the characteristics of each phase of development but also with regard to the specific tasks being addressed by the networks. Regional leadership in terms of coordinating and mobilizing actors and resources across subsystems in the RIS has been exercised through the policy networks, both by introducing new ways of approaching innovation issues in the region and by developing concrete strategies.

9. References

- Ansell C and Gash A. (2008) Collaborative governance in theory and practice. *Journal of public administration research and theory* 18: 543-571.
- Asheim BT, Moodysson J and Tödtling F. (2011a) Constructing regional advantage: Towards state-of-the-art regional innovation system policies in Europe? *European Planning Studies* 19: 1133-1139.
- Beer A and Clower T. (2014) Mobilizing leadership in cities and regions. *Regional Studies, Regional Science* 1: 5-20.
- Carson JB, Tesluk PE and Marrone JA. (2007) Shared leadership in teams: An investigation of antecedent conditions and performance. *Academy of Management Journal* 50: 1217-1234.
- Cooke P and Morgan K. (1998) *The associational economy: firms, regions, and innovation*. Oxford: Oxford University Press.
- Foray D. (2015) *Smart Specialisation - Opportunities and challenges for regional innovation policy*. Oxon: Routledge.
- Kickert WJ, Klijn E-H and Koppenjan JFM. (1997) *Managing complex networks: strategies for the public sector*. London: Sage.
- Klijn E-H, Koppenjan J and Termeer K. (1995) Managing networks in the public sector: a theoretical study of management strategies in policy networks. *Public administration* 73: 437-454.
- Klijn E-H, Steijn B and Edelenbos J. (2010) The impact of network management on outcomes in governance networks. *Public administration* 88: 1063-1082.
- Nauwelaers C and Wintjes R. (2003) Towards a new paradigm for innovation policy? in Asheim B, Isaksen A, Nauwelaers C, et al. (eds) *Regional Innovation Policy for Small-Medium Enterprises*. Cheltenham: Edward Elgar.
- Pearce CL and Conger JA. (2002) *Shared leadership: Reframing the hows and whys of leadership*. Longon: Sage.
- Sotarauta M. (2005) Shared leadership and dynamic capabilities in regional development. In: Sagan and Halkier (eds.) *Regionalism Contested: Institution, Society and Governance*. Urban and Regional Planning and Development Series. Cornwall: Ashgate.
- Sotarauta M. (2010b) Regional development and regional networks: The role of regional development officers in Finland. *European Urban and Regional Studies* 17: 387-400.
- Sotarauta M. (2014) Reflections on 'Mobilizing leadership in cities and regions'. *Regional Studies, Regional Science* 1: 28-31.
- Tödtling F and Trippel M. (2005) One size fits all? Towards a differentiated regional innovation policy approach. *Research policy* 34: 1203-1219.

Cross-Industry Innovation Capability for Path Renewal

Elisabet S. Hauge(University of Agder), Nina Kyllingstad(University of Agder), **Natalia Maehle***(Centre for Innovation / Bergen University College) and Ann Camilla Schulze-Krogh(University of Agder)

*natalia.mehle@hib.no

KEYWORDS: Cross-industry innovation capability, Innovation performance, Path renewal, Regional policy

1. Relevance

The 2008 global financial and economic crisis slowed down the European economy and the following recession has negatively influenced the development of many European regions. There is an urgent need to understand how to revive the regions experiencing an economic downturn. With few exceptions (Garud, Kumaraswamy, & Karnøe, 2010; Sydow, Schreyögg, & Koch, 2009), the existing literature is mainly concerned with aggregated development paths, and there is a lack of understanding of the role of firms in the process of regional renewal and path development. To cover this gap, the current study explores the value of firms' cross-industry innovation capability for regional path renewal and suggests the regional innovation policies aimed at developing this capability. By discussing the innovation policy implications, this study is highly relevant for the topic of the 2016 Annual Conference of the EU-SPRI Forum, Exploring New Avenues for Innovation and Research Policies.

2. Research aims and questions

The current study intends to explore the role of firms in the process of regional path development by focusing on cross-industry innovation capability (CIIC), i.e. the firm's ability to continuously transform knowledge and ideas into new products, processes, markets and systems across different industries. Our overall goal is to understand how CIIC influences innovation performance on the firm level and path renewal on the regional level. To do so, we attempt to answer the following questions; whether regional settings contribute to different degree of CIIC within firms and how regional innovation policies can be used to help firms in developing CIIC.

3. Definitions

The most central concepts used in the current study are cross-industry innovation capability (CIIC) and path renewal. CIIC is the firm's ability to continuously transform knowledge and ideas into new products, processes and systems across different industries. The idea is that firms with strong CIIC achieve more effective innovation performance. Based on the innovation capability framework (Lawson & Samson, 2001), we develop the CIIC concept consisting of eight elements which represent practices and processes within the firm stimulating and reinforcing cross-industry innovation. The following elements are suggested: institutionalizing cross-industry innovation as a part of firm's strategy; effective resource management combining different types of competences; learning from different industries and modes of innovation; encouraging divergent «across borders» thinking; organic organisational structure; open and tolerant culture; management of related technologies; cross-industry experience.

Path renewal describes a long-term process where regional business branches into related industries (Isaksen & Trippel, 2014).

4. Theoretical frameworks

We present an analytical model demonstrating how firms' cross-industry innovations lead to path renewal on the regional level. We use the concept of innovation capability from Lawson and Samson (2001) as our starting point and adjust it to the case of cross-industry innovation. We argue that when a considerable number of firms within a region have strong CIIC, it will lead to effective innovation performance on the firm level and as a result will contribute to path renewal on the regional level. However, regional context and settings defined by policy adoptions and innovation systems also influence path development. Therefore, the current study discusses the development of innovation policies and different types of regional innovation systems. We employ the typology of different RIS characterized as 1) organizationally thick & diversified RIS, 2) organizationally thick & specialized RIS, and 3) organizationally thin RIS (Isaksen & Tripple, 2014). Based on this typology, we explain regional differences and suggest adequate policy approaches for the various types of RIS.

5. Empirical materials

We use empirical data from three Norwegian regions; Agder, Rogaland and Hordaland. During the past ten years, the firms in these regions have increased their investments into the oil and gas industry, becoming gradually more oil-dependent. The recent severe decrease in oil prices had a negative impact on their industrial development and economy and led to downsizing of many firms and rising unemployment numbers (Statistics Norway, 2016). Therefore, we consider these regions as highly relevant for studying the mechanisms (or lack of mechanisms) for path renewal. Fifteen firms (five from each region) were selected for the analysis. The selection criteria were firm's size (small or medium) and connection to the oil and gas industry.

6. Description of the methodologies

We chose to use semi-structured interviews to explore our research question, because they enable us to acquire a deep, meaningful understanding of CIIC construct (McCracken, 1988). The interview guide was developed based on the theory of innovation capability (Lawson & Samson, 2001), RIS and path development. For example, interview questions covered different characteristics of each CIIC element (as discussed in subchapter 3). After the interviews were transcribed, the researchers went through the transcripts to find an evidence of the CIIC elements in the interviewed firms. During this stage, all authors were involved in cross checks and discussions to increase validity and reliability of the data analysis. Any discrepancies were discussed until the authors agreed upon the number of CIIC elements identified for each firm. Insights provided by such discussions are highly valued in content analysis and qualitative research (Welch, Piekkari, Plakoyiannaki, & Paavilainen-Mäntymäki, 2011). The author team followed these steps systematically for each firm. Finally, the authors performed a 'frequency count'. If a firm possessed one to three CIIC elements, it was identified as weak on the CIIC classification. Four to five CIIC elements resulted in a moderate CIIC classification, and finally a firm with six to eight CIIC elements was identified as strong in CIIC.

7. Expected outcomes

The current study demonstrates that the degree of firms' CIIC varies across regions depending on RIS characteristics. Most of the firms in the Hordaland region (four out of five) demonstrate strong CIIC, while the firms in the Agder and Rogaland regions show moderate and weak CIIC. Despite the fact that all three regions in our study are organizationally thick, the Hordaland region is diversified, while Rogaland and Agder are more specialized. Being in a context of a specialized RIS, where policy instrument historically has stimulated path extension (Asheim & Grillitsch, 2015), makes it difficult for firms to break out of the extension path mode. Therefore, the regional characteristics make firms in Hordaland better equipped to develop CIIC and tackle the economic decline. To address the issue of cross-industry innovation and path renewal, there is a need for new policy development. Traditionally, many of the policy instruments available to firms focus on R&D collaborations, networks and mobility within one specific sector. To encourage cross-industry innovation, it is necessary to employ more generic policy instruments not targeting specific sectors. Policymakers can use the CIIC elements identified in the current study to develop tailor-made policy tools aimed at strengthening CIIC in regional firms. In addition, schemes like Centres for research-based innovation combining the knowledge bases found in firms and research groups can be valuable, as they increase firms' absorptive capacity by making their knowledge base more diverse. A combination of different knowledge bases can lead to new entrepreneurial opportunities and innovation across different industries.

To summarize, this study contributes to the ongoing debate on path development in several ways. First, we develop an analytical model that deepens our understanding of path development from the firm perspective. In this way, we cover the gap in the literature implying a rather passive notion of the firm in regional renewal (Boschma & Martin, 2007; Christiansen & Jakobsen, 2012; Cooke, 2012). Second, we develop a new theoretical concept of cross-industry innovation capability and suggest the procedure, which can be employed to identify the presence of different CIIC elements in firms. This procedure will be useful for both researchers and policymakers when evaluating the degree of CIIC in different regions, and therefore, represents an important contribution to the literature. Third, we explore the role of cross industry innovation in the process of path renewal and argue that increasing CIIC on the firm level will lead to new path development on the regional level. This idea is rather innovative and opens up for more studies examining how innovation processes on a firm level contribute to regional development. As specialized regions are especially vulnerable to economic disruptions (Martin, 2012), the notion of path renewal and cross-industry innovation becomes highly relevant in the time of economic recession. Finally, we highlight the need to focus on the firm level while developing adaptive regional innovation policies and provide recommendation on regional policies promoting cross-industry innovation.

References

- Asheim, B., & Grillitsch, M. (2015). Smart specialisation: Sources for new path development in a peripheral manufacturing region. Retrieved from https://ideas.repec.org/p/hhs/lucire/2015_011.html.
- Boschma, R., & Martin, R. (2007). Constructing an evolutionary economic geography. *Journal of Economic Geography*, 7(5), 537-548.
- Christiansen, E. A. N., & Jakobsen, S.-E. (2012). Embedded and Disembedded Practice in the Firm-Place Nexus: A Study of Two World-Leading Manufacturers of Ski Equipment in the Lillehammer Ski Cluster. *Geografiska Annaler: Series B, Human Geography*, 94(2), 177-194.
- Cooke, P. (2012). Relatedness, Transversality and Public Policy in Innovative Regions. *European Planning Studies*, 20(11), 1889-1907.
- Garud, R., Kumaraswamy, A., & Karnøe, P. (2010). Path Dependence or Path Creation? *Journal of Management Studies*, 47(4), 760-774.
- Isaksen, A., & Trippel, M. (2014). Regional industrial path development in different regional innovation systems: A conceptual analysis. Retrieved from http://wp.circle.lu.se/upload/CIRCLE/workingpapers/201417_Isaksen_Trippel.pdf.
- Lawson, B., & Samson, D. (2001). Developing Innovation Capability in Organisations: A Dynamic Capabilities Approach. *International Journal of Innovation Management*, 5(3), 377-400.
- Martin, R. (2012). *Knowledge bases and the geography of innovation*. Sweden: Media-Tryck, Lund University.
- McCracken G. (1988). *The Long Interview*. Newbury Park, CA: Sage.
- Statistics Norway. (2016). Greatest rise in unemployment among those with higher education. Retrieved from <https://www.ssb.no/en/arbeid-og-lonn/statistikker/regledig/aar/2016-01-19#content>.
- Sydow, J., Schreyögg, G., & Koch, J. (2009). Organizational Path Dependence: Opening the Black Box. *Academy of Management Review*, 34(4), 689-709.
- Welch, C., Piekkari, R., Plakoyiannaki, E., & Paavilainen-Mäntymäki, E. (2011). Theorising from case studies: Towards a pluralist future for international business research. *Journal of International Business Studies*, 42(5), 740-762.

2F. TRACK THEME 3: CAN WE STILL LEARN FROM EVALUATIONS? EXPLORING NEW AVENUES IN THE EVALUATION OF STI POLICIES (II)

Evaluating large R&D&I support programmes using a systemic innovation perspective. The case of the EU Framework Programmes

Frans van der Zee*(TNO) and Hanna Kuittinen(Tecnalia)
frans.vanderzee@tno.nl

KEYWORDS: Evaluation, Impact assessment, EU Framework Programmes, R&D&I policies, STI policies, Innovation

Research aim and questions:

The system for evaluating the EU Framework Programmes for Research and Innovation (FPs) has been progressively updated since the mid-1980s. The earlier system, largely based on peer review style panel-based exercises has over the years been replaced with a combination of expert groups, a large number of specific individual evaluations and statistical information, including data gathered by the annual monitoring FP implementation indicator system. The most recent major FP evaluation exercise was the ex post evaluation of the 7th Framework Programme (FP7) by an independent high level expert group (Fresco et al., 2016). FP evaluations thus far have taken the approach of investigating whether the Programmes have fulfilled their aims and ambitions, have looked into at a variety of facets regarding its implementation, and have come up with various recommendations for the development and improvement of the Framework Programme in successive years.

The key question addressed in the proposed paper is whether the current FP evaluation framework - which is the result of a gradual evolution and 'upgrading' over the years - is still valid, adequate and sufficiently tailored in view of the current FP goals and ambitions. Especially when it comes to policy outcomes and their overall impact, the gradual shift from scientific excellence towards innovation and industry involvement in FPs not only requires different indicators and ways of measuring project and programme performance, but would logically also require changes in the overall setup of the evaluation framework itself. The paper explores whether the current FP evaluation methodology is still adequate and up to its aspired needs and, where not, how it can be improved. It does so by taking an evolutionary systemic perspective. It specifically analyzes how recent and today's major innovations have emerged and evolved/taken shape over the course of time, and more specifically how policies, in particular R&D&I policies, have contributed to the creation and uptake of recent major innovations. Based on a number of in-depth major innovation case studies, conclusions and recommendations are drawn for evaluating current and future Framework Programmes. While based on a wider set of analysed cases, the conference paper will specifically draw on and provide examples from three major innovation domains, notably LED (Light-emitting diode)-lighting, car navigation systems, and the latest generation super passenger jets (Airbus A380).

Relevance for the conference theme/track theme:

R&D&I policy evaluations in general, and especially those of large, multiannual R&D&I programmes, have to deal not only with the complexity of the programmes, their design and size (number of projects, budget), in combination with multiple programme goals, but also with increasing demands for public accountability (both resource allocation and spending) and increasing use of 'harder' evidence sustained by ongoing big data and open data developments (e.g. Quinlan et al., 2008; Technopolis Group & Mioir, 2012, Owen et al., 2013). What is especially a challenge is the shift in policy emphasis in R&D&I support programmes from science and fundamental research towards applied research up to the 'launching' stage of innovations (from pilot production, demonstration up to initial market introduction). The closer one gets to an innovation, the more influential contextual and other factors become (such as company involvement, market factors, framework conditions, etc.). Putting innovation at the forefront of the Framework Programme has therefore important consequences for its overall evaluation framework, adding another important layer to the already existing broader goals such as economic growth, employment and scientific excellence. Based on the historical innovation development trajectories of a number of major innovations, the elements for an evolutionary evaluation framework are traced and scrutinised for different types and categories of innovations.

Definitions: In bold an overview is given of the main concepts and definitions used in the paper. Major innovations are defined as innovations with a major - i.e. significant - impact, from an economic, societal or environmental point of view, or a combination thereof. What differentiates a major innovation from an innovation is the size and intensity of its economic, societal and/or environmental impact. To be labelled 'major', an innovation needs to have a sizeable and pervasive impact in at least one of the dimensions economic, societal and environmental. Major Innovations usually do not occur in isolation, but emerge and co-evolve with others what may be termed a family of innovations. Rather than one-off stand-alone innovations, what we observe in the real world are (sub)sets of interrelated innovations, some of which may be major. Co-evolvment refers to potential of major innovation to create change in industry, not only in terms of new processes (equipment, production methodology) but also in creating entire new industries. Systemic nature of major innovation shows here as co-evolvment, i.e. change in one industry may trigger multiple consecutive changes in other industries. Co-creation can be defined as a "strength of the stakeholder ecosystem (industry players, R&D labs, academic institutes, government, regulatory bodies involved in accelerating innovation) and degree of involvement of users in innovation." A systemic evaluation perspective to innovation refers to an integral framework in which public R&D&I support is one of the ingredients which potentially lead to an innovation. Whether an innovation actually 'materialises' depends on an intricate interplay between private and public drivers, barriers in which path dependency, critical mass and focus but also serendipity may play a role (evolutionary systemic perspective).

Theoretical framework:

The paper combines two strands of literature, one relating to the evaluation of R&D&I policies, in particular large R&D&I programmes (see also above), and the other relating to innovation theory itself. While concentrating on major innovations, the case studies follow the logic of non-linear models of innovation, embracing the concept of an innovation as a context-dependent, cumulative learning process characterized by continuous interactions and dynamic feedback loops. The contextual framework in which major innovations arise consists of a mix of drivers, resources and capabilities, including (potential) market demand, societal challenges, regulations and various policies. Their origin dates back to the work of Schumpeter (1942) that formed the start of a large body of literature exploring the role of different factors driving the propensity of innovation, including:

- The understanding of innovation as demand-driven chain-linked process characterized by feedback loops (e.g. Freeman, 1994; Kleinknecht, 1996; Marsili and Salter, 2006; Kline and Rosenberg, 1984; Cohen and Levinthal, 1990).
- Considering the innovation as a path dependent activity based on cumulative learning that follows a specific technological trajectory that emerge and coevolve with other technological trajectories (e.g. Dosi, 1982, 1997; Nelson and Winter, 1982).
- The technological trajectories emerge through interactions involving several actors that collectively shape the technological opportunities available in the ecosystem (e.g. Nelson and Winter, 1982; Levinthal and March, 1993; Dosi, Llerna and Labini, 2005).

Empirical materials: The paper is based on the research and the findings of a large EC study entitled "The contribution of the Framework Programmes to Major Innovations", commissioned by the European Commission DG Research and Innovation, unit A.5 Evaluation, finalized in 2015. The authors were part of the study team. The study was based on a longlist in total 30 case studies of major innovations, of which 10 were analysed in-depth. Exploratory desk research of CORDIS and eCorda data and relevant publications, various web searches, interviews, an online survey and expert panels were used at different stages of the project to arrive at a selection of major innovations for further examination.

Description of methodologies applied: See also theoretical framework. The paper is based on the findings of qualitative case studies and an evolutionary systemic perspective that underlies both the conception of the proposed overall FP evaluation framework (putting innovation at the centre stage) and the case studies. Apart from proposing a new evaluation framework, the paper also discusses main data issues in view of new developments (open data, big data, data analytics). The paper starts with a short overview of the current literature on large R&D&I programme evaluations.

Expected outcomes (scientific and policy advances): The paper proposes a systemic evolutionary framework for evaluating large complex R&D&I programmes, taking the EU Framework Programmes for Research and Innovation as an example. The results add to enhanced R&D&I policy evaluation in which the concept of family

of innovations, co-evolution and path-dependency, and the intricate interplay of public and private R&D&I actors, drivers/ incentives are prime. This wider perspective can be used for ex post, mid-term but also for ex ante policy evaluation purposes, with the benefit of better identifying and linking short-term targeted programme and project objectives (and results) with broader longer term goals and ambitions (and outcomes and impacts), by putting innovation at the heart of the evaluation framework.

What Bangs for your Bucks? Assessing the design and impact of transformative policy

Matthijs Janssen
Harvard Kennedy School / Dialogic
matthijs_janssen@hks.harvard.edu

KEYWORDS: Innovation policy, Policy mix, Impact assessment, Technological innovation system, Structural change

Relevance and research aim

After an era of generic support for economic development and innovation, narrowly targeted transformation policy is back on the table (OECD, 2014). Recent advances in the fields of new industrial policy (Rodrik, 2004; Hausmann & Rodrik, 2006) and transition thinking (Weber & Rohrer, 2012) converge on the idea that achieving structural change requires governments to take an active role in overcoming inertia. Rather than just leveraging R&D investments and setting framework conditions, policy makers are urged to participate in the development of socio-economic systems around particular technologies (Bergek et al., 2008). Associated policy support typically involves a diverse portfolio of system-specific interventions (Flanagan et al., 2011). The rise of transformative policy, in this paper characterized by being selective, process-oriented and multi-instrumental, poses severe challenges to rising standards of public accountability (Warwick & Nolan, 2014). Evaluation methods for calculating the ‘Bang for the Buck’ of R&D-leveraging measures are ill-suited when policy mixes are supposed to enact collectively driven economic transformation (Edler, 2008). While econometric techniques do get more sophisticated, they are unable to account for the indirect but significant influence of evolving socio-technical systems, directionality of change, and the combinatory effect of narrowly-targeted interventions. Thus, in order to make sense of transformative policy’s overall role in economic transformation, a novel assessment approach is urgently needed. Developing such an approach is the objective of this paper.

Theoretical frameworks

To come up with an assessment scheme for transformative policy, we draw upon different literatures concerned with governing structural transformation. A first aspect worth to be reviewed is the policy design itself. Especially the various studies on new industrial policy (NIP) provide a basis to lean on (Rodrik, 2004; Hausmann & Rodrik, 2006; Rodrik, 2014). We synthesize this line of work by describing the design principles that are fundamental for adequate policy organization as well as policy orientation. The four design principles for policy organization are related to information retrieval (embeddedness), discipline for policy adaptation, accountability, and leadership competence. The four design principles for policy orientation (the strategic focus) pertain to the imperative ‘inputs instead of transfers’, an open architecture, a focus on genuine novelty, and ensuring the flow of spillovers.

When appropriate governance structures are in place, the key question is whether actual change is coming about. The innovation and in particular TIS literature helps to explain the evolution of socio-technical systems in which new economic activities are embedded (Hekkert et al., 2007). The key insight proposed in this paper is that policy contributions to the building of technological innovation systems are in fact the ‘bangs’ auditors should be looking for. Surprisingly, as it is primarily focused on governance and performance of technological innovation systems, the TIS literature itself has rarely raised the issue of impact assessment.

The starting point of our impact assessment is a simple model for determining how policy matters for the strengthening of systemic functions (Hekkert et al., 2007). This model is essentially an adaptation of the one used for reform analytics (Hausmann et al., 2005). Instead of determining which lacking input is holding back growth, we apply it to express which system function would benefit most from policy intervention. Apart from taking into account interdependencies between the functions, we also introduce stringency with respect to the actual need for policy involvement.

Our model forms the basis for a framework that structures investigation of the extent to which a multi-instrumental policy approach is effective, decisive and targeted at the system functions most relevant for advancing the TIS (directly, or through interactions with other functions). As the impact framework allows us to connect the review of the policy design with measures of structural change, it is the heart of the assessment scheme we propose. To facilitate its use, we provide a set of guiding questions.

Empirical methods and findings

For the sake of illustration, we test the scheme in its entirety in a tentative assessment of the Dutch ‘Topsector approach’. A first motivation for taking specifically this case is that it is a research and innovation policy approach designed with many of the principles of new industrial policy in mind (OECD, 2014). Second, because the Topsector approach has been introduced in 2010/2011, it has been running a sufficient number of years to perform a meaningful assessment. Five years is a common period for governments to order an assessment, whereas it is clearly too early for significant economic change to take place. The Topsector approach is thus exactly at a point where analyses of systemic adaptations can be informative for both formative as well as summative purposes.

The main source for our case analysis is the latest Dutch country reports prepared for the Research and Innovation Observatory of the European Commission’s Institute for Prospective Technology Studies (Janssen & Den Hertog, 2015). This report builds on a highly extensive set of policy statutes, policy visions, strategy documents, evaluations and consultations to describe (policy) developments in the research and innovation system. This information is highly suitable for describing the Dutch Topsector approach and assessing its policy design. To be as thorough as possible, we restrict the impact assessment to one out of nine Topsectors only. Our choice for the Topsector Energy is based on availability of secondary sources. Apart from the type of documents available for any Topsector, the Topsector Energy has recently been examined in a study relying on extensive interviews with 19 stakeholders (Van Son, 2015).

Empirical findings

The Topsector approach was found to adhere to most of the design principles for transformative policy organization. The Topteams, consisting of science and industry representatives, seem to be an adequate structure for making sure that research in the ‘Topconsortia for Knowledge and Innovation’ (TKIs) is fitted to issues hampering technological progress. It also gives policy makers access to information on other constraints that might hamper further development. In contrast, some elements of the policy orientation are questionable. This concerns the openness of its architecture (due to apparent focus on sectors), support for radically new activities (the demand-driven nature of research implies incrementalism), and the extent to which spillovers are ensured (does knowledge transcend beyond TKI boundaries?).

By filling out the entire impact framework we are able to construct an overview of how supportive the policy interventions have jointly been for the Energy Topsector. Inertia was mainly overcome by concentrating joint research efforts on directions firms appear willing to invest in. The provided policy inputs yielded impulses of varying magnitudes, but not all of them seem to be addressing necessitous functions where policy intervention is indeed the only way to set further TIS development in motion. Policy impulses to financial and human capital availability where for instance largely in vain, as these were not a bottleneck in the period we assessed. The function of ‘entrepreneurial experimentation’ was more important, but this could mostly be taken care of by the market itself. These findings underline that it is paramount to check if a policy mix is decisively contributing to functions where impulses are truly needed.

A cross-framework analysis suggests that the design configuration can be linked to observations on the actual policy impulses that were provided in the Energy Topsector. Finally, we discuss how the frameworks for assessing policy design and impact feed into analyses concerned with structural change.

Outcomes

In the fields of economic development and innovation, currently unfolding policy changes and accountability demands do not go hand in hand. As policy makers try to strengthen their grasp on the complexity of socio-economic and technological change, they reduce possibilities for actually demonstrating effect. Traditional techniques for determining impact tend to reduce the concept of effectiveness to a single number. Such additionality calculations, like the infamous ‘bang for the buck’, falsely suggest that results of innovation policy are a unidimensional and linear phenomenon. In the case of transformative policy, there clearly are significant dynamics to take into account other than just the government failure of crowding out private investments. Nevertheless, it does remain fair to ask for the ultimate impact that policy intervention achieved.

A major contribution of this study is the development of an impact framework; the centerpiece of our assessment scheme (both literally and figuratively). Fundamental to the suggested way of measuring impact is the belief that, essentially, transformative policy is about adapting socio-economic systems in such a way that it opens opportunities for collective exploration of a set of technologies and/or business models. The impact framework provides a structure for gathering and analyzing information needed to assess how much policy inputs jointly contributed to changes in a certain domain. For some it will be uncomfortable that quantitative

estimations are only limitedly applicable. However, even via qualitative methods the proposed approach is likely to generate a comprehensive account of the actual (and perhaps ideal) role played by policy. Such an account yields insights useful for future policy efforts. After all, continuous assessment is key for a process-oriented policy approach (Hausmann & Rodrik, 2006; Edler et al., 2008).

References

- Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: a scheme of analysis. *Research Policy*, 37, 407–429.
- Edler, J., Ebersberger, B., & Lo, V. (2008). Improving policy understanding by means of secondary analyses of policy evaluation. *Research Evaluation*, 17 (3), 175–186.
- Flanagan, K., Uyarra, E., & Laranja, M. (2011). Reconceptualising the policy mix for innovation. *Research Policy*, 40, 702–713.
- Hausmann, R., & Rodrik, D. (2006). Doomed to choose: industrial policy as predicament, Blue Sky Seminar, Center for International Development, John F. Kennedy School of Government, Harvard University.
- Hausmann, R., Rodrik, D. & Velasco, A. (2005). Growth Diagnostics. Center for International Development, John F. Kennedy School of Government, Harvard University.
- Hekkert, M., Suurs, R.A.A., Negro, S., Kuhlmann, S., & Smits, R. (2007). Functions of innovation systems: A new approach for analysing technological change. *Technological Forecasting & Social Change*, 74, 413–432.
- Janssen, M. & Den Hertog, P. (2015). Research & Innovation policy Country Report for The Netherlands 2014. Seville: European Commission JRC IPTS (RIO).
- OECD (2014). New Industrial Policies. OECD Science, Technology and Industry Outlook 2014. DOI:10.1787/sti_outlook-2014-21-en
- Rodrik, D. (2004). Industrial policy for the twenty-first century. CID Working Paper. Center for International Development, Harvard University, Cambridge, MA.
- Rodrik, D. (2014). Green industrial policy. *Oxford Review of Economic Policy*, 30 (3), 469–491.
- Van Son, L.J.M. (2015). Evaluation of the top sector policy energy from an evolutionary perspective. Eindhoven: Eindhoven University of Technology / The Hague: Advisory Council for Science, Technology and Innovation.
- Warwick, K., & Nolan, A. (2014). Evaluation of industrial policy: methodological issues and policy lessons. OECD Science, Technology and Industry Policy Papers, 16. doi:<http://dx.doi.org/10.1787/5jz181jh0j5k-en>
- Weber, K.M., & Rohracher, H. (2012). Legitimizing research, technology and innovation policies for transformative change: combining insights from innovation systems and multi-level perspective in a comprehensive failures framework. *Research Policy*, 41, 1037–1047.

Impact assessment and grand challenges

Magnus Gulbrandsen*(University of Oslo, Centre for Technology, Innovation and Culture), Jakob Edler(University of Manchester, MIOIR) and Jordi Molas-Gallart(Polytechnic University of Valencia, INGENIO)

*magnus.gulbrandsen@tik.uio.no

KEYWORDS: Science policy, Impact, Evaluation, Grand challenges, Innovation policy, Conceptual discussion

Relevance for the conference

The 2016 EU-SPRI conference aims to provide knowledge foundations for research and innovation policy, and there is a special track on learning from evaluation which this paper intends to contribute to. A long-standing debate in science policy has been how to prioritise between fields of science and between research institutions (Weinberg 1962a and b). In a time of increasing research budgets such as the first two-three decades after WW2, this prioritisation was relatively easy, leading to a fairly stable and path-dependent balance between long-term research steered by researchers' own agendas and research steered by various societal needs. Evaluations in this context largely served to monitor the system and identify fields and organisations where extraordinary policy efforts could improve quality or reward high performance.

But since the first post-war crisis in the 1970s and not least in the current one, the emphasis on hard priorities has become stronger. The dominating current rationale is that of "grand challenges" denoting fundamental international and shared problems where research and innovation are seen as major activities in large-scale concerted societal efforts (Kuhmann & Rip 2015). Research evaluations have become a clearer instrument in distribution of resources between fields and organisation, and they have increasingly included measures of the effect and impact of research in society rather than intra-scientific characteristics only. Impact is high on the agenda and has become a central legitimisation for research (and innovation) support.

Research aim and questions

This paper aims to instigate a comprehensive and conceptual discussion of the relationship between impact (assessment) and grand challenges. We want to put forward a number of propositions for debate in the EU-SPRI community, and we want to shape a future-oriented research agenda about impact. Our context is a joint project with long-term (8 year) funding with ambitions to conduct new and ambitious empirical research on research impact. Even though there is plentiful knowledge about diffusion, use and impact of research and its results, there is still a widespread and well-founded belief that analysts have not cracked the problem of research impact assessment in a way that it is useful for policy makers. We argue that the main reason for this is fragmented research on the nature and modes of impact (different communities/perspectives, ad-hoc evaluations) and that fragmentation has restricted knowledge accumulation. Through discussions in the EU-SPRI community, drawing on examples and experiences from many different countries, we will strive to find new ways of reducing the fragmentation in the field of impact studies and new ways of tying impact to the framework of grand challenges.

Definitions

Research impact and research impact assessment is a broad area of research which over the last fifty years has generated substantial knowledge about different kinds of impact and the different ways investments in research influence economic, political, social, cultural and environmental developments (Godin & Dore 2004, Donovan 2011). Since investment in public and private research can have, in theory, many different impacts in very different sectors of society, the conceptual and methodological approaches to research impact assessment are correspondingly heterogeneous.

Theoretical frameworks

Roughly speaking, four different communities have been engaged in impact studies. The first, oriented at economics of R&D, has looked mainly at economic effects and has attempted to study the returns on public and private investment in research and development (R&D). The impact that private sector R&D has on the economic performance of firms and the economy at large has been a persistent theme both in public debate and in research on the economics of R&D and innovation (Mansfield 1990, Salter & Martin 2001). Empirical research indicates that social returns from R&D investments tend to be substantially higher than the potentials

for the firm (Griliches 1995, Jones & Williams 1998). This is related to the partly non-appropriable and public nature of technological knowledge that leads to spillover effects on later research and by increasing productivity of other economic activities (Griliches, 1995; Geroski, 1995; Jones and Williams, 1998; Hall et al. 2010).

We define social impact studies and research evaluation as the second relevant community. Its starting point is the understanding that research impact is heterogeneous and denotes more than “economic benefits” and involves many different stakeholders (Bornmann 2013). In addition to impact heterogeneity, other central challenges are related to latency, causality and attribution (Buxton 2011; Martin 2007). A range of new approaches to research impact assessment have been designed and implemented to deal with such challenges. The “Payback Framework” looks at different types of impact over time (Buxton & Hanney 1996, Donovan & Hanney 2011), the SIAMPI effort focuses on “productive interactions” between researchers and external stakeholders (Spaapen & van Drooge 2011; Molas-Gallart & Tang 2011), and the ASIRPA approach combines qualitative and quantitative data to gain insights into how different forms of impacts often appear together for different beneficiaries (Joly et al. 2015; Gaunand et al. 2015).

A third relevant community has studied knowledge exchange and science-based innovation. Here, a central perspective is the diversity of channels that academics and stakeholders use to maintain interactions and communicate with each other (Perkmann et al. 2013; Abreu & Grinevich 2013; Thune et al. 2015; Olmos-Peñuela et al., 2014). Empirical investigations indicate that the volume of knowledge exchange activities is relatively similar across different fields of science (Hughes & Kitson 2012). However, the channels or tools used for knowledge exchange differ markedly by fields of science, as do the types of stakeholders who are perceived as the most important partners (Abreu & Grinevich 2013; Thune et al. 2015; Olmos-Peñuela et al., 2014; Ramos-Vielba et al., 2015; Upton et al. 2014).

Finally, there is a diverse community that has conceptualised how specific products and technologies emerge over a long time period (e.g. Dosi 1982; Blume 1992; Bijker 1995). Technical change is seen as a socio-technical transformative process that involves not only changes in technology and the related scientific knowledge base, but also transformation in the social context in which the technology is embedded. It has for example been shown how scientific breakthroughs in medicine influence and are influenced by learning in medical practice and by new technologies and products, conceptualised as three “co-evolving pathways” (Morlacchi & Nelson 2011).

Methodological approach and outcomes

With these four communities in mind, we aim to set up a number of tensions and questions for debate concerning impact assessment and grand challenges. A non-exhaustive preliminary list is the following:

- There seems to be a major gap between qualitative and quantitative approaches to impact assessment; is it possible to find some new approaches to combining the two? The ASIRPA approach seems promising but is mainly tested on the impact of one specific research organisation, and scaling the methodology up may pose problems. Large-scale databases and big data approaches may provide a link.
- What is the relationship between impact and grand challenges; for example, can high impact with respect to some of the grand challenges (particular health issues, environmental issues and so on) be traced to research that was funded specifically to deal with these challenges, or to other types and areas of research? How can non-intended impacts of grand challenges-legitimised research be understood and dealt with?
- Responsible research and innovation (RRI) is an approach that seems to be favoured in policy communities discussing grand challenges; the approach entails discussing effects and impacts between many different stakeholders in an early stage of the research and innovation process. Can impact studies learn from the RRI approach and vice versa?

These are examples of issues we want to highlight and discuss in the final paper and at the EU-SPRI conference – and these are issues that have both a fundamental interest for the researchers who study science and innovation and for the policymakers who work in this area.

Towards an indicator framework and monitoring system for the evaluation of next-generation structural-oriented RTI programmes

Michael Dinges*(AIT Austrian Institute of Technology), Jakob Edler(University of Manchester) and Matthias Weber(AIT Austrian Institute of Technology)

*michael.dinges@ait.ac.at

KEYWORDS: RTI policy evaluation, Systemic RTI Policies, STI Indicators, Monitoring systems

Research, Technology and Innovation (RTI) policy measures based upon systems of innovation approaches inherently focus on triggering changes in the behaviour of decision makers, by creating new and sustained linkages and by shaping institutions of innovation systems (i.e. related to the industrial policy, the research and education policy, tax policy, etc.), in order to frame decision-making and ultimately facilitate sustainable change in knowledge production, innovation and diffusion. More general, these structural-oriented RTI instruments can be characterized as complex “Multi-Actor Multi-Measure Programs” (MAP) (Bührer et al. 2003) in the area of RTI policy, which are geared to different actors of the innovation system by making use of a variety of measures.

In this paper, we concentrate in particular on measures supporting structural co-operation, initially aiming to exert an influence on knowledge creation and innovation in industry. These kinds of measures were inspired by the ambition to go beyond the provision of funds via single, rather narrowly defined RTI projects and by the interest in systems of innovation (Metcalf 1995) oriented approaches. The main objectives of these new support measures were to facilitate a closer and strategically oriented interaction between the various actors of the innovation system, by creating new institute-like or networked structures for knowledge creation and diffusion and by incorporating multiple support measures. The support schemes paid tribute to the increasing relevance of cooperative knowledge creation and put a main focus on enabling a structural change for better functioning of local, regional, national or sectoral innovation systems – hence often called “structural” programmes).

Against this background, it is the aim of this paper to develop a novel evaluation and monitoring approach for structural programmes that takes into account the emerging changes in RTI policy and its governance. We develop and illustrate our approach using the example of the Austrian competence centres programmes as “good practice” of what structural programmes and evaluations are currently state of the art.

The starting assumption of this paper is that structural programmes pose a growing challenge of governance complexity for policy makers, programme managers and manager of centres and networks. While these programmes have been around for many years, the ambition associated with them has grown in recent years. This has to do with new requirements for RTI policy more generally, which exert influence upon structural programmes in specific ways. Among these emerging developments we can find among others a) the emergence of new and more open practices of research and innovation, which enhances the need to seek collaboration with an even broader range of knowledge-creating and knowledge-using actors, b) the rise of global value networks at industry level, requiring intensified internationalisation efforts in RTI and standardisation, and c) an increasing demand for legitimation of policies through demonstration of impact.

Moreover, we can currently see a new generation of RTI policy emerging, which stresses not only the economic but also the societal and political dimension of innovation (Edler and Nowotny 2015). This trend raises new requirements in terms of the adaptability of the structures created with the help of structural RTI programmes. In this light, the ultimate purpose of structural programmes needs to be reconsidered, for instance when a growing emphasis is put on societal challenges rather than just economic competitiveness as the overarching goal to which structural programmes should contribute. As these challenges are today often addressed in large-scale European, if not global initiatives, the necessity of structural programmes to reach out to international partners cannot be stressed enough.

The variety of goals and multiple activities involving different institutional actors, multi-levels and multi-agents decisions, as well as coupling with other policy instruments tremendously increases the complexity of MAP evaluations. In addition to general evaluation challenges of RTI support measures related to 1) the attribution of an intervention to observed effects, 2) the determination of counterfactual position, 3) time lags between research

and tangible outcomes, and 4) setting the right scope/focus of the assessment (cf. ESF 2012, Technopolis Group and MIOIR 2012), MAPs have distinct characteristics, which make evaluations thereof an even more daunting task:

- Related to the systemic nature of MAPs, there is a significant heterogeneous range of actors involved; impacts may vary for these actors. As a consequence, a coherent picture of causal linkages in view of such multitude of objectives is difficult to achieve.

- For impact evaluations of MAPs it is difficult to set the right focus of an evaluation, as at least impact dimensions related to network structures and co-operation, actors/beneficiaries comprising business enterprises and research organisations, the human factor/capacities, and system effects can be considered.

- Furthermore, the evaluation of MAPs may consider at least three different analytical levels: The level of the whole programme (that itself is embedded into a policy context whose assumptions need to be looked at as well), the level of “centres” or “networks” (if existing; and see above: we talk about a centre as one distinct intervention, i.e. a project) and the level of single research projects (Vinnova 2004).

Hence, the challenges for governing and evaluating this type of complex programs are closely related to their systemic nature and at least implicitly, they incorporate a complex theory/model of change, through which its activities seek to achieve desired outcomes and impacts. Many of MAPs incorporate a multitude of operational objectives, perform different types of instruments and activities with different degrees of emphasis, and rely to varying degrees upon decisions taken at multiple levels and from multiple agents.

Conceptually, we base our work on the idea of positioning indicators, i.e. indicators that allow to position those centres and networks and actors within them and “to identify linkages and fluxes between them” (Lepori 2007, see also (Godin, 2005; Barré, 2006), for understanding the development of a centre or network across the range of strategic behavioural, structural and performance dimensions.

In doing so, we suggest that the complexity of structural programmes and their governance can be tackled efficiently by defining, at the outset, a limited set of relevant positioning indicators which are the core of the monitoring system of centres and networks. These positioning indicators relate to the strategic orientation, the heterogeneity of actors, the degree of internationalisation, the governance structure and mechanisms, and a characterisation of centres in terms of size and novelty of cooperations.

This positioning indicator framework allows to reduce complexity by constructing a limited number of types of centre, network and project, whereby the dimensions of the typology can be defined according to specific research and evaluative questions. In addition, we suggest to develop a “meta-monitoring”, i.e. a set of indicators to monitor the environment of centres and networks, including policy and regulatory changes, to understand the change in their relative position in the system.

All too often, structural programmes and the centres and networks they fund are assessed using uniform logic models and lead indicators focussing on publications and innovations, R&D expenditures, and qualification. However, each programme, and each centre and structure is different in its combination of objectives, partners, ambitions, level of uncertainty of research performed, size, geographical stretch, function in the system, contribution to challenges and so on. Therefore, our approach allows moving away from this simplistic application of uniform logic models towards narratives to explain how inputs are used to create outputs and generate outcomes and impacts in line with the objectives of the programme.

Indicators for monitoring structural and behavioural changes as well as performance along the lines of the narratives at different levels can inform the different audiences on the narratives of importance to them at the level of analysis they are particularly interested in. Through the development of typologies, we can moderate between the idiosyncracies of each funded centre and network on the one hand and the overall, broader objectives of the programme on the other hand.

In sum, our framework applies the idea of positioning indicators, integrates monitoring into evaluation and management activities, allows the construction of types and reduces complexity in a contingent and flexible

manner. Such a framework can be used for analytical and research purposes as well as for governance purpose at centre and network level and at programme level. It is more important than ever, as the demands for MAP seem to be broadening, including not only the generation of new knowledge and innovation, but contributions to societal challenges.

References

- Barré, R. 2006. Towards a European STI Indicators Platform (ESTIP), position paper to the Second PRIME Network of Excellence Annual Conference.
- Bührer, S., Kuhlmann, S. Heinze, T. (2003), Politische Steuerung von Innovationssystemen?: Potenziale der Evaluation von Multi-Akteur-/Multi-Maßnahmenprogrammen, in In: S. Bührer/S. Kuhlmann (Hrsg.), Politische Steuerung von Innovationssystemen, Stuttgart, 3-23.
- Edler, J. / Nowotny, H. 2015 :The pervasiveness of innovation and why we need to re-think innovation policy to rescue it; in Council for Research and Technological Development (Ed.), Designing the Future. The economic, societal and political dimension of innovation. Vienna: Echomedia Buchverlag, pp. 431 - 453
- ESF - European Science Foundation (2012), A Guide to Evaluation Activities in Funding Agencies, framework and key issues for research, Energy Policy, Vol 28, No. 9, pp. 625-640.
- Godin, B 2005. Measurement and Statistics on Science and Technology: 1920 to the Present. London: Routledge.
- Jacobsson, S., and Johnson A., (2000), The diffusion of renewable energy technology: an analytical
- Lepori, B (2007): Financial fluxes. Methodologies for the analysis of research funding and expenditure: from input to positioning indicators, in: Research Evaluation 15 (2), pp133-143
- Metcalf, S. (1995). The economic foundations of technology policy: equilibrium and evolutionary perspectives. Handbook of the economics of innovation and technological change, 446.
- Smits, R., & Kuhlmann, S. (2004). The rise of systemic instruments in innovation policy. International Journal of Foresight and Innovation Policy, 1(1-2), 4-32.
- Technopolis Group and MIOIR (2012): Evaluation of Innovation Activities. Guidance on methods and practices. Study funded by the European Commission, Directorate for Regional Policy.
- Vinnova (2004), Multi Actors and Multi Measures Programmes, A STRATA project, A comparative guide to Multi Measures Programmes (MAPs) RTDI policy, 2004.

Parallel session 3

3A. INTERNATIONALIZATION AND INNOVATION

The application of the “universal” excellence in “peripheral” countries

Ismael Rafols and **Jordi Molas-Gallart***

(Ingenio (CSIC-UPV))

* jormoga@ingenio.upv.es

KEYWORDS: Excellence, Evaluation, Scientometrics, Periphery

This paper explores the application of “excellence” policies in “peripheral” contexts, that is, in geographical, cognitive or social spaces that are somehow marginal to or marginalised from the centres of scientific activity. The discourse on excellence rests on the implicit assumption that there is an objective property of research, quality or excellence, which can be universally captured. However, the universal “gold standards” for excellence are taken from research carried out in prestigious centres of academic activity, generally in most developed countries and regions. As a results, excellence tends to reflect practices relevant in dominant contexts --i.e. in the hegemonic countries, languages, gender, disciplines, etc.--, but that are often not present or adequate in peripheral contexts. It follows that scholarly activities in these peripheral contexts are perceived as less excellence, as well as “local”, and further marginalised.

We recognise that there are various dimensions of periphery or marginalisation. First, the geographical: e.g. global south vs. global north, regions vs. metropolises, at multiple levels. Second, the social group dimension: women, the disenfranchised, the poor, or perhaps the elderly have social needs that are different from those of richer or more powerful groups --and the problems affecting the former tend be less researched than those of the later. Third, the cognitive dimension: areas of research, such as epidemiology or surgery, that capture less attention in terms of publications or citations (and resources) than the more prestigious disciplines, such as molecular biology. However, e notice that various dimensions of marginalisation often overlap, with a multiplicative effect: e.g. in Salvador de Bahia (periphery in Brazil) study on primary health care (as opposed to medicine) in poor neighbourhoods (as opposed to rich)), written in Portuguese (as opposed to English).

In this article we focus on assessment practices in countries that are peripheral in global science (Spain, Brazil, Colombia, Czech Republic), reviewing analytical studies published in recent years (e.g. Molas-Gallart 2012; Chavarro et al., 2014; Good et al, 2015; Mugnaini, 2015). This review leads us to the observation, and apparent contradiction, that these universalistic notions of excellence, most often operationalised in terms of rigid quantitative indicators, have been most successfully implemented in these “peripheral” countries rather than in “central” countries such as the UK or the Netherlands.

We propose the following interpretation, based on Theodore Porter’s model on why quantification is used in policy (Porter, 1996): in a recent past in peripheral S&T regions, scientific elites were relatively small and could exercise discretion in the distribution of (scarce) resources. However, pressures in the last decades, for accountability and international competitiveness by government have facilitated the adoption of excellence rhetoric (quantification) under specific political conditions:

- Lack of trust in the local scientific elites (often nepotistic) by administrators
- Political weakness of local scientific elites in compared to those in central countries,
- Belonging of (part) the local scientific elite to elite international networks Thus see is as legitimate to use “excellence” (and indicators), since they ultimately aspire to be part of global science (as in center-periphery dependence theory)
- Belonging of administrators to global network (who also aspire to be part of global science) (as in center-periphery dependence theory)

In summary, we propose that the widespread use of universalistic notions of “excellence” in “peripheral” countries or regions is precisely the result of the weakness of “peripheral” science systems. Neither the administrators, nor the scientific elites have sufficient legitimacy to develop criteria different from universal “excellence” that respond to local needs (social or scientific). However, we also posit that this pattern has significant exceptions, such as Fiocruz Foundation in Brazil, that may deserve careful study as models for other

countries.

References

- Chavarro, D., Tang, P., & Rafols, I. (2014). Interdisciplinarity and research on local issues: evidence from a developing country. *Research Evaluation*, 23(3), 195-209.
- Good, B., Vermeulen, N., Tiefenthaler, B., & Arnold, E. (2015). Counting quality? The Czech performance-based research funding system. *Research Evaluation*, rvu035.
- Molas-Gallart, Jordi. "Research Governance and the Role of Evaluation A Comparative Study." *American Journal of Evaluation* 33.4 (2012): 583-598.
- Mugnaini, Rogério (2015) Journal evaluation cycle in Brazil: virtuous path or patchwork? XVI Encontro Nacional de Pesquisa em Ciência da Informação (XVI ENANCIB).
- Porter, T. M. (1996). *Trust in numbers: The pursuit of objectivity in science and public life*. Princeton University Press.

Bounded Collaboration and Changing Core-Periphery Relationship in Sino-Russian Scientific Co-Production

Abdullah Gök*(Manchester Institute of Innovation Research, Alliance Manchester Business School, University of Manchester), Maria Karaulova(Manchester Institute of Innovation Research, Alliance Manchester Business School, University of Manchester and Istituto di Management, Scuola Superiore Sant'Anna) and Philip Shapira(Manchester Institute of Innovation Research, Alliance Manchester Business School, University of Manchester and Georgia Institute of Technology)

*abdullah.gok@manchester.ac.uk

KEYWORDS: Scientific collaboration, Periphery, Global systems, China, Russia

Scientific collaboration between nations has always been considered one of the main science indicators. However, most of the attention is on the collaboration with or between centres of influence in science – countries that amass research outputs, publish main outlets for these outputs and set the general rules for academic conduct, including the language of publication. The dynamics of the collaboration between other countries and regional centres of influence has often been overlooked. In this paper, we investigate the bounded scientific co-production between countries in transition from periphery to core and vice versa. We also look into the influence of the relationship between core and transitional countries on the bounded collaboration between transitional countries, by employing a global systems perspective.

Empirically, we study the case of scientific collaboration between China and Russia in nanotechnology between 1990 and 2012 by employing a mixed-method design. We selected nanotechnology as a case for comparative analysis as i) the course of nanotechnology development closely overlaps with the change in Chinese and Russian research systems, ii) nanotechnology is an interdisciplinary and iii) nanotechnology has been a policy priority for both China and Russia (Tang et al., 2010; Karaulova et al., 2016). The bibliometric data examines scientific collaboration patterns between China and Russia as approximated to co-authored publications (Katz and Martin, 1997). On the qualitative side of our methodology, we completed a series of over 140 semi-structured interviews in Russia and China during 2014 and 2015. On the quantitative side, we conducted a bibliometric analysis of scientific publications by Russia and China addressed authors in nanotechnology by adopting the Porter et al. (2008) nanotechnology query approach. After cleaning and removal of duplicates, the dataset comprised 176,472 publications for China and 33,538 publications for Russia.

Over the past 100 years, the patterns of scientific co-production shifted significantly between the two countries. While China rose the most dynamically developing country in the world, the role of Russia declined from the core player to a peripheral actor in the regional and global research system. Previous research indicates that the rise of China's competence in nanotechnology has led to it becoming one of the global hubs of nanotechnology research and commercialisation (Shapira and Wang, 2010). Our research builds on these findings, reflecting China's gradual transition to become the leading country in terms of number of nanotechnology publications, ranking the first and producing about a quarter of the global output, while Russia has gradually declined from being one of the top actors to the 13th rank with around 3% share of the global output.

Although there are considerable geographic, economic, cultural and historical proximities between China and Russia, their scientific co-production is significantly bounded. For Russia, China is the 19th largest international partner with a share of around 2% of all internationally collaborated publications. For China, Russia is also ranked as the 19th representing less than 1% of all international collaborations. For both countries leading international partners are the USA and major European countries. Our empirical focus is on the causes and dynamics of this phenomenon by utilising a range of indicators.

The conceptual framework of this paper derives from the world-system theory in which the relationship between core, periphery and semi-periphery countries is explained in reference to the dynamics of a global system to which they are embedded and with a special emphasis on path-dependencies. First proposed by Wallerstein (2011 [1974]), the core-periphery theory has found some application in the studies of scientific collaboration and co-authorship.

These studies focus mainly on the relationship between ‘core’ and ‘periphery’ countries in scientific coproduction. In a seminal work, Schubert and Sooryamoorthy (2009) explore the applicability of the centre-periphery concept on scientific collaboration of Germany and South Africa, showcasing marginality in collaboration-seeking strategies of South African scientists. Similarly, Wagner and Leydesdorff (2005) identify a group of ‘core’ countries that take the most benefit from international scientific collaboration, but also reinforce disadvantaged positions of periphery countries. Choi (2011) explores effects of globalization and the emergence of new ‘Rising Stars’ in global core-periphery configurations of scientific production.

Attention has been paid to the bias of established research performance assessment indicators. Goldfinch et al. (2003) analyse citation rates of journal articles published in a periphery country and conclude that citation rates (normally associated with the quality of performance) may be associated with the overall ‘visibility’ of national research community and the degree of its embeddedness in global scientific networks.

Collaborations with the ‘core’ countries are seen in this literature as mainly beneficial for ‘periphery’ countries, as they provide resources and visibility. However, there is little evidence of scientific cooperation between non-core countries. At the same time, insights from political economy and international development demonstrate that the links the developing countries have among themselves, are not always cooperative and mutually beneficial, and may involve exploitation (Alden et al., 2008). By exploring the dynamics of bounded collaboration between China and Russia, this paper aims to highlight complex and multi-level structure of the relationship among innovation system actors in these two countries.

This paper offers contributions to three commonly posed criticisms of the world-systems theory. The first criticism alleges that the theory is centred on the core and issues faced by core countries. In this research, we demonstrate that it can also be applied successfully to analyse the dynamics of scientific coproduction of developing economies.

The second criticism suggests that the criteria of divisions of systems into ‘advanced’ and ‘non-advanced’ are problematic, and the divisions themselves are never static. In this paper, China is seen as a country in upward transition, while Russia – as a country in downward transition. We propose that the transition from periphery to centre (on part of China) only occurs when links and partnerships with other periphery countries (in this case, Russia) are not mediated by other ‘central’ countries, such as the USA. We conclude that, for China, this is not yet the case.

The third criticism states the world-system theory finds application predominantly in economics, which depreciates socio-cultural dynamics of centre-periphery inequalities. By assuming the focus of the research on co-production of scientific knowledge in the system of innovation setting, the emphasis is made on mutual learning, skills development and knowledge production and exchange between China and Russia. This approach offers significant contribution to the established body of studies of global systems, and it also suggests policy lessons to the national science, technology and innovation in the global world.

References

- Alden, C., Large, D., Soares de Oliveira, R., 2008. China returns to Africa: a rising power and a continent embrace. Columbia University Press, New York, USA.
- Choi, S., 2011. Core-periphery, new clusters, or rising stars?: international scientific collaboration among “advanced” countries in the era of globalization. *Scientometrics* 90, 25–41. doi:10.1007/s11192-011-0509-4
- Goldfinch, S., Dale, T., Jr, K.D., 2003. Science from the periphery: Collaboration, networks and “Periphery Effects” in the citation of New Zealand Crown Research Institutes articles, 1995–2000. *Scientometrics* 57, 321–337. doi:10.1023/A:1025048516769
- Katz, J.S., Martin, B.R., 1997. What is research collaboration? *Res. Policy* 26, 1–18. doi:10.1016/S0048-7333(96)00917-1.
- Karaulova, M., Göj, A., Shackleton, O., Sjaipira, P. (2016). Science System Path-Dependencies and Their Influences: Nanotechnology Research in Russia. *Scientometrics* (forthcoming).
- Schubert, T., Sooryamoorthy, R., 2009. Can the centre-periphery model explain patterns of international scientific collaboration among threshold and industrialised countries? The case of South Africa and Germany. *Scientometrics* 83, 181–203. doi:10.1007/s11192-009-0074-2
- Shapira, P., Wang, J., 2010. Follow the money. *Nature* 468, 627–628. doi:10.1038/468627a.
- Tang, L., Wang, J., and Shapira, P., 2010, “China,” in *Encyclopedia of Nanoscience and Society*, edited by D. Guston, SAGE Reference, pp. 86–90.
- Wagner, C.S., Leydesdorff, L., 2005. Network structure, self-organization, and the growth of international collaboration in science. *Res. Policy* 34, 1608–1618. doi:10.1016/j.respol.2005.08.002.
- Wallerstein, I., 2011. *The Modern World-System I: Capitalist Agriculture and the Origins of the European World-Economy in the Sixteenth Century, With a New Prologue*. University of California Press.

Internationalization support as the integrating axis of innovation policy – perspectives from European National Innovation Systems, Silicon Valley and technology startups.

Katarzyna Bitka(European Commission), Pawel Pietrasienski(Warsaw School of Economics) and **Wojciech Rokosz***(Warsaw School of Economics)
*wojciech.rokosz@gmail.com

KEYWORDS: Internationalization, Innovation policy, Startups

1. Relevance

With the growing importance and sophistication of instruments in innovation policy, the beneficiaries, academics and public servants alike call for better coordination and integration of different components of innovation policy. In the global knowledge economy, most of the very successful startup companies which scale-up globally are at the same time innovative and international. It is therefore worth considering whether the work on and success in accessing global markets could be more explicitly used as the axis integrating the various layers of innovation policy, spread across the different institutions, from idea, through R&D to commercialization in the market. This paper provides a fresh and holistic view on this issue.

2. Research aim(s) and question(s)

Innovation policy and support policies for companies with the potential to internationalize intersect in a critical point, which will be analysed in this paper. Not all beneficiaries of instruments of innovation policy want to target global markets – but some of the most promising do; similarly, not all beneficiaries of support for internationalization offer innovative solutions, but many of them do. This paper will analyse to what an extent these target groups overlap, and will verify the hypothesis, that targeting the policies towards globally scalable, innovative companies may constitute an integrating axis for policies in research, innovation and internationalization.

The research questions are the basis for the structure of the article. In the first place, the paper asks how internationalization support is embedded in national innovation systems in Europe. The purpose of this analysis is to see what are the key actors on local and national level for internationalization support, whether they are typically associated with a specific ministry or agency and whether overlaps occur between the authority of different organizations. The research dedicated to this section would also look at the strategies taken on national level to integrate the various components of innovation policy – high level councils, key political documents, etc. to see whether internationalization support figures there as important instrument.

The paper then proceeds with an analysis built upon the authors' earlier work, looking at the national administrations' links with Silicon Valley, to try and verify on the basis of this particular case the main hypothesis of the paper, namely that internationalization support can be considered an integrating axis for innovation policy. In the section, the various types of presence in Silicon Valley are analysed from the point of view of granted support and the place of the support scheme in the overall system. The paper quotes specific case studies of institutions which achieve the greatest degree of coordination across policies through integrated internationalization support.

The final section of the paper looks at the perspective of companies benefiting from internationalization support provided by programs distributed across the product lifecycle (from exchange programs for researchers, through study visits at innovation hotspots, to acceleration programs in global tech hubs like Silicon Valley). Looking at the specific programs and the experience of the firms, the section is meant to provide additional evidence to verify the hypothesis and to draw the conclusions on how the innovation systems can be better designed taking into account the development cycle and experiences of innovative firms which expand globally.

3. Definitions

The paper operates on the intersection of innovation policy and internationalization of firms, applying concepts from both fields. In view of that, the relevant instruments of innovation policy are considered to be the funding programs designed for companies offering innovative solutions, including grants, loans, guarantees, as well as broader support schemes such as incubators, accelerators and networking/mentoring programs. On the side of internationalization policy, the paper refers to instruments such as programs bridging innovative firms to innovation hubs, subsidies for export and trade fairs, etc. The paper aims to analyse and identify the right definition of the target group, looking at terms such as born global, small knowledge intensive firm, startup, scaleup, gazelle, yollie, etc.

4. Theoretical frameworks

The paper refers to the theory of national innovation systems (Lundvall (1992), Freeman, OECD) and internationalization of firms (Uppsala Model (Johanson and Vahlne, (1977)), network approach to internationalization (Johanson and Mattsson (1986)), "born-globals" phenomenon (Sharma et al., (2003)), etc.). It builds also on previous work, developed notably by Serger and Wise (2010), Edler and Meyer-Krahmer

(2008) on internationalization of R&I policies, and earlier work by Pietrasienski and Bitka (2016) on the trends in functioning of European Bridge Organizations in Silicon Valley.

5. Empirical materials

The paper bases its findings on primary and secondary data sources. For most of the work on the role of internationalization support within the national innovation systems, the authors are using the Research and Innovation Observatory reports published by the European Commission. For the work dedicated to presence of national institutions in Silicon Valley, the authors build upon their earlier work, with additional desk research to update the necessary material. Testimonies of startups benefitting from different forms of internationalization support are gathered by the authors for the needs of the present publication.

6. Description of the methodologies

The paper applies a diverse set of qualitative methodologies, analyzing relevant reports and policy documents, using conclusions from interviews and looking into the track records of beneficiaries of internationalization support. The chosen components of the study – looking at the national level, at the practices of national administrations supporting expansion of firms into Silicon Valley and at perspective of beneficiaries shall give a wholesome perspective, allowing to verify the hypothesis of importance of internationalization support as the potential integrating axis of other strands of innovation policy.

7. Expected outcomes

The paper presents the patterns and trends on the interplay between innovation policy and internationalization support on national level and in innovation hubs like Silicon Valley, allowing a comparative analysis which helps identifying policy trends and best practices. Integrative analysis based on the different material analysed in the paper gives a well-founded and potentially very useful policy guidance on the positioning of different strands of innovation policy with the internationalization support.

References

- Edler, J. and Meyer-Krahmer, F., 2005. "How International are National (and European) Science and Technology Policies?" in Llerena, P. and Matt, M. (Eds.). *Innovation Policy in a Knowledge Based Economy*. Springer, Berlin, Heidelberg, pp. 319-337.
- Freeman, C. (1995), 'The National Innovation Systems in historical perspective', in *Cambridge Journal of Economics*, vol. 19, no. 1.
- Johanson J., and L.G. Mattsson (1986). International marketing and internationalization processes – A network approach, in *Research in International Marketing*. Ed. P.W. Turnbull, and S.J. Paliwada, pp. 234-265.
- Johanson J, Vahlne J-E (1977). The internationalization process of the firm- A model of knowledge development and increasing foreign market commitments, *Journal of International Business Studies*, 8(1), pp. 23-32.
- Lundvall, B.-Å. (ed.) (1992), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, London: Pinter Publishers.
- OECD (2002), *Dynamising National Innovation Systems*, OECD, Paris.
- Pietrasienski, P., Bitka, K., (2016) Collaboration, Co-production, Coopetition and Coordination: a case study of the European Bridge Organizations in Silicon Valley. Forthcoming in *International Journal of Transitions and Innovation Systems*
- Schwaag-Serger, S, Wise, E., (2010) Internationalization of Research and Innovation – new policy developments, Joint Research Center CONCORDI conference paper
- Research and Innovation Observatory, European Commission: <https://rio.jrc.ec.europa.eu/>

Globalising innovation systems: Southeast Asian pathways

Alexander Degelsegger*(Centre for Social Innovation), Svend Otto Remoe(Research Council of Norway) and
Rudie Trienes(Royal Netherlands Academy of Arts and Sciences)

*degelsegger@zsi.at

KEYWORDS: Southeast Asia, ASEAN, Global innovation networks, Innovation framework conditions, Innovation policy, Region, Internationalisation, Technoglobalisation, Emerging economies

1. Relevance

Southeast Asia is one of the economically most dynamic regions on earth. The region's growth path has been based on its role as a production base for low, medium and, in some countries, high-technology sectors. Consequently, Southeast Asia has long been a major recipient of global foreign direct investment flows. What is new, however, is that inward business expenditure on R&D is rising, with foreign firms increasingly performing R&D in the region (cf. OECD 2013). At the same time, domestically funded research activity has substantially increased in some countries in the region.

This situation does not only go along with changes in national innovation system dynamics (e.g. those described in Lundvall/Intarakumnerd/Vang 2006). It also modifies the ways actors in Southeast Asia participate in global production and innovation networks. Intra-firm networks are shifting their activity towards research and development, and from the international exploitation to the global generation of innovations – a process that is conceptualised in the literature on global production and innovation networks (Ernst 2009; Liu/Chaminade/Asheim 2013). In terms of innovation policy, countries like Singapore, Malaysia and also Thailand have fine-tuned the focus of attracting FDI to an approach particularly incentivising inward R&D investments. Complementary to that, national policies also aim to facilitate inter-firm networks with the underlying motivation of enabling knowledge spill-overs and upgrading Southeast Asian firms' role in global value chains (particularly in pharma/biotech, electronics/IT and automotive sectors). Moreover, a sophisticated set of public support instruments is in place to support innovation capacity, start-ups and innovation activity in local companies (research commercialisation support, intermediary institutions, innovation financing, etc; cf. Degelsegger et al. 2014).

In relation to both innovation dynamics and policy options, however, there is a question that has still not been adequately addressed: the role of the supranational regional level. Southeast Asia's integration in global innovation networks (GINs) runs parallel to an ASEAN economic integration process, which co-develops with the framework conditions for innovation in the region. The ASEAN level potentially changes the landscape of and linkages between sub-national innovation hubs currently centred in Singapore and selected locations in countries like Malaysia or Thailand. In terms of generating innovations, increasingly qualified human resources, more and more mobile research careers or the gradual harmonisation of standards and intellectual property regimes affect how research and development is performed in Southeast Asia. In terms of exploiting innovations, ASEAN level integration influences the ways multinational and local companies find to access the Southeast Asian market with its 600m customers. It turns out that it is not only attractive for businesses around the globe: It is also crucial for the currently most active innovation hubs within the region, which are often confined to domestic markets too small to scale businesses for global competitiveness.

2. Research aim(s) and question(s)

What role does the supranational regional level in Southeast Asia play as a strategic arena for innovation policy options? How do regional processes affect the ways innovation hubs in Southeast Asia perform and the role they play in GINs? What opportunities and challenges does the current situation pose for international cooperation with Europe, both in terms of innovation performance and policy?

3. Definitions and theoretical frameworks

In this paper, we speak of innovation hubs or centres. These concepts denote regional clusters of innovation-oriented economic actors and related knowledge production. They can be subnational (a specific metropolitan area) or national (in the case of the city state Singapore). They can be sectoral (e.g. in pharmaceutical research

and production) or span innovation activities in various sectors. Global production and innovation networks are defined according to Yeung and Coe (2015) and Ernst (2009), respectively.

With innovation framework conditions, we refer to aspects that influence the way innovation is carried out and that are not at the core of traditional research and innovation policy (like research funding schemes). Innovation framework conditions, in this wide usage of the term, can include intellectual property rights regulations, innovation-oriented tax incentives, public procurement for innovation, standards, visa regulations affecting mobility or science diplomacy issues. Consequently, policies on innovation framework conditions are also innovation policies, in our understanding.

These policies unfold in different policy arenas: from national ones to regional (e.g. in Southeast Asia), international (e.g. bi-regional) and global ones. We understand innovation policy not in a top-down fashion as regulation, but as a set of governance arrangements involving multiple actors (cf. Mayntz 2006). When we speak of the regional level in this paper, unless otherwise stated, we refer to a supranational level (e.g. Southeast Asia or ASEAN). While Southeast Asia refers to the geographic region, ASEAN is the political grouping (much like the distinction of Europe and the EU).

4. Empirical materials

The study builds on a qualitative data from document analysis of national and regional innovation policies and related studies. Furthermore, we have collected qualitative data through a series of semi-structured expert interviews (see below). The qualitative material is complemented by quantitative data on R&D investments and outputs (patents, etc.).

5. Description of the methodologies

In order to answer the research questions introduced above, we have chosen a methodology that combines document analysis of relevant policies and secondary data sources with a set of semi-structured expert interviews. For the qualitative primary data, we have interviewed 25 experts in Malaysia, Singapore, Thailand and Vietnam. In addition, we held two expert group discussions, one in Jakarta and one in Manila, involving an additional set of 15 Indonesian and Philippine experts. With experts we refer to officials from innovation ministries and funding agencies, public sector researchers and research managers, technology transfer professionals, representatives of intermediary institutions, chambers of commerce and private sector representatives.

6. Expected outcomes

Our analysis indicates that the regional ASEAN level is of limited relevance when it comes to supranational policy action. While ASEAN has institutionalised the regional dialogue in science and technology, it does not provide any binding regulatory policy action or significant innovation incentives. Instead, ASEAN is used as an intergovernmental exchange forum and policies like the ASEAN Plan of Action for Science, Technology and Innovation (APASTI) have the character of guidance documents with little resources for implementation. ASEAN is also in competition with other regional groupings, particularly in the area of trade liberalisation. Free-trade areas like the US-driven Trans-Pacific Partnership or free trade agreements between individual ASEAN Member States and the EU address intellectual property, standards and other innovation-related issues. In spite of the intergovernmental character of ASEAN, the individual Member States are channelling strategic policy action through the grouping. Some ASEAN Member States try to strengthen national IP regimes in the region through ASEAN-wide cooperation. Others work on the harmonisation of higher education standards to facilitate mobility and a regional higher education market.

This sort of regional policy activity is directly related to national strategies for the integration into GINs: While public incentives to innovation remain a national issue, Southeast Asian countries expect a region-wide innovation system to provide opportunities for the strengthening and exploitation of domestic innovation, which presently suffers from a disconnect between considerable research capacities and lagging domestic exploitation of the knowledge produced. Singapore, in particular, expects benefits from performing a regional hub function in areas like intellectual property and innovation financing. The idea is to combine a strong R&D-base with legal and financial services, making it attractive for foreign companies to produce or at least protect in Singapore those pieces of knowledge and related IP (patents, trademarks, etc) that are relevant for their activities in Southeast Asia.

This regional hub function is one of the possible roles of Southeast Asian innovation centres in GINs. As far as issues like intellectual property are concerned, this function is potentially generic and not limited to specific sectors. Other ways of participating in GINs are bound to specific sectors: different Southeast Asian players find their way into global knowledge production and innovation networks through biodiversity or natural resources (biofuels), engineering (automotive), pharmaceutical and clinical research, ICT (hardware, software) or product and process innovations in consumer goods industries (food, etc).

Whatever the way, Southeast Asian innovation centres do not join GINs through the regional level. Their existing linkages and current policy incentives are oriented towards traditional centres of knowledge production outside Southeast Asia. Nevertheless, they aim to exploit innovations at the regional level, benefitting from the large Southeast Asian markets.

It is still unclear whether the globalisation of specific Southeast Asian innovation centres will have a regional effect, e.g. for the development of a regionally integrated knowledge market. In terms of public policies, the ASEAN level is currently not equipped to mitigate potential market failures. The present situation might reduce the regional value of GINs, e.g. through differentiation and unequal participation or through R&D outsourcing that is not innovation-oriented (tax improvements through transfer pricing). In the worst case, it will hinder the establishment of new innovation centres and of GINs originating in Southeast Asia. In any case, it poses difficulties for policy-level cooperation with Europe where strong supranational innovation policies and framework conditions are in place.

References

- Degelsegger, Alexander / Gruber, Florian / Remoe, Svend Otto and Trienes, Rudie (2014): Stimulating Innovation in Southeast Asia, Vienna/Bonn: SEA-EU-NET.
- Ernst, Dieter (2009): A New Geography of Knowledge in the Electronics Industry? Asia's Role in Global Innovation Networks, Honolulu/Singapore: East-West Center/Institute of Southeast Asian Studies.
- Liu, Ju / Chaminade, Cristina and Asheim, Bjorn (2013): The Geography and Structure of Global Innovation Networks: A Knowledge Base Perspective, in: *European Planning Studies*, 21(9), 1456-1473.
- Lundvall, Bengt-Ake / Intarakumnerd, Patarapong / Vang, Jan (eds., 2006): Asia's Innovation Systems in Transition, Cheltenham: Edward Elgar.
- Mayntz, Renate (2006): Governance Theory als fortentwickelte Steuerungstheorie?, in: Schuppert, G.F. (Hg.): *Governance-Forschung. Vergewisserung über Stand und Entwicklungslinien*, Baden Baden: Nomos, 11-20.
- OECD (2013): *Innovation in Southeast Asia*, Paris: OECD.
- Yeung, Henry Wai-Chung and Coe, Neil M. (2015): Toward a Dynamic Theory of Global Production Networks, in: *Economic Geography*, 91(1), 29-58.

3B. INNOVATION, ENTREPRENEURSHIP AND ECONOMIC GROWTH

A critical review of entrepreneurial ecosystems: towards a future research agenda

Yana Borissenko*(CIRCLE) and Ron Boschma(Utrecht, CIRCLE)
*yana.borissenko@circle.lu.se

The concept of Entrepreneurial Ecosystem (EE) has recently attracted much attention (Stam 2015). Cohen (2006) was the first to use the concept of entrepreneurial ecosystems and defined it as "... an interconnected group of actors in a local geographic community committed to sustainable development through the support and facilitation of new sustainable ventures" (p. 3). Nevertheless, the ideas behind a systemic view on entrepreneurship are much older (Dubini 1989; Van de Ven 1993). Scholars have stressed the importance of interactions between elements of an entrepreneurial system that would increase entrepreneurial performance of a region.

We argue that the EE literature not only builds on but also adds new ideas to three types of literatures: the entrepreneurship, the innovation system and the cluster literature. There is a large body of literature on entrepreneurship that dates back to Schumpeter (1934) but there are only few studies that have looked at entrepreneurship from a systemic perspective. The Innovation System literature has focused on networks of actors that are involved in the generation, diffusion and use of innovations, and how institutions influence interaction patterns (Freeman, 1987), but has not made explicit links with entrepreneurship (Landström et al., 2015). According to Acs et al. (2014), "it is perhaps a little surprising, if not even ironic, that although the NSI literature was heavily influenced by the Schumpeterian tradition, the entrepreneur remained conspicuously absent in this literature" (p. 477-478). The vast literature on clusters, starting with Porter (1990) refers to clusters as providing opportunities for entrepreneurship (Rocha and Sternberg 2005), and cluster research adopting a network approach has proven to be useful to explain the innovative performance of cluster firms (Boschma and Ter Wal 2007; Giuliani 2007). However, research on entrepreneurship in clusters has not taken an explicit systemic approach, and the EE concept could make a potential contribution here.

However, EE scholars have also raised concerns (Stam & Spiegel 2016). First, the EE literature lacks a clear analytical framework that makes explicit what is cause and what is effect in an entrepreneurial system. For now, this literature often has primarily produced long lists of factors that might matter, but it is not yet clear what causes what. Second, the EE literature has been criticized for providing a static framework that describes relations within EE without considering its evolution over time (Mason and Brown 2014; Mack and Mayer 2015). So, it has a poor understanding of how the EE get established and develop over time. Third, the Entrepreneurial Ecosystem literature has expressed strong support for the systemic dimension of entrepreneurship. The EE is a systemic concept with many connections but it is not always clear in what way the different elements are connected. While it is recognized that EE is about eco-systems, there is no universal agreement about the definition of a system, what the EE system contains, and what are the causal links in the EE, and almost no reference has been made to the network literature, both in theoretical and analytical terms. Fourth, geography has played an important part in the EE literature, as many studies have taken a case of a region and described the structure of an EE in its regional setting. However, it is still unclear in these studies how regional factors (besides network features and non-local influences) impact on entrepreneurship (Malecki 2011). Fifth, the EE concept has recently become popular in policy circles (Isenberg 2011). For the reasons outlined above, we argue that it is still too early to derive any strong policy implications from the EE concept.

The main objective of the paper is to present a future research agenda that addresses these points of critique.

References

- Acs, Z. J., Autio, E., & Szerb, L. (2014) National systems of entrepreneurship: Measurement issues and policy implications, *Research Policy*, 43(3): 476–494. doi:10.1016/j.respol.2013.08.016
- Boschma, R. A., & Ter Wal, A. L. (2007). Knowledge networks and innovative performance in an industrial district: the case of a footwear district in the South of Italy. *Industry and Innovation*, 14(2), 177-199.
- Cohen, B. (2006). Sustainable valley entrepreneurial ecosystems. *Business Strategy and the Environment*, 15(1), 1-14.
- Dubini, P. (1989). The influence of motivations and environment on business start-ups: Some hints for public policies. *Journal of Business Venturing*, 4(1), 11–26.
- Freeman, C. (1987) *Technology policy and economic policy: Lessons from Japan*. London: Pinter.
- Giuliani, E. (2007). The selective nature of knowledge networks in clusters: evidence from the wine industry. *Journal of economic geography*, 7(2), 139-168.
- Isenberg, D. (2011) *The entrepreneurship ecosystem strategy as a new paradigm for economy policy: principles for cultivating entrepreneurship*, Babson

Entrepreneurship Ecosystem Project, Babson College, Babson Park: MA

Landström, H., Åström, F., Harirchi, G. (2015) Innovation and entrepreneurship studies: one or two fields of research. *International Entrepreneurship and Management Journal*, 11 (3): 493-509.

Malecki E. J. (2011) Connecting local entrepreneurial ecosystems to global innovation networks: open innovation, double networks and knowledge integration, *International Journal of Entrepreneurship and Innovation Management*, 14, 36-59.

Mack, E., & Mayer, H. (2015). The evolutionary dynamics of entrepreneurial ecosystems. *Urban Studies*, 0042098015586547.

Mason, C. & Brown, R. (2014) Entrepreneurial ecosystems and growth oriented entrepreneurship. Background paper prepared for the workshop organised by the OECD LEED Programme and the Dutch Ministry of Economic Affairs on Entrepreneurial Ecosystems and Growth Oriented Entrepreneurship, The Hague, Netherlands.

Porter, M. E. (1990). The competitive advantage of nations. *Harvard business review*, 68(2), 73-93.

Rocha, H. O., & Sternberg, R. (2005). Entrepreneurship: The role of clusters theoretical perspectives and empirical evidence from Germany. *Small Business Economics*, 24(3), 267-292.

Stam, E. (2015). Entrepreneurial ecosystems and regional policy: a sympathetic critique. *European Planning Studies*, 23(9), 1759-1769.

Stam, E., & Spigel, B. (2016) Entrepreneurial Ecosystems, forthcoming in: Blackburn, R., De Clercq, D., Heinonen, J. & Wang, Z. (Eds) (2016) *Handbook for Entrepreneurship and Small Business*. London: SAGE.

Schumpeter, J. A. (1934) *The Theory of Economic Development* (Cambridge, MA: Harvard University Press).

Spigel, B. (2015), The Relational Organization of Entrepreneurial Ecosystems. *Entrepreneurship Theory and Practice*. doi: 10.1111/etap.12167

Van de Ven, H. (1993). The development of an infrastructure for entrepreneurship. *Journal of Business venturing*, 8(3), 211-230.

Why enhancing resources and capabilities of newly-established firms can lead to superior innovative performance? Implications for innovation and entrepreneurship policy.

Aimilia Protogerou*(Laboratory of Industrial and Energy Economics, National Technical University of Athens), Yannis Caloghirou(Laboratory of Industrial and Energy Economics, National Technical University of Athens) and Nicholas Vonortas(Center for International Science and Department of Economics and Technology Policy, The George Washington University)

*protoger@gmail.com

KEYWORDS: Young firms, Innovative performance, Human capital resources, External knowledge linkages

New firms have been identified as engines for growth, innovation and wealth creation. While a good share of young, small firms are expected to be short lived, exiting the market within a few years from their formation (OECD, 2014), surviving young firms, and especially a relative small share of them that manages to grow, account for a significant share of new job creation (Coad et al., 2014). Young, small firms that innovate successfully increase their chances of survival, and are highlighted as the main drivers for introducing new technologies and products as well as increasing long-term productivity (Aghion and Howitt, 2005), stimulating, therefore, economic development and growth. The low share of young innovative firms within European industries, both manufacturing and services, have attracted greater attention on this group of firms among scholars and policy makers alike (Audretsch et al., 2014). In terms of policy, this striking outcome has created a significant interest among policy makers on how policy can be designed to support innovation and encourage young entrepreneurial firms to grow. The ways in which public policy can induce innovation has proven much more complex than considered before. In this respect, the interaction of a broader set of policies stimulating both innovation and knowledge intensive entrepreneurship may be needed in order to support more young firms to create and capture value. All too often entrepreneurship and innovation policy overlooks the diversity of paths towards successful innovation and growth and slips into myopic strategies related to oversimplified quantitative targets and such as R&D spending and the like (Caloghirou et al., 2015). In this vein, the investment in resources and capabilities that may help a newly-established firm to identify and exploit new business opportunities is important to innovative performance and may also provide significant feedback to policy action.

Being young, entrepreneurial firms tend to lack substantial tangible and intangible resources that restrict their resilience and ability to adapt to changing environmental conditions. On the other hand, innovating firms develop their own unique collection of fundamental resources and capabilities that engender organizational performance (Autio et al., 2000; Penrose, 1959). The purpose of this study is to investigate the impact of diverse firm resources and competences such as founders' human capital, workforce human capital and acquisition of knowledge from external sources, namely, universities and technology collaborations, on the innovation performance of newly established firms and suggest relevant policy implications that may be helpful to policy makers.

One type of resource that might be particularly relevant to the innovative performance of young firm's is human capital encapsulated both in founders and the workforce. Founders' characteristics, including their educational attainment, prior experience, age, and expertise, can constitute an important strategic asset for young firms because a) they develop firm strategies and coordinate the required resources to implement them, and b), as these firms are small, the capabilities of founders themselves serve disproportionately as critical resources to the creation of competitive advantage (Arvanitis and Stucki, 2012). In addition, firms require an adequate stock of qualified manpower to absorb new technological and market knowledge, as well as create and transfer new technological information that may foster innovative activity (Romijn and Albaladeho, 2002). Although knowledge stock encapsulated in a young firm's human capital is crucial for innovative activity, young firms 'cannot rely only on internal capabilities; rather they establish formal and informal networks which allow them to obtain knowledge and expertise' (Malerba and Torisi, 1992; p. 50). Access to external information and knowledge are pivotal elements of a firm's absorptive capacity and hence for its innovative activities (Caloghirou et al., 2004).

This paper empirically explores the determinants of product innovation and R&D intensity of newly established firms by defining a model that considers the joint effect exercised by factors that are both internal and external to the firm on its innovative performance. The analysis is supported by detailed survey information on a large sample of small companies 3-10 years old from ten European countries. These companies are in high-tech and low-tech manufacturing and knowledge-intensive business services (KIBS) sectors.

The current study provides evidence that aspects of both internal and external firm factors are critical for explaining innovative activity. Regarding founders characteristics, for specific human capital the results highlight the vitality of previous R&D experience to both radical innovation and R&D intensity. This finding implies that innovative activities necessitate a certain level of innovation-specific know-how in order to manage effectively available research resources, to devise R&D strategies and to organize and coordinate relative projects. Prior industry experience appears to impact positively R&D intensity in contrast with general professional experience which exerts a significantly negative effect on innovation input. The fact that work experience in the same sector of the new firm has a positive impact on innovation highlights the key role of industry-specific capabilities of founders in providing young firms with a competitive advantage. We also find that founders' educational attainment is significantly related to both measures of innovation activity.

We also checked for the existence of synergistic effects arising from the presence of complementary skills within a founding team. Our findings highlight that increased diversity in terms of functional expertise, i.e. the simultaneous presence of technological, commercial and managerial skills, enhances the ability of firms to pursue radical innovation and at the same time boosts R&D intensity. This finding suggests that given the human and financial constraints that many young firms face in achieving the final marketing stage (Gimmon and Levie, 2010), policy makers, should try to encourage, for example, single technical entrepreneurs or technically oriented founding teams to embrace business and management training or they should create mechanisms through which adequate support could be offered to such firms. In addition, policy makers that are responsible for allocating financial aid to firms which undertake projects of high innovative potential should not only look for technical efficiency in a team but they should also ensure the existence of adequate managerial and business skills that will enhance firm performance.

Our findings partially support the hypothesis that the knowledge and skills brought into the firm by the workforce positively contribute to a young firm's innovative activity. This may be related to the fact that at this stage of the firm's life cycle, the human capital of founders is much more decisive in shaping its innovative capability. Moreover, resources devoted to training may not always translate in higher innovative performance, as its purpose would also be to improve managerial or secretarial functions. What's more, the value of employees' individual education level as a competitive advantage may be diminishing in the years to come, as the proportion of people with higher education levels constantly increases, especially across developed countries (OECD, 2015). Therefore, our findings suggest that beyond supporting education and training programmes, policy makers should also consider incorporating initiatives that encourage the development of an 'innovative human capital' by developing more 'soft' skills for innovation "intertwined with methods to incentivize and inspire managers to innovate and encourage innovation within the firm" (McGuirk et al., 2015, p. 973).

Last but not least, our findings support the hypothesis that the ability of a young firm to interact and access external knowledge sources through university networking and formal technology collaborations has an important effect on its innovative activity. Thus policies to strengthen linkages between universities and small young firms should always be encouraged, as well as policies that support interfirm technology cooperation. An interesting point from our analysis is that human capital resources, especially those of founders, and external knowledge linkages have a positive parallel role in the innovative performance of young firms. This indicates the necessity of the development of internal firm capabilities and human capital in conjunction with networking capabilities and the use of external sources of knowledge in order to create value-added innovative activities. Therefore, efforts for establishing interaction mechanisms and openness to knowledge sharing should complement internal efforts for a balanced and more efficient approach to innovation.

Entrepreneurial experimentation: A key function in Entrepreneurial Systems of Innovation

Åsa Lindholm Dahlstrand*(CIRCLE, Lund University), Martin Andersson(CIRCLE, Lund University and BTH) and Bo Carlsson(CIRCLE, Lund University and Case Western Reserve University)

*asa.lindholm_dahlstrand@circle.lu.se

KEYWORDS: Entrepreneurship, Innovation system, Experimentation, Policy

1. The originality of the proposal and its relevance for the conference theme

In this paper, we argue that both technical and entrepreneurial experimentation are critical for economic growth. And, further, that entrepreneurship should be treated as a systemic phenomenon. Both exploration and exploitation activities are necessary for the development of an Entrepreneurial System of Innovation.

This paper discusses “entrepreneurial systems of innovation” as an analytical and conceptual approach to understand the workings as well as conditions of entrepreneurial experimentation in an economy, and how this feeds innovation. In this system, it is not enough to consider entrepreneurial experimentation as an outcome, entrepreneurial experimentation is also a critical input into the system.

While linking up to the work on innovation systems, national systems of entrepreneurship and entrepreneurial eco-systems, the framework developed in this paper is different. It puts actors and actions at the centre and emphasizes one specific systems feature that we argue is key to experimentation processes, i.e. the interactions between new entrepreneurial firms and established businesses.

We identify two critical mechanisms - the spin-off and the acquisition of knowledge-based firms - for the entrepreneurial experimentation in the system. We propose that the spin-off mechanism is critical for the creation of high-quality new firms, and that the acquisition mechanism is important for the scaling up of exploitation activities in such firms.

An economic system without vibrant experimentation will stagnate. This means that innovation policy must interact with entrepreneurship policy. Policies are more likely to facilitate effective entrepreneurship if they work to reduce the costs of experimentation in general. Not only should entrepreneurship policies seek to target startups, the entrepreneurial experimentation must also be viewed as input into the development and growth of the system. This implies that an entrepreneurial innovation policy must carefully consider the broader institutional framework, and potential systematic market failures which increases the cost, or create too uncertain future returns, associated with experimentation.

2. The research aim

In this paper, we argue that both technical and entrepreneurial experimentation are critical for economic growth. And, further, that entrepreneurship should be treated as a systemic phenomenon, similar to the way the innovation systems literature treats organisations and institutions when considering functions that determine a system’s ability to explore and exploit scientific discoveries and technological innovation. Both exploration and exploitation activities are necessary for the development of an Entrepreneurial System of Innovation. In this system, it is not enough to consider entrepreneurial experimentation as an outcome, entrepreneurial experimentation is also a critical input into the evolution of the system.

Overall, theoretical and empirical investigations of the relationship between knowledge and entrepreneurship have been insufficient (Qian et al 2013). Braunerhjelm and Henrekson (2015) argue that the challenge is to provide an institutional framework that connects knowledge and entrepreneurial effort in promoting growth, and that to facilitate such a connection, the Schumpeterian entrepreneur must be given a central role in the growth process. In this paper we address this challenge by proposing an Entrepreneurial System of Innovation, where the entrepreneurial experimentation is a key function for commercial exploitation and economic growth. Our aim is to develop a framework for the integration of innovation policy with entrepreneurship policy, where entrepreneurial experimentation is not only an output (in terms of start-ups) but also input into the development and growth of the system.

3. The definitions of the most central concepts used

In the process of Creative Destruction (Schumpeter 1942), radical technological innovations create new market opportunities while simultaneously damaging, destroying, or transforming demand in many existing product markets. Such transformations evolve under considerable uncertainty in terms of technologies, applications and markets. Technological change provides the basis for the creation of new processes, new products, new markets,

and new ways of organizing; and the entrepreneur is central to this process (Schumpeter 1934, p. 66). A main reason for this is that such a process necessitates entrepreneurial exploitation. Entrepreneurs must discover opportunities in which to use the new technologies (Shane 2000). This process of opportunity identification and commercial exploitation is far from trivial and could best be described in terms of Entrepreneurial Experimentation.

4 The outline of the theoretical framework

A main source of uncertainty reduction is entrepreneurial experimentation, which implies a probing into new technologies and applications, where many will fail, some will succeed and a learning process will unfold (Kemp et al 1998). Entrepreneurship is fundamentally about experimentation, because the knowledge, business model and market focus required to be successful are often not known in advance or deduced from some set of first principles. The probabilities of entrepreneurial success are low, extremely skewed and unknowable before an investment is made, and for entrepreneurs, it can be virtually impossible to know beforehand whether a particular opportunity will be successful or not (Kerr et al 2014).

While there are many historical examples in which inventors failed to recognize the commercial value of their inventions (see e.g. Rosenberg 1994), theories of economic growth typically ignore the role of entrepreneurial experimentation in the process of technological change. These theories generally assume that the development of new technology leads to an immediate increase in economic output because entrepreneurs immediately grasp the entrepreneurial opportunities that result from technological change (Kirzner 1985). It is not necessarily the individual entrepreneurs who create new opportunities. Instead, the creation of opportunities, for example through technical experimentation, is an important and indispensable part of an entrepreneurial system. Even if the creation of entrepreneurial opportunities is not part of the entrepreneurial process (e.g. Audretsch, 1995; Shane, 2003), it is the basis for entrepreneurial experimentation and the exploitation of opportunities in the system. Central to the entrepreneurial experimentation is not whether or not opportunities exist but rather what is done about them and by whom (Acs et al 2014, Shane, 2003; Shane and Venkataraman, 2000). Similar to Shane's (2000) argumentation about the discovery of entrepreneurial opportunities it is possible that a small amount of technological change might generate a large amount of economic output because entrepreneurs experiment with a large number of opportunities in which to exploit the technology. Conversely, a large amount of technological change might generate a small amount of economic output because it generates limited entrepreneurial experimentation. Not only the discovery of opportunity but also the decision to exploit opportunity (Schumpeter 1934, p. 79), is crucial for entrepreneurial experimentation to take place.

This paper discusses "entrepreneurial systems of innovation" as an analytical and conceptual approach to understand the workings as well as conditions of entrepreneurial experimentation in an economy, and how this feeds innovation. While linking up to the work on innovation systems, national systems of entrepreneurship and entrepreneurial eco-systems, the framework developed in this paper is different. It puts experimentation at centre stage and emphasizes one specific systems feature that we argue is key to experimentation processes, i.e. the interactions between new entrepreneurial firms and established businesses. We identify two critical mechanisms - the spin-off and the acquisition of knowledge-based firms - for the entrepreneurial experimentation in the system. We propose that the spin-off mechanism is critical for the creation of high-quality new firms, and that the acquisition mechanism is important for the scaling up of exploitation activities in such firms.

5. Description of empirical materials

This is a conceptual/theoretical paper and does not include empirical analysis

6. Description of the methodologies

This is a conceptual/theoretical paper and does not include empirical analysis

7. Expected outcomes

An economic system without vibrant experimentation will stagnate. We expect to develop a framework for the integration of innovation policy with entrepreneurship policy. This paper contributes by introducing a clear view on what makes the system in the sense that we introduce spinoffs and acquisition as distinct actions that are directly linked to behaviours and incentives of well-defined actors, and which can explain feedback effects and interdependencies that make up a system.

Policies are more likely to facilitate effective entrepreneurship if they work to reduce the costs of experimentation in general. We believe that not only should entrepreneurship policies seek to target startups, the entrepreneurial experimentation must also be viewed as input into the development and growth of the system. This implies that an entrepreneurial innovation policy must carefully consider the broader institutional framework, and potential systematic market failures which increases the cost, or create too uncertain future

returns, associated with experimentation.

References

- Acs, Z. J., Autio, E., & Szerb, L. (2014). National systems of entrepreneurship: Measurement issues and policy implications. *Research Policy*, 43(3), 476-494.
- Audretsch, D. B. (1995) *Innovation and Industry Evolution*. Cambridge, MA: MIT Press.
- Braunerhjelm, P. and Henrekson, M. (2015) An Innovation Policy Framework: Bridging the Gap between Industrial Dynamics and Growth, IFN Working Paper no 1054, Research Institute of Industrial Economics, Stockholm, Sweden.
- Kemp, R., Schot, J., Hoogma, R., (1998). Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. *Technology Analysis and Strategic Management* 10, 175–195.
- Kerr, W. R., Nanda, R., and Rhodes-Kropf, M. (2014) Entrepreneurship as Experimentation, *Journal of Economic Perspectives*, Volume 28, Number 3, 25–48
- Kirzner, I. (1985) *Discovery and the Capitalist Process*. University of Chicago Press, Chicago, IL.
- Qian, H., Acs, Z. J., & Stough, R. R. (2012). Regional systems of entrepreneurship: the nexus of human capital, knowledge and new firm formation. *Journal of Economic Geography*, 12(5), 1009.
- Schumpeter, J. 1934. *Theory of Economic Development*. Harvard University Press, Cambridge, MA.
- Schumpeter, J. A. 1942. *Capitalism, socialism and democracy*. New York: Harper & Row.
- Shane, S. (2000). Prior knowledge and the discovery of entrepreneurial opportunities. *Organization science*, 11(4), 448-469.
- Shane, S. (2003) *A General Theory of Entrepreneurship. The Individual-Opportunity Nexus*, Cheltenham: Edward Elgar.
- Shane, S and Vankataraman, S (2000) The promise of entrepreneurship as a field of research. *Academy of Management Review*, 26(1): 217-226.

Innovation and firm growth: investigating the multilevel drivers and resulting implications for policy

Helena Lenihan and **Helen McGuirk***
(Kemmy Business School University of Limerick)
*helen.mcguirk@ul.ie

KEYWORDS: Innovation, Firm growth, Firm size, Innovation policy

1. Relevance

Innovation is now acknowledged to be a key contributor to economic and firm growth (Fagerberg et al. 2013). The factors driving innovation have over recent decades been a topic of active debate. Most studies on the drivers of innovation tend to concern themselves either with firm-level characteristics or the effect of the ‘outside world’, at global, national or regional levels. Such a narrow approach may result in a rather limited explanation regarding the multiple drivers of firm level innovation. We aim to fill this gap in the literature by combining three main factors at firm and national level in order to avoid the possible problems that may arise from a single or narrow approach (Naz et al. 2014). Bridging this gap contributes to innovation theory by emphasising the importance of a holistic approach to analysing the determinants of innovation. Given public policy is concerned with providing enabling conditions for innovation and growth (Lenihan 2011), our findings provide potentially important implications for firms and policy makers.

2. Aims

There is limited (Naz et al. 2015; Kato et al. 2014) multiple level analysis that examine the driving factors of firm level innovation in a detailed and holistic manner. The latter studies focus on individual countries (Germany and Japan respectively) and for specific firm types. The aim of our study is to extend existing research, by blending factors at individual, firm and national levels as drivers of innovation across Europe and to explore the policy implications emanating from our results.

In this novel research, we advance the argument for a holistic approach to analysing the drivers of innovation and contribute to innovation literature in three main ways: Firstly, we emphasise the importance of estimating multilevel determinants of firm-level innovation. We combine determinants at individual, firm and national level and estimate the effect on four types of innovation. In so doing, we overcome possible omitted variable bias. Secondly, our analysis of small, medium and large sized firms contributes to the call by Manes et al. (2015) that little is known of the factors driving innovation in small and medium firms. Thirdly, we suggest innovation policy has a potentially important role in fostering innovation in small, medium and large firms with the ultimate aim of increasing their innovation activity.

Such a holistic approach to analysing the drivers of innovation is especially important given the complex, non-linear nature of innovation, the challenges in identifying what determines this valuable activity for firms and the central position innovation holds in industrial/enterprise policy at European level (EU 2015).

3. Definitions

Emerging in the 1980s, innovation theory is founded on economic development, a resource-based view (Teece 1980; Lockett and Thompson 2001) and a knowledge-based theory (Grant 1996). The reasons why some countries are innovation leaders and others are not, or why one firm innovates and another does not, perplex many and provoke endless debate amongst academics (Montalvo 2006) and policy makers (United Nations 2009; EU 2016).

While firms are regarded as learning organisations, small firms are different in nature from large firms, given the distinctive factors that characterise them (Lai et al. 2016). Conflicting views on the impact of firm size on innovation extend as far back as Schumpeter (1934). Distinguishing between firm sizes can also highlight differences in behaviour in large and small firms’ innovation activity (Vaona and Pianta 2008).

4. Theoretical frameworks

In terms of the theory of firm growth, Penrose (1959) stresses the importance of firms’ idiosyncratic resources, including in-house knowledge, skilled personnel and efficient procedures. Foss (2005) focuses on the knowledge-based perspective of the firm and the importance of, what Antonioli et al. (2010, p.456) term, ‘new organizational practices’. Such practices include team working, autonomy of teams and delegation of

responsibilities, which contribute to a firm's absorptive capacity (Antonioli et al. 2010). Given that the literature establishes the importance of such resources and capabilities for innovation, these form the bases for our hypotheses related to firm-level drivers of innovation, and are formulated as follows:

H1a: Firms' dynamic capabilities have a positive effect on firm-level innovation.

H1b: A firm's intrapreneurial-enabling environment has a positive effect on its innovation.

Human capital can be created from the emergence of individuals' knowledge, skills, abilities and other characteristics (Ployhart and Moliterno 2011). The current research builds on and extends the study of innovative human capital, conceptualised by McGuirk et al. (2015), which refers to a multidimensional approach to measuring human capital. In order to operationalise this development, we include a number of additional measures. Our hypotheses related to human capital are as follows:

H2a: Employees' third level education has a positive effect on firm-level innovation.

H2b: Employees' training has a positive effect on firm-level innovation.

H2c: Employees' trust has a positive effect on firm-level innovation.

H2d: Teamwork among employees has a positive effect on firm-level innovation.

The workforce available to firms, the growth of the economy, diversity and the use of public supports have all been considered as possible influences on firms' innovation activities. To further develop our holistic analysis, we outline the role of national factors in driving firm-level innovation and propose the following hypotheses:

H3a: National institutional arrangements have a positive effect on firm-level innovation.

H3b: Higher levels of national workforce diversity have a positive effect on firm-level innovation.

H3c: Economic creativity has a positive effect on firm-level innovation.

H3d: Higher instances of entrepreneurship have a positive effect on firm-level innovation.

H3e: Public support for innovation has a positive effect on firm-level innovation.

5. Empirical materials

The principal dataset used to estimate our 10 hypotheses derives from the recently published European Company Survey (ECS 2015). The respondents were management representatives (the most senior individuals in charge of personnel) and the focus of the questions explored workplace practices, human resource management, employee characteristics and innovation activities. We augmented the ECS firm-level data with national-level data from EuroStat and the World Bank.

6. Description of the methodologies

The aim of the empirical analysis is to examine the effects of firms factors (H1a,b), employees' human capital (H2a-d) and national factors (H3a-e) on four types of innovation (product/service, process, marketing and organisational) in the firm. Our regression function is as follows:

$$I_i = \alpha + \beta_1 \text{Firm factors} + \beta_2 \text{employee's human capital} + \beta_3 \text{National factors} + \beta_4 \text{controls} + \varepsilon_i$$

We estimated logit regressions for each of the four types of innovation (four models) across each firm size (small, medium and large), yielding a total of twelve separate regressions.

7. Expected outcomes (scientific and policy advances)

Our findings are potentially interesting to both firms' management/owners and policy makers, as they provide valuable insights into the utility of a holistic approach to identifying drivers of firm-level innovation.

Only recently have studies examined multilevel drivers of innovation and our analysis extends this innovation literature in the following ways:

- It estimates multilevel determinants (at individual, firm and national level) on four types of innovation. This provides a comprehensive and much under-researched analysis of a holistic approach to drivers of innovation.
- We analyse for small, medium and large-sized firms. Our results, based on a newly merged dataset with information from a sample of firms across 21 European countries, provide a 'big picture' view of a holistic approach to what drives innovation. The findings reveal that different firm sizes and innovation types warrant different holistic drivers; small firms' innovation activity is determined, for the most part, by what facilities/resources are available inside the firm, while innovation in large and medium sized firms are driven by firm and national level factors.
- From a policy perspective we explore the implications that emanate from our findings. It is acknowledged that in a market economy, public policy intervention is necessary where firms prove unwilling or unsuccessful in attaining their objectives, in other words, a problem must exist (Edquist 2011). Where a problem occurs,

governments fund projects to compensate for market failure and to reduce uncertainty (Gök and Edler 2011). Similarly, the systems failure theory views governments as concerned not only with markets but also with institutions and opportunities that encourage innovation paths (Bleda and delRio 2013). With the above theoretical backdrop and based on our findings, we suggest that innovation policy might consider to focus on small firms separately to medium and large firms. Furthermore, we provide insights into how best to support different firm sizes for innovation to flourish.

References

- Antonlioli, D., Mazzanti, M. and Pini, P. (2010) 'Productivity, innovation strategies and industrial relations in SMEs. Empirical evidence for a local production system in northern Italy', *International Review of Applied Economics*, 24(4), 453-482.
- Becker, G. S. (1964) *Human Capital*, Chicago and London: The University of Chicago Press.
- Bleda, M. and Del Rio, P. (2013) 'The market failure and the systemic failure rationales in technological innovation systems', *Research Policy*, 42(2), 1039-1052.
- Copus, A., Skuras, D. and Tseggenidi, K. (2008) 'Innovation and Peripherality: An Empirical Comparative Study of SMEs in Six European Union Member Countries', *Economic Geography* 84(1), 51-82.
- Deschryvere, M. (2014) 'R&D, firm growth and the role of innovation persistence: an analysis of Finnish SMEs and large firms', *Small Business Economics*, 43(4), 767-785.
- ECS (2015) *European Company Survey 2013*, UK Data Archives.
- Edquist, C. (2011) 'Design of innovation policy through diagnostic analysis: identification of systemic problems (or failures)', *Industrial and Corporate Change*, 20(6), 1725-1753.
- EU (2016) *Internal market, Industry, Entrepreneurship and SMEs*, website <http://ec.europa.eu/growth/industry/innovation/>
- Fagerberg, J., Martin, B. and Andersen, E.S. (2013) *Innovation studies: evolution and future challenges*, Oxford: Oxford University Press.
- Foss, N. J., Knudsen, C. and Montgomery, C. (1995) 'An Exploration of Common Ground: Integrating Evolutionary and Strategic Theories of the Firm' in Montgomery, C., ed. *Resource-Based and Evolutionary Theories of the Firm: Towards a Synthesis*, Boston, MA: Kluwer Academic, 1-16.
- Gök, A. and Edler, J. (2011) 'The Use of Behavioural Additionality in Innovation Policy-Making', in EUNIP International Workshop on Evaluating Innovation Policy: Methods and Applications, Florence Italy.
- Grant, R. M. (1996) 'Toward a Knowledge-Based Theory of the Firm', *Strategic Management Journal*, 17, 109-122.
- Kato, M., Okamuro, H. and Honjo Y. (2015) 'Does Founders' Human Capital Matter for Innovation? Evidence from Japanese Start-ups' *Journal of Small Business Management* 2015 53(1), 114-128
- Lai, Y., Saridakis, G., Blackburn, R. and Johnstond, S. (2016) 'Are the HR responses of small firms different from large firms in times of recession?' *Journal of Business Venturing*, 31, 113-133.
- Lenihan, H. (2011) 'Enterprise policy evaluation: Is there a 'new' way of doing it?' *Evaluation and Program Planning*, 34 (4), 323-332.
- Lockett, A. and Thompson, S. (2001) 'The resource-based view and economics', *Journal of Management*, 27, 723-754.
- Lorenz E. and Lundvall, B-A. (2011) 'Accounting for Creativity in the European Union: A multi-level analysis of individual competence, labour market structure, and systems of education and training', *Cambridge Journal of Economics* 35, 269-294.
- Lenihan, H. (2011) 'Enterprise policy evaluation: Is there a 'new' way of doing it?' *Evaluation and Program Planning*, 34 (4), 323-332.
- Manez J.A., Rochina-Barrachina, E., Sanchis-Llopis, A. Sochis-Llopis J. (2015) 'The determinants of R&D persistence in SMEs', *Small Business Economics*, 44, 505-528.
- McGuirk, H., Lenihan, H. and Hart, M. (2015) 'Measuring the impact of Innovative Human Capital on small firms' propensity to innovate', *Research Policy* 44(4), 965-976.
- Montalvo, C. (2006) 'What triggers change and innovation?', *Technovation*, 26(3), 312-323.
- Naz, A., Niebuhr, A. and Peters, J. C. (2015) 'What's behind the disparities in firm innovation rates across regions? Evidence on composition and context effects' *Annals Regional Science*, 55, 131-156.
- Ployhart, R. E. and Moliterno T. P. (2011) 'Emergence of the Human Capital resource: A Multilevel Model', *Academy of Management Review* 36(1), 127-150.
- Schumpeter, J. (1934) *The Theory of Economic Development*, New Brunswick: Transaction Publishers.
- Teece, D. J. (1980) 'The Diffusion of an Administrative Innovation', *Management Science*, 26(5), 464-470.
- United Nations (2009) 'Enhancing the Innovative Performance of Firms' United Nations Economic Commission for Europe, United Nations, Geneva, ECE/CECI/8.
- Vaona, A and Pianta, M. (2008) 'Firm Size and Innovation in European Manufacturing' *Small Business Economics*, 30(3), 283-299

3C. INNOVATION SYSTEMS AND SUSTAINABILITY TRANSITIONS (II)

How Policies Affect the Economics of Distributed Energy Storage: A Case Study in California

Jan Ossenbrink*, Sveinbjörn Finnsson, Catharina R. Bening and Volker H. Hoffmann
(ETH Zurich)

*jossenbrink@ethz.ch

KEYWORDS: Distributed Energy Storage, Policy development, Techno-economic modelling

1. Relevance

Driven by generous support schemes in many countries, solar PV technology has undergone enormous learning and scale effects over the past decade (Ferroukhi et al., 2014). Policy makers around the world currently reassess their mix of instruments to account for solar PV's progress along the technology lifecycle (Hoppmann et al., 2014) and increasingly focus on the emergent technological challenges around the system integration of distributed energy resources (DER) such as the coupling of residential solar PV with distributed energy storage (DES) (Bronski et al., 2015).

This situation confronts policy makers with a significant degree of complexity that originates from the large number of relevant technologies on the one hand and policy instruments that are in place or being discussed on the other hand. Since their decisions on whether to maintain, adapt, or phase out existing policies or propose, design, and implement new ones are likely to shape market conditions for DER in the near future, policy makers need to be explicit about their choice of policy instruments. This requires a thorough understanding of how a given policy mix affects the economics of DER in a particular application and of which costs accrue from the corresponding intervention (Flanagan et al., 2011; Rogge et al., 2015).

2. Research aim and question

Since the link between policy and economics is often treated as a given in most contemporary analyses, we ask how policies affect the profitability of distributed energy storage for PV self-consumption. We select this application for several reasons. First, solar-plus-storage may enable intelligent self-consumption which can be regarded an effective countermeasure against a number of adverse effects of stand-alone solar PV such as violations of voltage and frequency bands in distribution grids or unequal redistribution of grid infrastructure cost among ratepayers. Therefore it seems worthwhile for policy makers to account for these additional value propositions of solar PV when coupled with distributed energy storage (PV+DES) and reflect this in the incentive structures of their policy mix. Second, solar-plus-storage systems can be configured in various technological setups. In particular both mature and novel technologies play a role with individual technological characteristics and stages in their lifecycle which makes them more or less reliant on the presence of certain policy incentives. This provides an interesting setup to study the influence of a given policy mix on multiple underlying technologies. In addition, solar-plus-storage is regarded an important component in the future energy system of countries worldwide which lets the implications of this study appeal to audiences in various contexts.

3. Definitions

In this study we focus on policy in the sense of carrots, i.e. incentives and their underlying mechanisms, notwithstanding the impact of regulation (sticks) and customer information (sermons). With regard to the technology in focus we concentrate on distributed energy storage (DES); we look at three particular energy storage technologies (battery storage, heat pump and immersion heaters) as they represent the most common systems to increase the share of self-consumption for residential solar PV systems.

4. Empirical materials

Building on the database of US state incentives for renewables and efficiency (DSIRE) we manually render a comprehensive account of all policy instruments that currently affect the economics of solar plus storage systems in California. This includes their individual policy characteristics (e.g. level of support, temporal dynamics, expiry dates) and a layout of their underlying support mechanism (e.g. upfront vs performance based, scope of supported technologies, ties to other instruments such as rate structures). In addition, for the different technological setups included in the techno-economic part of our analysis we compile comprehensive lists of technical parameters that characterize each of the appliances. Comparing these setups to the latest EIA's

residential energy consumption survey database we ensure that our simulation represents a realistic setup for a single family house in California.

5. Description of the methodologies

To study how policy affects the economics of distributed energy storage for PV self-consumption we follow a two-step approach. An exploratory analysis of a real-world policy environment is complemented by bottom-up techno-economic modelling to assess the profit-ability of alternative solar-plus-storage investments. We simulate four particular investment cases, namely the reference case of stand-alone solar PV, and the combination of solar PV with one out of three energy storage technologies. Comparing these investments to a baseline setup in which the household is supplied with electricity and gas from the grid, and meets the ambient heat and warm water demand of its residents through a natural gas boiler, we derive several key economic indicators such as IRR, NPV and payback time. The analysis is complemented by a series of sensitivity analyses on the key technological, economical and policy factors.

6. Expected outcomes

Studying the drivers behind residential PV self-consumption in California we find that the current mix of policy instruments plays a pivotal role in determining whether distributed energy storage will be deployed. In the uncertain but rapidly evolving technological domain of distributed energy resources, clear policy frameworks are needed both to address the high investment costs of immature clean technologies, and to appropriately remunerate each resource for the comprehensive set of values that it can provide. In this respect our results point to several inconsistencies characterizing the elements and goals of the current policy mix affecting distributed energy storage for self-consumption in California.

First, we find that net-energy-metering (NEM), i.e. the main policy instrument supporting residential solar PV through feed-in remuneration at retail electricity prices, provides no incentive to align PV operation with the electricity system as a whole. Thereby it falls short of utilizing the grid's full connection capacity for distributed renewables and puts at risk the long-term resilience of the electricity grid. Instead the NEM scheme effectively provides the electricity grid as free energy storage and inherently disincentivizes PV self-consumption. In the absence of NEM, other policy instruments such as the federal investment tax credit or the SGIP support for batteries could be significantly reduced whereas the profitability for the underlying PV+DES investment was maintained or even increased. However, this would come at the expense of investments into stand-alone solar PV systems (IRR=1.2% when feed-in is not remunerated) and could thereby put the Californian renewable procurement goals (33% by 2020, 50% by 2030) at risk. The NEM example points to an important dilemma. Incentivizing energy storage for renewable self-consumption is inseparably tied to disincentivizing feed-in. This imposes the challenge on policy makers of how to provide favorable conditions for emerging DES technologies without disrupting the extension of PV capacity. The current solution - alleviating the problem rooted in one policy instrument by supporting the most expensive DES option (battery storage) with substantial investment grants from another instrument (SGIP) - leads to an inconsistent and inefficient policy mix.

Second, the Californian SGIP grant that covers up to 60% of the investment costs of qualifying energy storage systems is such a strong support scheme that in case of battery storage it crowds out the federal investment tax credit (ITC). This inconsistency stems from the fact that the ITC was never designed to support storage systems but does so based on a ruling from the internal revenue service (IRS) in charge of governing the program. The double-support for battery storage in California remains at least until the ITC phases out in 2022 and provides an example of inconsistency between policy instruments on different governance levels.

The issues identified above reflect that designing a consistent mix of policy goals and means for distributed energy resources is an intricate task. While the current mix of instruments must be seen as an interim solution rather than a fixed toolset to govern the system integration of distributed energy resources, we show that policy makers already have a range of options at their disposal that allow them to set market conditions on a broad spectrum.

References

- Bronski, P., Creyts, J., Crowdis, M., Doig, S., Glassmire, J., Guccione, L., Lilienthal, P., Mandel, J., Rader, B., Seif, D., Tocco, H., Touati, H., 2015. The Economics of Load Defection.
- Ferroukhi, R., Gielen, D., Kieffer, G., Taylor, M., Nagpal, D., Khalid, A., 2014. RETHinking Energy: Towards a new power system. Bonn.
- Flanagan, K., Uyarra, E., Laranja, M., 2011. Reconceptualising the “policy mix” for innovation. *Research Policy* 40, 702–713.
- Hoppmann, J., Huenteler, J., Girod, B., 2014. Compulsive policy-making—The evolution of the German feed-in tariff system for solar photovoltaic power. *Research Policy* 43, 1422–1441.
- Rogge, K.S., Reichardt, K., Kern, F., Nightingale, P., Martin, B., Ramirez, M., Tidd, J., Savona, M., 2015. Going Beyond Instrument Interactions : Towards a More Comprehensive Policy Mix Conceptualization for Environmental Technological Change. SPRU Working Paper Series 12.

Innovation policy and network evolution: the case of the Dutch energy system

Maryse Chappin*(Utrecht University), Joost Koch(Netherlands Enterprise Agency) and Marko Hekkert(Utrecht University)
m.m.h.chappin@uu.nl

KEYWORDS: Energy Innovation Policy, Innovation Networks, Network accumulation, Network evolution

Relevance

Innovation deals with recombination of knowledge (Konig, Battiston, Napoletano, & Schweitzer, 2011). Central in innovation development and technological progress is the idea of accumulation. Moreover, innovation seldom happens in isolation (Edquist, 1997). The importance of collaboration in the context of innovation is highlighted in the innovation literature (c.f. Schilling & Phelps, 2007; van der Valk, Chappin, & Gijsbers, 2011). Networks are also important in the context of sustainable innovation (Valkering, Beumer, De Kraker, & Ruelle, 2013). The general idea is that firms cannot possess all the knowledge and capabilities themselves (Powell, Koput, & Smith-Doerr, 1996) and different partners can add different resources (Knoben & Oerlemans, 2010; Laursen & Salter, 2006).

Innovation policy often aims to stimulate interaction and collaboration between actors. For instance subsidy measures for R&D projects often ask for public-private partnerships. This collaboration is not necessarily limited to the boundaries of the project itself. Since organizations take part in more projects, innovation networks emerge. Knowledge developed in projects can be used by other projects. In other words, projects can benefit from each other. Projects that focus on different stages of the innovation process should not be isolated. The networks might enable the accumulation of knowledge. But these networks will also evolve over time. Network dynamics in general is an understudied topic in the network literature. It is, however, also not known to what extent these policy measures indeed result in a network and how these networks evolve over time. We will argue in this paper that just looking at “normal” network measures (such as density or centralization) will not provide the complete picture. New ways of analyzing these networks are necessary to obtain a better understanding of the relationship between innovation policy instruments and network evolution.

Research aims and questions

In this paper we focus on the energy innovation policy in the Netherlands for the period 2003 until 2013. The aim is to gain insight into the evolution of the innovation networks originating from the energy innovation policy. Moreover, we aim to obtain more insight into the issue of accumulation. Our research question is: how do innovation networks in the Dutch energy system evolve and accumulate?

Definitions and theoretical background

In this paper we analyse innovation networks in the Dutch energy system that are the result of energy innovation policy. These networks emerge because several organizations participate in more projects. Networks are said to “...channel direct flows of information and resources from position to position within a social structure” (Owen-Smith & Powell, 2004:5).

Over time, when new projects start, new actors will enter the network, while other actors will leave the network when projects end. These entries and exits will impact upon the network. The network members that will leave take valuable and strategic knowledge with them. If this knowledge is tacit, it will permanently disappear from the network. On the other hand, an advantage of organizations leaving the network, might be the possibility to obtain new knowledge (Madsen, Mosakowski, & Zaheer, 2003). This might avoid a relative redundancy of members’ perspective (Reagans & Zuckerman, 2001). New entrants can provide this new knowledge.

Research, however, has shown that a certain stability of the network is required. A small network remains stable if the composition remains unchanged (Palla, Barabasi, & Vicsek, 2007). In a volatile network, it will be difficult to learn from earlier “events”. This hinders knowledge accumulation.

In this research we distinguish three different innovation stages and accompanying innovation networks. We used the IEA definitions for research, development and demonstration (IEA, n.d.). The IEA defines energy research as “research in order to acquire new knowledge towards the development of energy-related technologies for sourcing, transporting or using energy and for enhancing energy efficiency”. Development as “the systemic work, which is directed to the production of new materials, components or devices, to install new processes,

energy systems and services, or to substantially improve components or devices that have already been produced or installed”. And demonstration as “the design, construction, and operation of a new configuration of components or devices in a prototype, near or at commercial scale with the purpose of providing technical, economic and environmental information to industrialist, financiers, regulators and policy makers”. Connections between the networks of the different stages will be beneficial for innovation innovation development and technological progress since these connections will enable accumulation.

Empirical materials

In this paper we analyze the energy innovation policy in the Netherlands for the period 2003 until 2013. In that period the following energy innovation agendas were relevant: the energy research strategy (EOS), the energy transition policy (ETP) and the top sector energy policy (TSE). We collected data for all innovation projects (~1500) that were granted within these different policy agendas. The main data source for the innovation projects is the financial database of NEA, which is the administration agency of the ministry of Economic Affairs. For each of the granted projects this database contains information on the public investment, the actors involved, the start and end date, and a link to the formal project plan and reports. In this paper we focus on three most important sustainable energy systems for the Netherlands: solar energy, wind energy and biofuels. The next step was to also classify the innovation stage for all the projects. This resulted in a project database that enabled us to construct networks. For each of the energy systems (solar, wind and biofuels), we constructed a network per year for each innovation stage.

Methods

The first step in the analysis was to provide some descriptives of the networks (e.g. number of nodes and links as well as components). Next we calculated some common network measures (e.g. density, centralization, transitivity). The final step of the analysis is a more in-depth study of the network. We analyze which organizations are prominent in the networks. Not only by calculating centrality measures, but also by analyzing who is present in all networks over the years. Moreover, we identified brokers (organizations that are connecting the network of the different innovation stages). Finally, we look more into the type of actors that form the stable core and that act as brokers. In order to do so, we look at the position of the actors in the value chain.

Expected outcomes

The preliminary results show on the basis of the descriptives and standard network measure, that we can to a certain extent describe how the networks evolve over time. Over the years the cohesion of the network and the centralization fluctuate a bit for the different energy systems. The density for the wind networks for instance range between 0.13 and 0.22 (on a scale from 0-1). But these results do not enable us to really understand if accumulation is possible.

Preliminary outcomes of the more in-depth analyses show that for all three energy systems we have actors that are present in all networks. These actors form the stable core. For solar energy and biofuels the stable core consists of over ten organizations. The stable core for wind is smaller. Only a few actors are present in the networks throughout the whole period. For the different energy systems we also observe differences between the type of actors that make up this stable core. The first results show that for biofuels for instance we observe more small firms.

The first analyses also show that there some organizations are present in all three innovation stages. Further analyses will reveal what kind of organizations are mainly acting as these brokers.

References

- Edquist, C. (1997). *Systems of Innovation Approaches: Their Emergence and Characteristics*. In *Systems of Innovation*. London: Pinter.
- IEA. (n.d.). IEA. Retrieved from www.iea.org
- Knoben, J., & Oerlemans, L. a. G. (2010). The importance of external knowledge sources for the newness of innovations of South African firms. *International Journal of Innovation and Regional Development*, 2(3), 165. <http://doi.org/10.1504/IJIRD.2010.033503>
- Konig, M. D., Battiston, S., Napoletano, M., & Schweitzer, F. (2011). Recombinant knowledge and the evolution of innovation networks. *Journal of Economic Behavior and Organization*, 79(3), 145–164. <http://doi.org/10.1016/j.jebo.2011.01.007>
- Laursen, K., & Salter, A. (2006). Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. *Strategic Management Journal*, 27(2), 131–150. <http://doi.org/10.1002/smj.507>
- Madsen, T., Mosakowski, E., & Zaheer, S. (2003). Knowledge Retention and Personnel Mobility: The Nondisruptive Effects of Inflows of Experience. *Organization Science*, 14(2), 173–191. <http://doi.org/10.1287/orsc.14.2.173.14997>
- Owen-Smith, J., & Powell, W. W. (2004). Knowledge Networks as Channels and Conduits: The Effects of Spillovers in the Boston Biotechnology Community. *Organization Science*, 15(1), 5–21. <http://doi.org/10.1287/orsc.1030.0054>
- Palla, G., Barabasi, A.-L., & Vicsek, T. (2007). Quantifying social group evolution. *Nature*, 446(7136), 664–667. Retrieved from <http://dx.doi.org/10.1038/nature05670>
- Powell, W. W., Koput, K. W., & Smith-Doerr, L. (1996). Interorganizational Collaboration and the Locus of Innovation: Networks of learning in biotechnology.

Administrative Science Quarterly, 41(1), 116–145. <http://doi.org/10.2307/2393988>

Reagans, R., & Zuckerman, E. W. (2001). Networks, Diversity, and Productivity: The Social Capital of Corporate R&D Teams. *Organization Science*, 12(4), 502–517. <http://doi.org/10.1287/orsc.12.4.502.10637>

Schilling, M. a., & Phelps, C. C. (2007). Interfirm Collaboration Networks: The Impact of Large-Scale Network Structure on Firm Innovation. *Management Science*, 53(7), 1113–1126. <http://doi.org/10.1287/mnsc.1060.0624>

Valkering, P., Beumer, C., De Kraker, J., & Ruelle, C. (2013). An analysis of learning interactions in a cross-border network for sustainable urban neighbourhood development. *Journal of Cleaner Production*, 49(August 2012), 85–94. <http://doi.org/10.1016/j.jclepro.2012.09.010>

van der Valk, T., Chappin, M. M. H., & Gijsbers, G. W. (2011). Evaluating innovation networks in emerging technologies. *Technological Forecasting and Social Change*, 78(1), 25–39. <http://doi.org/10.1016/j.techfore.2010.07.001>

Competing actor interests and conflicts in sustainability transitions: Case of wind and solar PV energy in India

Suyash Jolly
(Royal Institute of Technology(KTH))
suyashjolly611@yahoo.co.in

KEYWORDS: Interests, Conflicts, India

Grand challenges associated with sustainability, climate change and transformation of energy systems based on fossil fuels are complex in nature and require collective action between multiple actors with different interests and multiple interpretations about issues at stake (Garud & Gehman, 2012; Howard-Grenville et al, 2014). Complex issues associated with 'grand challenges' often have no direct and readymade solutions and different actors may have different views and interpretations in terms of possible solutions but might end up in conflicts with each other (Ansari, Wijan & Gray, 2013; Howard-Grenville et al, 2014). Given the urgency of the need for a rapid transition to a low-carbon economy, there is a pressing need for sustainability transition scholars to develop a better understanding of different interests of actors, their interests and conflicts between them emerging in the process. This is important as conflicts associated with emerging sustainable energy innovations in reality are much more complex than challenger actors overcoming resistance by incumbent actors through activist tactics as highlighted in earlier innovation studies (Bakker et al, 2014). Existing studies have mostly focussed on competing frames of proponents and opponents of sustainability transitions without realizing that actors might change their interests depending upon ongoing developments and can even support or hinder transitions depending upon their interests. Furthermore there is a need for understanding the contestations and conflicts between multiple actors with competing interests and the manner in which compromise or temporary settlement between them by pragmatically decide one course of action over another and marginalizing interests of few actors while supporting others (Hargrave & Van de Ven, 2006; Guerard et al, 2013).

This motivates the key research question of the paper: What kind of conflicts emerge between actors with competing interests and strategies while engaged in mainstreaming promising sustainable niches ? Empirically the paper focuses on development of wind and solar PV energy in India and illustrates ongoing conflicts between multiple actors in shaping pathways for these promising sustainable niches in India. Specifically, this paper looks at conflicts associated with introduction, removal and subsequent reintroduction of (1) accelerated depreciation benefit for wind energy and (2) domestic content mandates for solar PV energy in India. The paper looks at these two case studies as they show essential conflicts between multiple actors engaged in mainstreaming of wind and solar PV energy in India, attracted significant attention in terms of policy debate and debates about future policy support for the two sustainable niche innovations in India. This article utilizes a qualitative case study approach as it is useful for studying the development of novel innovations and offers advantages such as being open ended and flexible, useful in capturing richness and diversity of different interests and strategies of multiple actors and allowing collection of rich empirical data. This paper utilizes multiple data sources such as archival data (e.g. existing policy and regulatory documents on wind and solar PV energy, journal articles, presentations by experts during conferences and workshops), written letters by industry experts to government officials and policy makers, reports from industry associations, news paper articles highlighting debates and conflicts, media reports, publications by consulting organizations and trade magazines by industry associations), semi-structured interviews with wind and PV solar energy experts and observations in industry conferences. The data analysis involved developing an understanding of the summarized data from different sources by looking at role of different actors, their framings on the conflicting issues i.e. (1) removal and re-introduction of accelerated depreciation benefit and (2) introduction and removal of domestic content regulation and anti-dumping duties in terms of framing by multiple actors in opposition or in support of the two conflicts. In the wind energy case, I highlight tensions between one set of actors (i.e. wind energy associations in India, medium and small scale industries, wind turbine manufacturers) supporting re-introduction of AD benefit as it was the essential driver of wind energy development in India and other set of actors (i.e. Ministry of New and Renewable Energy, Ministry of Finance, Independent wind power producers, civil society organizations) considering re-introduction of AD benefit as harmful for long term development of wind energy in India. In the solar PV case, I explore tensions due to introduction of domestic content requirement and anti-dumping duties in order to promote domestic solar PV manufacturing in India. In this case, I highlight conflicts between one set of actors (i.e. domestic solar PV manufacturers, solar industry associations, MNRE) who supported introduction of domestic content requirements (DCR) and anti-dumping duties while other set of actors (i.e. PV project developers, civil society organizations, WTO, US Government) being not in favour of these measures as they felt that it might not result in development of long term indigenous capabilities for domestic manufacturing and even lead to restrictive trade practices.

This paper contributes to sustainability transitions literature by studying conflicts emerging during sustainability transitions in the context of emerging economies in global south. In doing so, it contributes to a better understanding of ongoing conflicts associated with sustainability transitions by emphasizing conflicts experienced by actors while in shaping transformation pathways towards sustainability (Garud & Gehman, 2012; Ferraro, Etzion & Gehman, 2015). It also highlights the role of actors interests and strategies and conflicts between them while supporting sustainable niche innovations through specific policy instruments and incentives such as accelerated depreciation and domestic content requirement. It also highlights the role of tensions associated with balancing multiple interests of different actors in opposition to each other over nature of policy support relevant for gaining short term benefits or creating conditions for long term sustainability benefits.

References

- Ansari, S.M., Wijen, F. H., & Gray, B., 2013. Constructing a climate change logic: An institutional perspective on the tragedy of the commons. *Organization Science*, 24: 1014–1040.
- Bakker, S., 2014. Actor rationales in sustainability transitions- Interests and expectations regarding electric vehicle recharging. *Environmental Innovation and Societal Transitions*, 13, 60-74.
- Ferraro, F., Etzion, D., Gehman, J., 2015. Tackling grand challenges pragmatically: Robust action revisited. *Organizational studies*, 36(3), 363-390.
- Garud, R., & Gehman, J., 2012. Metatheoretical perspectives on sustainability journeys: evolutionary, relational and durational. *Research Policy*, 41: 980–995.
- Guérard, S., Bode, C., & Gustafsson, R., 2013. Turning point mechanisms in a dualistic model of institutional emergence: The case of the diesel particulate filter in Germany. *Organization Studies*, 34: 781-822.
- Howard-Grenville, J., Buckle, S. J., Hoskins, B. J., & George, G., 2014. Climate change and management. *Academy of Management Journal*, 57 (3): 615-623.
- Hargrave, T. J., & Van De Ven, A. H., 2006. A collective action model of institutional innovation. *Academy of Management Review*, 31(4): 864-888.

Regional innovation systems and transformative change: The case of the chemicals industry in West Sweden

Hanna Martin
(CIRCLE, Lund University)
hanna.martin@circle.lu.se

KEYWORDS: Regional innovation systems, Regional innovation policy, Transformative change, New path development

In economic geography, innovation studies and related disciplines, there has during the past decade been an increasing interest in the question how new regional industrial growth paths emerge. Particularly evolutionary economic geography has significantly enhanced our understanding of the path dependent nature of regional development and has shed light on different forms and mechanisms of regional industrial change (Martin 2010, Boschma and Frenken 2011). While this literature initially had a strong focus on firm-level routines as drivers for regional economic evolution, recent contributions are increasingly also highlighting the importance of a broader range of actors, policy and institutions (Simmie 2012, Dawley 2014, Dawley et al. 2015, Martin and Coenen 2015). Also protagonists of the regional innovation system (RIS) approach have lately sought to contribute to research on regional industrial evolution, amongst others by considering different types of new path development (Tödtling and Trippel 2013) or arguing for regions varying capacities to develop new growth paths (Isaksen and Trippel 2016). New path development is set in motion by endogenous transformation processes through new re-combinations of knowledge and cross-sectoral knowledge flows (Boschma 2015), or by more research-driven modes based on a strong organisational support structure of a RIS. Accordingly, policy approaches for new regional path development largely target the support of these processes, yet depending on the particular characteristics of a RIS (Isaksen and Trippel 2016).

Despite these recent contributions, the literature has however hardly paid attention to transformative change that is change implying a stronger emphasis on the directionality of innovation. While the current literature largely considers innovation for the generation of economic growth, transformative change is needed – by way of example - to cope with long-term challenges such as environmental concerns which imply climate change, pressure on natural resources and growing piles of rubbish (Coenen et al. 2015). This paper engages in the lacking explanatory power of the recent RIS literature with regard to transformative change. Its objective is to address the scope that RIS, and particularly RIS policy, have to impact transformative change of their industries: What are the possibilities and limitations of RIS (policy) to bring about, respectively impact, transformative change? The paper thereby follows a broad understanding of policy used in the RIS literature (Morgan and Cooke 1998) which considers policy as collective action of both public and private actors and stakeholders, which shape and result in public authorities' decisions (Birkland 2014).

Empirically, the paper studies the case of the chemicals industry in the Gothenburg-Stenungsund region at the Swedish west coast, which constitutes Sweden's largest basic chemicals industry cluster specialized in fuel and materials production. The cluster is a heavily polluting, fossil-resource intense industry with a long-term need to transform towards more sustainable, environmentally friendly modes. The region can be classified as a core region, possessing an organizationally thick and diversified RIS which is assumed to offer advantageous preconditions for new path development (Boschma 2015, Isaksen and Trippel 2016). Moreover, the region has a rather high potential for an increased production and utilization of bio-based, sustainable chemical and material products as well as renewable energy. Despite proceeding technology development, ongoing cooperation between the public and private sector in the region and an ambition to become leading in the production of sustainable chemistry products by 2030, going from words to action seems difficult for the regional industry.

In light of current grand challenges such as environmental concerns, the chemicals industry in the Stenungsund-Gothenburg region makes a relevant case to argue for a stronger consideration of transformative change in the literature on new regional industrial path development in general, and in the RIS literature in particular. Applying an ecological imperative to grand challenges, what the literature on new path development in RIS has devoted less attention to is that technologies with "sustainability promise" (Schot and Geels 2008:538) constitute an alternative to established technologies which are not (immediately) competitive on the market; and this not only with regard to technology-related aspects as such, but also with regard to issues such as user practices and

regulatory frameworks. Relating to Martin's (2010) critique regarding a rather dominant focus on localization and specialization economies for explaining new path development, the paper opens up for a broader view on technological change. To do so, it takes a cross-disciplinary perspective by drawing on the literature on socio-technical transitions and its conceptualization of socio-technical regimes and niches (Geels 2002, Schot and Geels 2008). In particular, it draws on the notion of 'protective space' which is used to conceptualize and analyze how sustainable innovations emerge and grow, respectively decline, in the context of established innovation systems (Schot and Geels 2008, Raven et al. 2015). Three properties targeting shielding, nurturing and empowerment of niches (Smith and Raven 2012) will be used to point out the scope of (policy action in) RIS to impact transformative change.

The empirical analysis is mainly based on qualitative research methods, including personal in-depth interviews with key stakeholders of the regional industry that is firm representatives, industry experts, policy makers and university representatives. Additionally, the analysis draws on websites, policy reports and other strategy documents. The findings suggest that aspects described as important for new path development in the recent literature constitute an important foundation to consider also with regard to transformative change of regional industries. Regional transformative change and regional policy action related to it, yet suggests a broader view on new path development, including policy approaches that have been less addressed so far.

References:

- Birkland T.A. 2014. *An introduction to the policy process: Theories, concepts and models of public policy making*: Routledge.
- Boschma R. 2015. Towards an Evolutionary Perspective on Regional Resilience. *Regional Studies* 49(5): 733-751.
- Boschma, Ron and Koen Frenken. 2011. The Emerging Empirics of Evolutionary Economic Geography. *Journal of Economic Geography* 11 (2):295-307.
- Coenen, L., Hansen, T. and Rekers, J.V. 2015. Innovation Policy for Grand Challenges. An Economic Geography Perspective, *Geography Compass* 9(9), 483-496.
- Dawley, Stuart, Danny MacKinnon, Andrew Cumbers and Andy Pike. 2015. Policy Activism and Regional Path Creation: The Promotion of Offshore Wind in North East England and Scotland. *Cambridge Journal of Regions, Economy and Society* 8 (2):257-272.
- Dawley, Stuart. 2014. Creating New Paths? Offshore Wind, Policy Activism, and Peripheral Region Development. *Economic Geography* 90 (1):91-112.
- Geels F. W. 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study, *Research Policy* 31, 1257-1274.
- Isaksen A and Trippel M. 2016. Path Development in Different Regional Innovation Systems: A Conceptual Analysis. In: Parrilli MD, Fitjar RD and Rodriguez-Pose A (eds) *Innovation Drivers and Regional Innovation Strategies*. New York: Routledge, 66-84.
- Martin, Ron. 2010. Roepke Lecture in Economic Geography—Rethinking Regional Path Dependence: Beyond Lock-in to Evolution. *Economic Geography* 86 (1):1-27.
- Martin, H. and Coenen L. 2015. Institutional Context and Cluster Emergence: The Biogas Industry in Southern Sweden. *European Planning Studies* 23(10): 2009-2027.
- Morgan K and Cooke P. 1998. *The Associational Economy: Firms, Regions, and Innovation*, New York: Oxford University Press.
- Raven, R., Kern, F. and Smith, A. 2015. Niche construction and empowerment through socio-political work. A meta-analysis of six low-carbon technology cases, *Environmental Innovation and Societal Transitions*, doi:10.1016/j.eist.2015.02.002.
- Schot, J.W. and Geels, F.W. 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. *Technology Analysis & Strategic Management* 20(5), 537-554.
- Simmie, James. 2012. Path Dependence and New Technological Path Creation in the Danish Wind Power Industry. *European Planning Studies* 20 (5):753-772.
- Smith, A. and Raven, R. 2012. What is protective space? Reconsidering niches in transitions to sustainability, *Research Policy* 41(6), 1025-1036.
- Tödtling F. and Trippel M. 2013. Transformation of regional innovation systems. From old legacies to new development paths, in Cooke, P. (Ed) *Re-framing Regional Development. Evolution, Innovation and Transition*, pp. 297-317. Routledge, London, New York.

3D. INNOVATION AND MEDICAL APPLICATION (I)

Divergent trajectories of sectoral evolution: The case of Traditional Chinese Medicine in China (1949-2015)

Chao-Chen Chung*(National Cheng-kung University) and Hao Hu(University of Macau)

*chaochen.chung@gmail.com

KEYWORDS: Sectoral innovation system, Traditional Chinese medicine, Sub-sector, China

1. Research aims, definitions and relevance

Divergent evolutionary trajectories embedded in the sectoral innovation system have been initially observed by many existing literature. A sectoral system following the definition of Melarba (2002) is composed of three elements, i.e. knowledge and technology, actors and networks, and institutions. Bergek and Onufrey (2014) have demonstrated that multiple technological paths can co-exist in the same industry and are characterized by simultaneous long-term persistence. Leiponen and Drejer (2007) have described the heterogeneity of firms as the main actors within the sector, while Malerba and Nelson (2011) have analyzed how institutions shape the sectoral innovation system unique in different countries. Indeed each of the three components of the sectoral system could possess multiple dynamics which co-exist in the sector at the same time. Nevertheless, until now since different literature only discusses the divergence within the sectoral system from a particular aspect, how the multiple dynamics of the three components integrated shape the different trajectories of sectoral evolution remains unknown.

This article synthetically explores the divergent evolutionary trajectories within the sectoral system of innovation. We assume different patterns of development which are characterized by the contrasting dynamics of the three components could exist simultaneously in the same sector. Since each of the three components of the sector reveals multiple dynamics, different trajectories which are integrated shaped by the particular dynamics of three components will also display unique patterns of development which are distinctive from other pattern co-existing in the sector. A single trajectory which is the composition of the particular dynamics of the three components of the sectoral system in this article is defined as a ‘sub-sectoral innovation system’. We assume plural sub-sectors with each own unique evolutionary patterns are simultaneously embedded in the same sectoral system. We not only emphasize the specific characters shown by the co-existing patterns of evolution, but the influence of institutions on the plural dynamics embedded in the overall sector. As long as national institutions as widely acknowledged by the existing literature play essential roles in the development of the sectoral system, in this article we pay special attention to the roles of national institutions on the divergent dynamics of sectoral evolution. As government’s research, technology, development and innovation (RTDI) policies as specific forms of national institutions especially serve the national industrial concerns, we concentrate our discussion of national institutions on RTDI policies.

We choose the sector of Traditional Chinese Medicine (TCM) in China as the empirical case. The sector has emerged for long time, yet only recently gains a few academic discussions (Hu and Chung, 2015). The evolution of the sector however is not fully explored by the present academic community. In fact there are two main sub-sectors embedded simultaneously in the TCM sector: the sub-sector of Chinese Patent Medicine (CPM, Zhong Cheng Yao) and the sub-sector of Chinese Herbal Piece (CHP, ZhongyaoYinpian). Indeed CPMs are the ready-made herbal medicines which are made up of multiple herbal compounds derived from CHP or fresh herbs. Besides, CHPs are the ‘processed herbs’ which are manufactured through proceeding fresh herbs. In practice, the two sub-sectors process the same sources of herbs, and their end products target the same groups of patients who demand TCM. However, evolutionary trajectories of the two sub-sectors are distinctive from each other. Both sub-sectors adopt the theory of TCM and pharmaceutical related technologies, including chemistry and modern biotechnology, as their knowledge bases. Yet, the sub-sector of CPM introduced chemistry and modern biotechnology to reinterpret the TCM theory since 1990s to innovate new CPMs, while the sub-sector of CHP only introduced the knowledge bases of chemistry and modern biotechnology in the 2000s to improve the processing techniques of CHP. Besides, dominant CPM firms were the large state-own enterprises which built up networks with universities as early as 1980s, but the main CHP firms were the relatively large private companies which only cooperated with universities in the late 2000s. Moreover, the Chinese government launched different sets of policies towards the two sub-sectors. Only CPM was considered as strategic industry after the 1980s and supported by huge public resources, and even after the mid-2000s the government merely concerned the safety of CHP. In short, the two sub-sectors revealed distinctive dynamics in terms of the three

components of TCM sector. The contrasting trajectories possessed by the two sub-sectors thus provide an interesting example for the analysis of different trajectories embedded in the sectoral system.

To deepen the understanding towards the sub-sectoral innovation systems, we establish the conceptual framework based on the existing literature. After the analysis of the evolution of the two sub-sectors of CPM and CHP, we will reflect on the existing literature on the basis of our empirical findings. Eventually we expect our finding of the diversity among the sectoral innovation system will contribute to the present RTDI policies which concern the sectoral development.

2. Methodologies and empirical materials

Several data sources were used to collect all types of data to conduct a comprehensive analysis of the evolution of CPM and CHP.

First, archival data were collected from the China Food and Drug Administration (CFDA) and Chinese National Knowledge Infrastructure (CNKI). CFDA provided key governmental policy and regulatory documents related to CPM and CHP since 1950 in both digital and paper formats. CNKI was searched using the search term ‘patent medicine’ and ‘herbal piece’ for titles of academic publications to provide scientific and technological development information about two sub-sectors.

Second, field interviews were conducted with industrial practitioners and academic researchers. A series of interviews was conducted with three leading TCM university researchers who specialise in CPM and CHP to understand the evolution process. Two senior managers of dominant state-owned enterprises and private companies were also interviewed. The interview questions considered technology, industrial development, policy support and technical obstacles.

3. Expected outcomes

The two sub-sectors of TCM indeed reveal contrasting dynamics. Through the investigation of the divergent trajectories of CPM and CHP, we find the evolution of the sectoral system is the disparate process which goes beyond the analysis of the existing literature. While Malerba (2002) describes that government RTDI policies should ‘match’ the development of sectoral innovation system, we find the concept of ‘match’ should be clearly re-defined. While there are different sub-sectors co-existing in the same sectoral system, policies would have uneven influence on the development of the sectoral system. The inclination of policies would shape the particular sub-sectors more competitive than others. Yet, in the long-term, the un-balanced development between different sub-sectors may lag the development of the sector as a whole. The strategic policy support towards the particular sector should be based on the full understanding towards the different dynamics of the among the sectoral innovation system. Then the sectoral RTDI policies are able to effectively support the development of the sector.

REFERENCES

- BERGEK, A. & ONUFREY, K. 2014. Is one path enough? Multiple paths and path interaction as an extension of path dependency theory. *Industrial and Corporate Change*, 23, 1261–1297.
- HU, H. & CHUNG, C.-C. 2015. The innovation and modernisation of herbal piece in China: system evolution and policy transitions (1950s–2010s). *European journal of integrative medicine* 7, 645–649.
- LEIPONEN, A. & DREJER, I. 2007. What exactly are technological regimes? Intra-industry heterogeneity in the organization of innovation activities. *Research Policy*, 36, 1221–1238.
- MALERBA, F. 2002. Sectoral systems of innovation and production *Research Policy*, 31, 247–264.
- MALERBA, F. & NELSON, R. 2011. Learning and catching up in different sectoral systems: evidence from six industries *Industrial and Corporate Change*, 20, 1645–1675.

Frugality and outreach: innovation in the Indian diagnostic devices market - The case of 3nethra

Dimitri Gagliardi*(Manchester Institute of Innovation Research) and Morten Rasmussen(CARSA)

*dimitri.gagliardi@manchester.ac.uk

KEYWORDS: Frugal innovation, Medical innovation, Diagnostic devices, Outreach, Emerging markets, Constrained conditions, Bottom of the pyramid

The mainstream narrative of innovation advances that technological breakthroughs and revolutionary new products and services are at first bought for hard cash by lead consumers and pioneers and then increasingly by the masses. In emerging markets where the elite/lead consumers class is still relatively small compared to that in the western world, “is not enough to concentrate on the Gucci and Mercedes crowd; [companies] have to learn how to appeal to the billions of people who live outside Shanghai and Bangalore, from the rising middle classes in second-tier cities to the farmers in isolated villages. That means rethinking everything from products to distribution systems” Woolridge, 2010, p.2. From a theoretical standpoint the conceptualisation of frugal innovation (FI) is rather recent and only in the latest years is emerging as a tentative formalisation developed in close relation with growth in emerging markets.

We investigate the rationale behind FI and bring to the fore the arguments that brought the debate at the top of the research and policy agenda. In the following section we introduce our study of an unfolding case of FI in the Indian diagnostic device sector. Finally, we discuss our findings and related them to the general debate on FI and highlight how FI may not be simply stripped-down version of classical innovation or a minor-league form of innovation. Fundamental elements of classical innovation economics and policy such as knowledge advancement, high skills, market-state coordination/collaboration, and multi-actors investments play a major role in FI. We put our findings in perspective emphasising its limitations and conclude with a viable research plan.

Defining Frugal innovation

The argument made by Prahalad (2005) on the ‘bottom of the pyramid’ – large emerging market with income-constrained customers – showed that the strategic setting of multinational corporations based in the western world attempting to compete in emerging market were misplaced by local companies who could out-compete them on costs. The identification of ‘core value’ attached to the product was determinant in succeeding in these markets (Christensen and Raynor, 2003). The lessons gained from these observations informed the strategic behaviour of the larger players: understand the ‘real’ value of the product, devoid it of all the frills and un-essential features and propose it to the market at a reduced price (Gollakota et al, 2010).

How is frugal innovation defined? Zeschky et al (2011) state that frugal innovations are “good-enough, affordable products that meet the needs of resource constrained consumers” (p.38). The implications of this definition is that FI concern with innovations produced or supplied with a large cost advantage, concerns products and services of an inferior quality/performance compared to existing innovations and are marketed to resource-poor markets (von Zedtwitz et al 2015).

Rao (2013) argues that frugal innovation is disruptive. Linking this concept to Christensen’s (2003) idea of disruptive innovation, Rao advocates a change in perspective of the origin of innovation that would bring about the disruptive features of radical innovation in a resource constrained, yet large, market. The emphasis is on lower costs and essential functions. The R&D process of FI limits the developers in the use of excess resources, yet the institutional and policy setting constitute the framework within which FI can be studied (Rao, 2013, p. 70). Bhatti and Ventresca (2013) argue that the dynamics in emerging markets and austerity in developed economies tend to make the FI option particularly appealing. The characteristics of FI such as its relevance for the prospective consumers, its technological feasibility, and the fact that it is impact-oriented can provide basic services to all citizens sustainably (Radjou et al 2012).

The case study

India is largely import-dependent on medical equipment from foreign companies such as GE, Siemens and Philips. Forus Health is a technology-based company headquartered in Bangalore, India. It was established in 2010 by Dr. Shyam Vasudev Rao (specialist in high performance computing architecture) and K. Chandrasekhar (a scholar and practitioner of science and technology management). Forus Health flagship product, 3nethra, is the world’s first portable ophthalmic pre-screening device. The device costs around 1/6 of the price of similar devices. It weighs around 14 kg, it is rugged and portable and it runs on battery powered by low-power solar cells.

The scanning with 3nethra can be undertaken in just 30 seconds and is operated by a technician with 4 to 6 weeks training rather than an ophthalmologist. It can detect eye problems ranging from glaucoma, diabetic retina, cornea and cataract when patients are not yet experiencing any symptoms. The embedded software provides an automated report: “normal” or “need to see a doctor”. In latter cases, the electronic report and the images are sent to a remotely-based ophthalmologist who will make a preliminary diagnosis and provide

guidance on whether the patient should either be visited urgently by a specialist or book-in through normal procedures.

The ideation and development phase began from the observations that there were a vast number of patients that, with simple screening, could be prevented very common eye diseases and that, given the location of these patients, in rural India, normal diagnostic procedures and healthcare resources were insufficient to cover this need. Importantly, they sourced knowledge from hospitals and a leading Indian ophthalmologist. During this period they consulted doctors and technicians who provided the necessary medical and diagnostic inputs whilst the software running on the machine was being developed internally. 3nethra underwent through clinical trials at Kasturba Medical College in Manipal and obtained the necessary international certification.

During the first two years of development, the venture was mostly bootstrapping mainly with own funds and limited seed money. Forus Health delivered only 15-20 products and only about ½ paid for. In December 2012, Forus Health raised a second round of venture capital, including a soft loan from the government with low interests. Although, the Indian home-grown medical devices industry is still nascent, the Ministry of Science and Technology funded few initiatives to foster innovation in medical devices, covering everything from problem area identification and scaling up manufacturing to training for clinical trials.

As of June 2015, 3nethra has been used to screen more than 1.5 million people in rural areas in India, in over 100 semi-mobile and mobile kiosks. Globally, it has been deployed to screen more than 6 million people.

Funding injected by IDG Ventures and Accel Partners is currently used to extend its diagnostic capabilities and assess the retina for possible early symptoms of diabetes, cardiovascular nephrology and neurological problems, to expand its operations in India and tap emerging markets in Africa and Latin America as well as developed markets. In fact, the directors believe that there is potential for expansion in the United States, where rapid, simple and cheap ophthalmic pre-screening solutions constitute a favourable proposition.

Discussion and conclusions

This case study brought to the fore that FI is not that different from classical innovation except for the particularly constrained conditions within which it emerges. Because of these conditions, particular demands are exerted on the development process as well as on the final product and services. In our case it is evident that the need for outreach (geographical outreach as well as specialist knowledge) has been at the heart of the venture.

The following table summarises the characteristics of the product that have been crucial for its success.

Characteristics of FI

Rugged and Lightweight Operational in harsh physical environments and portable.

Human centric design Based on intuitive design, requires little training for its use

Mobile enabled Apart from the advanced diagnostic automation of screening and diagnosis, internet connectivity assure that positive or dubious cases are promptly assed by a specialist remotely.

New distribution models Use of new and non-conventional channels and access health kiosks and camps in remote areas

Use of local resources Little to no use of imported materials or equipment

Sustainable Integration of renewable technologies

Affordable Low costs associated with input and operation and high performance

From the case study we also understand that the current debate on FI, albeit still nascent, is placing particular emphasis on the “good enough” to satisfy the less demanding/ resource constrained share of the market. From our interviews, it is evident that this might not be the case. In particular, we highlight that throughout the innovation process, research and development activities have been carried out exploiting and integrating advanced technology close to the technological frontier for example in optics, ophthalmology, energy, connectivity and engineering, whilst contemporarily exploratory activities have been carried out especially in the area of conjugating software development, imaging and diagnostic algorithms.

Tensions in the debate:

Tensions in the debate on FI :

Low tech vs frontier science and technology FI may involve frontier science and technology

Cheap vs Better FI typically involves cheaper solutions, but also cases with better performance, higher efficiency and more suitability

Products vs services FI extends to services (i.e. screening logistics)

De-featuring vs re-modelling Whereas de-featuring implies a simplification or removal of non-essential features, FI concerns essentially with re-modelling: i.e. changes to design and method

Source: adapted from Bound and Thornton (2013)

Concluding, we may consider FI as an example of innovation carried out in constrained environments whereby both the process and the outcome is shaped by a sequence of problem solving activities specific to the final objective of the innovation. Considering FI only in the light of de-featuring or applied to low-tech areas or directed at poorer customers may be rather reductive as we have seen. Science, technology and ingenuity seem to

be the main ingredient of frugal innovation.

It is important also to consider that FI does not happen in a vacuum where the entrepreneur exploits a niche in 'no-man land': institutional and policy factors do play an important role. Determinant in fact have been the roles of Ministry of Science and Technology in setting up support schemes for a nascent medical device sector, important have also been the many collaborations of Forus Health with hospitals, ophthalmologists, technicians and consultants in carrying out the R&D and clinical trial. Moreover, the support of active and interested venture capitalist provided the necessary backing for a success story.

Having made some interesting advances in the understanding of FI, this study suffers of the shortcoming associated with all single-case studies: generalising our finding to frugal innovation may conduct to misleading conclusions. More research is therefore necessary.

References

- Bhatti, Y. A., & Ventresca, M. (2013). How Can 'Frugal Innovation' Be Conceptualized?. Available at SSRN 2203552.
- Bound, K., & Thornton, I. W. (2012). Our frugal future: Lessons from India's innovation system. London: Nesta.
- Christensen, C. M., & Raynor, M. E. (2003). Why hard-nosed executives should care about management theory. *Harvard business review*, 81(9), 66-75.
- Gollakota, K., Gupta, V., & Bork, J. T. (2010). Reaching customers at the base of the pyramid—a two-stage business strategy. *Thunderbird International Business Review*, 52(5), 355-367.
- Immelt, R.J, Govindraj, V., Timble, C. (2009). How GE is disrupting itself, *Harvard business review*, October Issue
- Leifer, R. (2000). *Radical innovation: How mature companies can outsmart upstarts*. Harvard Business Press.
- Prahalad, C. K. (2005). *The fortune at the bottom of the pyramid: Eradicating poverty through profits*. Wharton School Publishing.
- Radjou, R., Prachu, J. and Ahuja, S. 2012. *Jugaad Innovation -- Think Frugal, Be Flexible, Generate Breakthrough Growth*. Jossey-Bass.
- Rao, B. C. (2013). How disruptive is frugal?. *Technology in Society*, 35(1), 65-73.
- Raynor, M. E., & Christensen, C. M. (2003). *The innovator's solution*. Harvard Business School Press Boston, USA.
- Wooldridge, A., 2010. The world turned upside down. *The Economist*, Special Report, 15 April
- Zedtwitz, M., Corsi, S., Søberg, P. V., & Frega, R. (2015). A typology of reverse innovation. *Journal of Product Innovation Management*, 32(1), 12-28.
- Zeschky, M., Widenmayer, B., & Gassmann, O. (2011). Frugal innovation in emerging markets. *Research-Technology Management*, 54(4), 38-45.

The future of Swedish IVD

Pauline Mattsson*, Erik Hellsing, Lisa-Marie Larisch and Patrik Hedefjäll
(Karolinska Institutet)
*pauline.mattsson@ki.se

KEYWORDS: In vitro Diagnostics, Sectoral innovation system, Technology specific innovation systems, Functional dynamics

Relevance

This study will provide insights into the structure and dynamics of the Swedish IVD industry and innovation system. Based on insights on the strengths and weaknesses of the current IVD innovation system and emerging technology trends we expect to be able to formulate policy initiatives that can further improve the innovative capability not only of the current IVD industry, but also of the related pharma and healthcare system. Technological developments in genome-based diagnostics play a key role in the life science industry in enabling preventive and personalized medicine. We want to explore to which extent the Swedish IVD-industry, pharma and healthcare system is prepared to exploit this opportunity. We will address this task by analyzing how different functions of the Swedish innovation system have performed over the last 16 years.

Research aim and research questions

The aim of this study is to understand conditions for innovation in the Swedish in-vitro diagnostic industry by primarily using a system function approach described by Hekkert et al 2007. Based on the aim the following research questions have been developed:

- What are the conditions for innovation within the innovation system of IVD at current state?
- How have the conditions for innovation within IVD-industry changed the last 16 years?
- To what extent is the Swedish IVD-industry prepared to exploit genome-based diagnostic technologies together with healthcare, IT- and pharma industry?
- To what extent does the position of various innovation system actors within the system along the value-chain and the three spheres academia, government and markets influence their capability to realize innovations successfully

From a more theoretical perspective we aim to identify how the actors' positions in the system affect their ability to fulfill various innovation system functions in a sectoral setting focusing on the specific region of Sweden. Our analysis will thereby help clarify how structural conditions interact with system functions. .

Theoretical framework

This study will use a sectoral innovation system (SIS) approach to study factors that influence the development, diffusion and use of innovation in the focal Swedish IVD industry with its related pharma and healthcare system. An innovation system approach considers the development of innovation as a social interactive process shaped by institutional incentives and barriers and driven by a set of activities that fulfill important IS functions.

When policies for supporting innovation are created they are often formed within the current regime of technology and the more novel technologies or industries' barriers for innovation might not be addressed as much (Hekkert et al 2007). As we are especially interested in the emerging field of genome-based diagnostics we believe a technology system approach could guide policy makers further. According to Hekkert et al (2007) there are seven system functions that influence the performance of a technology specific innovation system:

- Entrepreneurial activities
- Knowledge development
- Knowledge diffusion through networks
- Guidance of the search
- Market formation
- Resource mobilization
- Creation of legitimacy

Earlier studies using a functional innovation system approach have mainly been focusing on technology specific innovation systems (TSIS) where the main focus is not bound to a geographical area or sectoral system. These studies have mainly focused on assessing the performance of a technological innovation system, to identify shortcomings and to derive recommendations of the design of policies for a specific technology (Alkemade et al., 2011; Jacobsson and Karltorp, 2013; Weber and Rohrer, 2012; Wieczorek and Hekkert, 2012). We will here apply the functional innovation approach of Hekkert et al 2007, Bergek et al 2008 to a sectoral setting as defined by Malerba (2002), but focused to the Swedish geographical setting.

Empirical material

In Vitro Diagnostics (IVD) is an important segment in the global healthcare industry. The marketplace is witnessing rapid growth fuelled by technological advancements, better diagnostic tools, improved treatment monitoring, and increased availability of point-of care tests and over-the-counter tests. More specifically IVDs are medical devices and accessories used to perform tests on samples, (e.g., blood, urine and tissue that have been taken from the human body) in order to help detect infection, diagnose a medical condition, prevent disease and/or monitor drug therapies.

The context for this study is the Swedish IVD industry consisting of about 100 product development and sales companies. As in the rest of the world, the Swedish IVD industry is undergoing constant development and the expectations of the IVD industry are high. Good diagnostic tools could benefit the healthcare sector by reducing costs and increase health benefits. Personalized medicine is an area where IVD will play a significant role. In order to live up to the expectations the industry will have to continue to invest in R&D and develop new products and services. In addition access to the clinical setting is a crucial factor when it comes to testing but also implementing the products.

Methodology

An online survey was sent out to all identified existing Swedish IVD-companies. The questions were designed based on the theory of Technology Specific Innovation Systems as described by Hekkert et al. (2007). This approach suggests analyzing seven innovation system functions. Six of seven functions were addressed directly by specific questions for capturing each of the functions. One of the functions, Guidance of search, was left out due to feasibility reasons and because there was strong agreement between the researchers that this function would be more validly explored through interviews. To include a time perspective in this cross-sectional design, respondents of the survey were asked to consider the time period of 2000-2016 when answering most of the questions. The period of 16 years allowed considering major economic and political changes with a reasonable risk of recall bias.

To be able to further understand strategic decisions regarding outsourcing, collaborations, investments in R&D, and motivations behind going into the IVD sector we will carry out interviews with selected individuals. The aim of the interviews is to add qualitative data to the quantitative results obtained from the regression and social network analyses based on the survey data.

Expected outcomes

The survey data will be analyzed according to the different functions. By using regression analysis we will be able to determine the strength of each function and their inter-dependency. We will be able to determine under what conditions the different functions perform based controlling for company specific characteristics and collaborations.

In addition we will be able to analyze the entire IVD sector and how it has developed over the last decades, how preconditions for innovation have changed, and finally get some insights into where the sector will further develop.

Based on our results we will be able to:

- 1) Suggest how the function approach can be used in a sectoral context rather than in the more common TIS context.
- 2) Design policy recommendations how the IVD- sector can further be supported.

References

- Alkemade, F., Hekkert, M.P., Negro, S.O., 2011. Transition policy and innovation policy: friends or foes? *Environ. Innovation Soc. Transitions* 1, 125–129.
- Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., Rickne, A., 2008b. Analyzing the functional dynamics of technological innovation systems: a scheme of analysis. *Res. Policy* 37, 407–429.
- Hekkert MP, Suurs RA, Negro SO, Kuhlmann S, Smits RE. Functions of innovation systems: A new approach for analysing technological change. *Technological forecasting and social change*. 2007 May 31;74(4):413–32.
- Jacobsson, S., Karltorp, K., 2013. Mechanisms blocking the dynamics of the European offshore wind energy innovation system—Challenges for policy intervention. *Energy Policy* 63, 1182–1195.
- Malerba, F., 2002. Sectoral systems of innovation and production. *Res. Policy* 31, 247–264.
- Weber, K.M., Rohracher, H., 2012. Legitimizing research, technology and innovation policies for transformative change: combining insights from innovation systems and multi-level perspective in a comprehensive ‘failures’ framework. *Res. Policy* 41, 1037–1047.
- Wieczorek, A.J., Hekkert, M.P., 2012. Systemic instruments for systemic innovation problems: a framework for policy makers and innovation scholars. *Sci. Public Policy* 39, 74–87.

3E. PUBLIC PROCUREMENT FOR INNOVATION (I)

Mandatory Procurement for Innovation & Inclusive Growth: Critical Appraisal of India's Policy for Development of Small & Medium Enterprises (SME)

Kapil Patil

(Centre for Studies in Science Policy, School of Social Sciences, Jawaharlal Nehru University, New Delhi)
kapilpatil24@gmail.com

KEYWORDS: Public procurement, Innovation, SMEs, Innovation policy, Incentives and barriers

Despite the serious academic and policy attention accorded to public procurement for innovation in recent years, the subject remains curiously under-explored and under-researched in the context of a developing economy like India. The extant literature on public procurement outlines several limitations in case of developing countries to employ systemic innovation policy mix including public procurement for innovation (PPI). These limitations include the lack of desired levels of technical and administrative capacity for procuring innovations. At the technical level, this extends to lack of specific capacities such as, conducting extensive market surveys, developing platforms for identifying public technological needs, transforming such societal needs into functional requirements; while, at the administrative level the challenges include, tackling corruptive behaviour among public servants, changing risk-averse culture of public procurers towards risk-managing and avoid coordination failures. Additionally, the increasing integration of the developing countries into the WTO regime has further constrained the space for pursuing explicit developmental and innovation related goals through public procurement (Kattel 2010).

Notwithstanding such constraints, which are widely pervasive in India, the country has enacted a policy of mandatory procurement from SME's for not only boosting their innovation and competitiveness but also to bridge the widening economic inequalities. Small and medium size enterprises (SMEs) are known to play a vital role in sustaining economic growth and job creation in developing economies thereby reducing income inequalities with a disproportionate impact on marginalised sections of the society (Beck et al. 2004). The public sector offers an important market for small enterprises. Improving overall access to procurement contracts for SMEs therefore, have been is a key priority for governments' worldwide (World Bank 2010). Improving participation of SME's in public procurement could potentially enhance their overall competitiveness by fostering innovation, and result in comprehensive growth and economic distribution (European Commission 2005).

The share of micro and SME sector in India is estimated to account for 45% of industrial output and 40% of exports, comprising 30 million enterprises in various sectors employing approximately 70 million people (IFC MSME Report 2012). To further augment this potential, in April 2012, Indian government enacted the SME preference in public procurement policy where minimum of 20% of goods and services would be sourced mandatorily from micro entities and SMEs in India annually (GoI 2012). The SME's while participating in public procurement confronts several barriers in the form of incurring 'administrative costs' which disproportionately affects SMEs compared to large firms. Additionally, the public procurers tend to exhibit considerable degree of risk averseness when dealing with SME's (ADB 2011). To offset this, the mandatory procurement policies for SME's could potentially lead to market capture behaviour which undermines the very objectives such policies seek to achieve (ADB 2012). Amidst, such perils, this paper seeks to critically evaluate the implementation of India's mandatory procurement policy for SME sector and to account for its outcomes.

Over the last four years, the policy appears to have shown mixed outcomes which the proposed research paper seeks to explain using diverse qualitative and empirical tools. The primary purpose for this research is to analyse (a) whether government policy of mandatory procurement from SMEs in public procurement has yielded desired objectives of innovation and inclusive growth; (b) what are the most common discernible incentives and barriers that facilitate or discourage successful procurement of innovation and SME inclusion policies in mandatory public procurement in India?, (c) whether it is advisable for India to extend such a policy in future in the backdrop of growing pressures of trade liberalisation?

The proposed research aims to explore each of the questions above in order to gauge to what extent mandatory procurement policy has contributed to the achievement of policy objectives with regards to the inclusion of innovation and SME participation in public procurement practices. The research is based on the analysis of primary as well as secondary data published by the public agencies, research conducted in Ministry of Micro, Small, & Medium Enterprises (MSME) in India, and the evaluation of at least two public sector units (PSU's) involved in mandatory procurement that sought to increase the efficiency of procurement through innovations, described in a case study form.

This paper attempts to show that the conditions for conducting explicit public procurement of innovation (PPfI) are not favourable in India. However, mandatory procurement policy has attained mix results due to targeting of certain products by PSU's from the suppliers. This point will be further elaborated in the proposed paper. Given the glaring absence of scholarship in the subject in India, this paper will seek to add to the conceptual as well as policy-orientated literature on public procurement by generalising the experience of India in the context of developing countries.

References:

- Beck et al. (2004), "SMEs, Growth, and Poverty", NBER Working Paper No. 11224 March 2005
European Commission (2005), "Implementing the Community Lisbon Programme: More Research and Innovation – Investing for Growth and Employment: A Common Approach.", COM, 2005: 488
Government of India (2012), "Memorandum – Effective Implementation of Public Procurement Policy for Small & Medium Enterprises", Ministry of Micro, Small & Medium Enterprises, 2012
International Finance Corporation (2012), "Micro, Small and Medium Enterprise Finance in India", IFC MSME Report 2012
Rainer Kattel & Veiko Lember (2010), "Public procurement as an industrial policy tool an option for developing countries?", Tallinn University of Technology Working Papers in Technology Governance and Economic Dynamics 31, TUT Ragnar Nurkse School of Innovation and Governance

Early supplier involvement and public procurement for innovation: evidence from Finland

Ville Valovirta*, Juha Oksanen, Antti Pelkonen and Matthias Deschryvere
(VTT Technical Research Centre)
*ville.valovirta@vtt.fi

KEYWORDS: Public procurement for innovation, Early supplier involvement, User-producer interaction

Early supplier engagement and communication of future purchasing needs have been argued to stimulate innovation among suppliers. Innovating firms lack information about specific user needs which is necessary to develop products with high user relevance. By communicating their future needs early in advance, user organisations can stimulate innovation among their suppliers. When users are government organisations they can acquire double benefits through improved supply of goods and services as well as economic benefits from increased industrial innovation and associated spillover effects. Public procurement for innovation thus emerges as an attractive strategy to advance both public service improvement goals as well as innovation policy targets.

The literature on public procurement for innovation highlights the importance of early communication of user needs and interaction between procurers and suppliers (Edquist et al. 2000, Edler & Georghiou 2007, Rolfstam 2013). However, evidence on the virtues of early supplier involvement has so far predominantly focused on the impacts on firm innovation on the supply side. How early supplier involvement can simultaneously benefit government procurers and impact execution of their mission has been less investigated. This is a shortcoming as commitment from procurers is necessary for adoption and diffusion of innovation procurement practices. What public procurers can gain from early supplier involvement with regard to their service production operations is a primary concern for them while innovation policy targets come only as secondary targets.

We examine early supplier involvement by public procurers as a form of user-producer interaction as suggested by Lundvall (1985, 1993) and Rothwell (1994). In this line of work both user and producer face uncertainty with innovation. The producer has uncertainty about user needs. User has uncertainty about the technical performance of the new product, and its impacts on the user's execution of organisational mission. Early communication of user needs and interaction with suppliers can create learning effects on the both sides of the buyer-supplier interface.

This paper presents evidence on the frequency of early supplier involvement and its impact on innovation based on survey data. We use data from two surveys conducted in Finland. The first survey was addressed at firms and the other survey to public sector procurement units. The firm survey replicates a survey conducted by Manchester University (Georghiou et al. 2014, Uyarra et al. 2014). Our data was collected by a web questionnaire in winter 2012-2013. A stratified random sample of 9359 companies across industrial sectors was composed. In total 514 responses were registered of which 349 firms had delivered products, services and/or solutions to public sector customers during the last three years. The second survey to public procurers was based on a new questionnaire. The sample of 5500 public procurers were compiled from the tender notices published in the national public procurement portal in 2008-2011. The sample was topped up by a supplementary sample of 1500 public sector decision makers. The survey was conducted in autumn 2013 and 374 responses were obtained.

The survey results indicate that among various potential factors, early communication of needs and buyer-supplier interaction are considered by both suppliers and procurers having most impact on innovation. For supplier firms, early communication of purchasing needs and interaction with the buyers are perceived as factors with highest effect on innovation. These results are fully in line with the similar UK survey. As for public procurers, early interaction is seen as generating improvements in suppliers' products and solutions. Moreover, these practices have potential to provide information about the supply, lead to better specifications, and increase understanding of supplier capabilities. Early supplier involvement is thus instrumental to execution of successful public procurement.

In addition to subjective assessments of procurers and suppliers about the impacts of early supplier engagement on innovation, we also investigate if the data allows establishing association between early supplier involvement and supplier innovation. The preliminary analysis does show positive association between these variables, but

whether it is statistically significant is yet to be confirmed. (The analysis for this part is still in progress at the time of submitting the abstract.) There are also limitations with regard to the number of observations in the data which need to be controlled for.

Despite these data limitations it appears obvious that the importance of early supplier involvement is recognised by both procurers and suppliers. However, the frequency of practicing it is strikingly low among public procurers. Only eleven percent of firms report having received sufficient information about public procurer needs, and only fifteen percent of them have been in early interaction with the buyer. If the benefits are perceived so positively, why are public procurers not engaging then more with suppliers? One potential explanation could be that public procurers avoid supplier engagement in order to avoid giving them with unfair advantage with regard to upcoming tenders. According to the survey results, this does not seem to explain the low frequency of interaction. The clear majority of public procurers don't think interaction with particular suppliers would give them unfair advantage. Among the suggested hurdles this was the least common barrier as perceived by the procurers.

The contribution of the paper is to provide new evidence about early supplier engagement and communication of future needs as driver for innovation in the context of public procurement. The benefits of early involvement are perceived high by both public procurers and suppliers. As a form of user-producer interaction it does contribute to learning effects with ability to reduce uncertainty involved with innovation. This can have a positive effect on propensity to innovate as risks for creating and capturing value are perceived lower. The benefits to the procurer are also significant as it contributes to more innovative supply and better specifications.

For innovation policy makers, encouraging early supplier involvement should be an attractive strategy. Its practice requires little additional expenditure and can produce double benefits to the society: improved public service and industrial innovation. On the other hand, it involves a cultural and organisational change, which can be slow to implement and challenging to manage.

References

- Edquist, C., Hommen, L., Tsipouri, L. (eds.) 2000. Public technology procurement and innovation. Springer, New York.
- Edler, J., Georghiou, L. 2007. Public procurement and innovation: resurrecting the demand side. *Research Policy* 36, 949-963.
- Georghiou, L., Edler, J., Uyarra, E., Yeow, J. 2014. Policy instruments for public procurement of innovation: choice, design and assessment. *Technological Forecasting & Social Change* 86, 1-12.
- Lundvall, B. 1985. Product innovation and user-producer interaction. Aalborg University, Aalborg.
- Lundvall, B. 1993. User-producer relationships, national systems of innovation and internationalization. In D. Foray & C. Freeman, eds. *Technology and the wealth of nations*. Pinter, London.
- Rolfstam, M. 2013. Public procurement and innovation: the role of institutions. Edward Elgar, Cheltenham.
- Rothwell, R. 1994. Issues in user-producer relations in innovation process: the role of government. *International Journal of Technology Management* 9 (5-6), 629-649.
- Uyarra, E., Edler, J., Garcia-Estevéz, J., Georghiou, L., Yeow, J. 2014. Barriers to innovation through public procurement: a supplier perspective. *Technovation* 34, 631-645.

Opening the black box of innovation adoption in the public sector: Understanding institutional factors as a basis for intelligent organisational management and policy making

Jakob Edler and Clara Weisshaar*
(Alliance Manchester Business School)
*clara.weisshaar@manchester.ac.uk

KEYWORDS: Innovation adoption and diffusion, Institutional analysis, Public sector organisations, Public procurement of innovation

It is widely acknowledged that innovation adoption and diffusion in the public sector are slow and complex processes (Albury, 2005; Coriat and Levinthal, 1990). Evidence of previous research indicates that the adoption of innovation varies considerably across public sector organisations, regardless of the perceived potential benefit of the new product or service (Cash and Moster, 2000; Edquist, 2005). The topic is of great significance, due to the increasing pressure on the public sector to achieve more efficient allocation of resources and higher quality public services (Cunningham and Karakasidou, 2009). Even more, in recent years the diffusion of innovation in itself has become an important dimension of innovation policy. This is based on the understanding that, first, innovation dynamics are fostered by timely and quick diffusion and, second, that the actual use of innovation can contribute greatly to societal benefits (Edler 2010). Therefore, a number of policies have been initiated to foster the diffusion of innovation, including various policy schemes to support public procurement of innovation (Edler 2016, Uyarra 2016). However, so far the success of those measures is poor. In this article we argue that one reason for that is the lack of understanding the intra-organisational institutional conditions for the adoption of innovation in the public sector. We know from a number of case studies (Edler/Yeow 2016; Yeow, Uyarra, Gee, 2015; Lember et al., 2007) and survey based analysis (Uyarra et al 2014) some of the basic challenges for public procurement of innovation, such as risk aversion, avoiding learning costs, lack of political will, poor use of innovation friendly procurement processes, poor leadership and coordination. However, we do not know the deeper, institutional causes for these kinds of challenges. To conceptualise and empirically analyse these underlying institutional conditions for adoption behaviour in public sector organisation is the main aim of this article. This article therefore seeks to contribute to the understanding of how different institutional factors and structures make a difference in PPI and the adoption of innovation, which helps to develop management and policy practice to unblock the obstacles for the much needed diffusion of innovation.

This aim is in line with recent policy research on demand-oriented innovation policies which emphasises the need to generate a greater understanding of the underlying conditions and contextual factors that influence and shape the effectiveness of innovation policy (Borrás and Edquist, 2013). There has been increasing recognition of the importance of the institutional set-up and structures in determining organisation's decision-making behaviour related to the procurement and diffusion of innovation. With the concept of innovation in the public sector this paper seeks to bridge the gap between innovation studies and research, especially in contributing towards a more context specific and holistic perspective to innovation adoption (Carlford et al., 2010; Coriat and Weinstein, 2002).

Innovation studies highlighted the slow and unpredictable nature of innovation adoption where the underlying institutional factors are not fully understood (Albury, 2005; Carlford et al, 2010). This has been held especially important in relation to large "multi-level" complex organisations (Allman et al., 2011). This research in particular builds on Rolfstam's (2008) initial foundations of an institutional theory-based approach for public procurement of innovation (PPI), by seeking to capture the relationship between the multiple levels of institutions both within public sector organisations and in their context. Therefore, the main research question is: What are the underlying (external and internal) institutional features that affect the ability and willingness of organisations to buy and apply an innovation? Hence this article encompasses three levels of analysis, which are identifying the types and impact of external institutional factors, the internal institutional set-up and the interaction across the different institutional dimensions.

While the importance of the institutional context is becoming more widely recognised, most research is yet unable to account for the variable and changing nature of policy dynamics for innovation (OGC, 2008; Edquist et al. 2000). In response to this, various policy debates highlight the importance of the topic in providing a more innovation-friendly institutional set-up beyond the study of formal institutions, calling for a better understanding of the underlying conditions for the adoption of technological innovations (Rolfstam, 2008; Edler et al., 2005; Uyarra et al., 2014; Rolfstam, 2012). Due to the highly interactive and social process of innovation generation

and adoption, the use of institutional theory enables to analytically capture the phenomenon under study within its particular context (Gagliardi, 1990). It allows to investigate the underlying social and institutional conditions for the absorption and diffusion of innovation. In turn this paper will contribute both to institutional theory and to innovation policy studies. In doing so, it will inform management of public organisations and policy for innovation adoption.

The paper develops a comprehensive framework to capture innovation adoption in a more holistic way. To do so, it adopts and operationalises Robert Scott's (1995) institutional framework which combines various overlapping and contrasting institutional schools into one single comprehensive framework. The framework best reflects and captures the richness and diversity of institutional analysis, combining the given and more 'fixed' regulatory features, with the "softer" morally governed and culturally supported variables of norms and cognition.

Furthermore, building on this framework allows us to distinguish the wider external and internal institutional environment to explore the underlying contextual predispositions to innovation absorption and diffusion. Despite the attractiveness and popularity of Scott's eclectic institutional approach, there have yet been limited attempts in the literature to fully apply Scott's institutional framework, and a number of authors have been calling for greater empirical research to test and operationalise three institutional dimensions, and their interdependence (Mizruchi and Fein, 1999; Kostova and Roth, 2002; Greenwood et al. 2008). This is what this research is doing.

The empirical case for our multi-dimensional institutional analysis is innovation adoption in organisations within the complex setting of the National Health Service in the UK. A set of case studies is conducted and analysed, comparing cases of (non-)adoption of the same innovative technology in hospitals in Scotland and England. This multiple case study approach enables to capture the importance and interplay of national and organisational institutional conditions for innovation adoption and diffusion behaviour.

The article thus contributes a conceptual framework to capture the external and internal institutional context determining innovation adoption in (public) organisations and a first empirical exploration. The institutional perspective implemented helps close the gap between innovation adoption and public procurement of innovation literature by exploring the underlying 'predispositions' to innovation adoption according to identified external and internal institutional contexts. As highlighted in the PPI literature, despite the high level of political intent in shaping and improving policy instruments, PPI was still perceived as failing to meet its full potential in driving innovation (Edler et al, 2015). Hence the relationship of regulatory, normative and cultural-cognitive elements across wider organisation and system level has proven to play an important role in explaining adoption behaviour. This article argues that a better understanding of the origin and nature of the interaction and relationships of variables helps to explain differences in innovation procurement behaviour and use. The article concludes with a set of concrete implications for management and policy for adoption in complex public organisations.

(1250 words without references)

References

- Albury, D. (2005) *Fostering Innovation in Public Services*, Public Money & Management, Vol 25(1), pp. 51-56
- Allman, K.; Edler, J.; Georgiou, L.; Jones, B., Miles, I.; Omidvar, O.; Ramlogan, R. Rigby, F. (2011) *Measuring wider framework conditions for successful innovation. A system's review of UK and international data*. NESTA report, January.
- Borrás, S. and Edquist, C. (2013) The choice of innovation policy instruments. *Technological Forecasting and Social Change*. Vol.89(8), pp.407-429.
- Carlfjord, S., Lindberg, M., Bendtsen, P., Nilsen, P., & Andersson, A. (2010). Key factors influencing adoption of an innovation in primary health care: a qualitative study based on implementation theory. *BMC family practice*, 11, 60. doi:10.1186/1471-2296-11-60
- Cash, D.W., and Moster, S. C. (2000) Linking global and local scales: designing dynamic assessment and management processes. *Global Environmental Change*, Vol. 10, pp. 109-120
- Coriat and Levinthal (1990) Absorptive capacity: a new perspective on learning innovation, *Administrative Science Quarterly*, 35, 128-52.
- Cunningham, P.N. and Karakasidou, A. 2009. 'Innovation in the Public Sector'. European Commission. eScholarID:61493
- Currie, W. and Guha, M. (2007) Conflicting institutional logics: a national programme for IT in the organisational field of healthcare. *Journal of Information Technology*, Vol. 22: pp. 235-247.
- Damanpour, F. (1988). "Innovation type, radicalness, and the adoption process". *Communication Research*, 15, 545-67. (En Wolfe, R. A., 1994)
- Edler, J., Tsiouri, L., Hommen, L., & Rigby, J. (2005). *Innovation and Public Procurement. Review of Issues at Stake*. (Study for the European Commission). Brussels, Belgium: European Commission
- Edler, J., Yeow, J., 2016. Connecting demand and supply: The role of intermediation in public procurement of innovation. *Research Policy* 45, 414-426.
- Edquist, C. (2005, November). Systems of Innovation: Perspectives and Challenges. In Fagerberg, J., Mowery, D., and Nelson, R. (Eds.), *Oxford Handbook of Innovation* (pp. 181-208). Oxford, UK: Oxford University Press.
- Gagliardi, P. (1990) Artifacts as pathways and remains of organizational life. In *Symbols and Artifacts: Views of the Corporate Landscape*, edited by Pasquale Gagliardi (pp.3-38). New York: Walter de Gruyter.
- Greenwood, R., Oliver, C., Suddaby, R., Sahlin-Andersson, K. (2008) *Organizational Institutionalism*. London: SAGE Publications Ltd.
- Herriott, R. E. and Firestone, W.A. (1983) Multisite qualitative policy research: Optimizing description and generalizability. *Educational Researcher*. Vol.12:14-19.
- Lember, V., Kalvet, T., Kattel, R., Penna, C., Suurna, M., 2007. *Public Procurement for Innovation in Baltic Metropolises – Case Studies*, Tallinn.
- OGC (2008); *Capturing Innovation – Nurturing Suppliers's Ideas in the Public Sector*. London. [Online]. Available from: <http://www.dfpni.gov.uk/index/procurement-2/cpd/cpd-policy-and-legislation/pp->
- Mizruchi, M. and Fein, L. (1999) The social construction of organizational knowledge: A study of the uses of coercive, mimetic and normative isomorphism. *Administrative Science Quarterly*. Vol.44(4), pp.653-683.
- Wolfe, B. (1994) Organisational Innovation: Review, Critique and Suggested Research Directions. *Journal of Management Studies*. Vol. 31:405-31
- Mizruchi, M. and Fein, L. (1999) The social construction of organizational knowledge: A study of the uses of coercive, mimetic and normative isomorphism. *Administrative Science Quarterly*. Vol.44(4), pp.653-683.

- Rolfstam, M. (2008) Public Procurement of Innovation. Lund University. CIRCLE.
- Rolfstam, M. (2012) An institutional approach to research on public procurement of innovation. *The European Journal of Social Science Research*. Vol.25(3), pp.303- 321.
- Scott, W.R (1995), *Institutions and Organizations. Ideas, Interests and Identities*. Paperback: 360 pages Publisher: Sage
- Uyarra, E., 2010. Opportunities for Innovation through Local Government Procurement A Case Study of Greater Manchester
- Uyarra, E., Edler, J., Garcia-Estevez, J., Georghiou, L, Yeow, J. (2014) Barriers to innovation through public procurement: A supplier perspective. *Technovation*, Vol. 34:631-645.
- Yeow, J., Uyarra, E., Gee, S., 2011. Sustainable Innovation through Public Procurement: The Case of 'Closed Loop' Recycled Paper. *Manchester Business School Working Paper Number.*, pp. 615.

Heterogeneity of demand on innovation policy instruments: assessment and implications

Vitaliy Roud
(National Research University Higher School of Economics)
*vroud@hse.ru

KEYWORDS: Innovation policy, Policy evaluation, Innovation modes, Diagnostic analysis, National innovation systems

1. Relevance

This study contributes to the growing body of research on the evidence-based policy making in the field of innovation. The data derived from a specialized survey covering innovation activities of the Russian manufacturing enterprises as well as the factual usage of the particular instruments from the portfolio of existing innovation policy measures is employed for empirical assessment of the heterogeneous demand on the innovation policy. Understanding the firm-level patterns of demand on the proposed supporting mechanisms helps to reveal the set of empirical ‘policy mixes’ and their actual targets, which in the end determines the efficiency of the innovation-related governance. It seems to be an appropriate contribution to the research on the diagnosis-based policymaking in the field of science, technology and innovation.

2. Research aims and questions

Key aim is to address the need for methodologies on designing innovation policies that are aware of the complex composition of objectives and the heterogeneity of demands within the national innovation system. Assessing the patterns of usage of the innovation policy measures based on firm-level data helps to address the challenges the challenges of diagnostic analysis and identification of systemic problems of the national innovation system stated in (Edquist 2011).

Main research questions include:

- Determining the match between the stated objectives of the innovation policies with the actual usage of policy instruments and their effects (as perceived by companies);
- Which types of companies are covered by the policy support framework?
- Which companies benefit from the existing mix of instruments?

3. Definitions of the core concepts

The study employs the Oslo Manual Framework for defining the core concepts of innovation, innovation activity and innovation types. The indicators behind the study rely on the Community Innovation Survey-type indicators. The ‘national systems of innovation’ concept follows the conventional tradition of C. Freeman and R. Nelson, however making a special focus on the functional dimensions of NIS (e.g. Edquist, 2011).

Innovation policy framework and the particular instruments are treated in line with the OECD approaches, specifically followed by the Working Group on Innovation and Technology Policy (TIP) within the.

4. Theoretical frameworks

Immediate background for this paper comprises two major strands of research.

One concerns development of the taxonomies of innovation behavior, specifically the recent advances that provide means to capture the heterogeneity of innovation strategies at the firm level. This tradition can be traced from the sectoral level exercises (Pavitt 1984, OECD 1997, Peneder 2003) to the firm-level classifications (Arvanitis&Hollenstein, 2001, Hollenstein 2003, Castellacci 2008, Peneder 2010 etc.). The evidence derived from this line of literature reveals the complex composition of heterogeneous actors within the single innovation system at the given moment: the scholars observe variety of performance, sophistication of strategies, general perception of the (competitive) environment, and thus potential reaction on the incentives (and innovation policy measures).

Another framework in use explores the performance of national innovation system in terms of a set of functional dimensions, thus creating background for diagnosis-based policy-making in the field of science, technology and innovation (see e.g. Smits, Kuhlmann, 2004, Hekkert et al., 2007, Flanagan et al., 2011, Borrás, Edquist, 2013). Key implication immediately applicable within this study is a clearly indicated need for methodologies to design policy mix that is aware of composition of objectives and demands existing within the innovation system.

5. Empirical materials

The empirical basis for this study comprises two datasets. One is the official statistical survey of innovation activities of the enterprises – an annual mandatory survey executed since 1994 by the Federal Statistical Service of the Russian Federation, aiming at roughly 40000 medium and large companies in mining, manufacturing, utilities and selected services (see further comments in OECD, 2011, p.133). The survey is harmonized with the

Community Innovation Surveys (CIS) and fully compliant to the Oslo Manual Framework. The other is a specialized regular survey covering more than 1200 enterprises in manufacturing and services. It has been executed as a Russian branch of the European Manufacturing Survey (organized by a consortium of 16 research centres and universities in EU and beyond, coordinated by ISI Fraunhofer, Germany), expanding the original framework with a number of modules that ensure the methodological compatibility with CIS and also provide facilities to estimate the respondents' experience of usage of state support instruments.

6. Description of the methodologies

A number of statistical techniques is used to reveal the specificities of firms' demand on innovation policy practice. The patterns of utilization of the policy instruments are identified using latent class analysis method. Factor analysis is used to construct the dimensions of the estimated effects of state support as perceived by the companies.

Multinomial probit regressions are employed to construct *ceteris paribus* effects of particular factors determining heterogeneity of demand and efficiency, specifically, with regard to the taxonomies of innovation strategies constructed at the firm level.

Resulting correspondence between the innovation modes and the propensities to the applied mixes of policy instruments is generalized in order to assess the match between the actual practice and the stated objectives of innovation policy.

7. Expected outcomes

The outcomes shall reveal the applicability of the firm-level taxonomies of innovation behavior for the means of assessing the potential efficiency of the top-down designed policy mix. Empirical evaluation of the demand on the support measures may contribute to the discussion on finding the balance between horizontal and vertical (selective) approaches to policymaking.

8. Selected references

- Arundel, A., & Hollanders, H. (2008). Innovation scoreboards: indicators and policy use. *Innovation Policy in Europe: Measurement and Strategy*, Edward Elgar Publishing Ltd, Nauwelaers C and Wintjes R (ed), Cheltenham, UK, pp. 29-52.
- Borrás, S., & Edquist, C. (2013). The choice of innovation policy instruments. *Technological Forecasting and Social Change*.
- Castellacci, F. (2008). Technological paradigms, regimes and trajectories: Manufacturing and service industries in a new taxonomy of sectoral patterns of innovation. *Research Policy*, 37(6), 978-994.
- Edquist, C. (2011). Design of innovation policy through diagnostic analysis: identification of systemic problems (or failures).
- Flanagan, K., Uyerra, E., & Laranja, M. (2011). Reconceptualising the 'policy mix' for innovation. *Research Policy*.
- Frenz, M., & Lambert, R. (2012). Mixed modes of innovation: an empiric approach to capturing firms' innovation behaviour (No. 2012/6). OECD Publishing.
- Hekkert, M. P., Suurs, R. A., Negro, S. O., Kuhlmann, S., & Smits, R. (2007). Functions of innovation systems: A new approach for analysing technological change. *Technological forecasting and social change*
- Hollenstein, H. (2003). Innovation modes in the Swiss service sector: a cluster analysis based on firm-level data. *Research Policy*, 32(5), 845-863.
- Pavitt, K. (1984). Sectoral patterns of technical change: towards a taxonomy and a theory. *Research policy*, 13(6), 343-373.
- Peneder, M. (2003). Industry classifications: aim, scope and techniques. *Journal of Industry, Competition and Trade*, 3(1-2), 109-129.
- Peneder, M. (2010). Technological regimes and the variety of innovation behaviour: Creating integrated taxonomies of firms and sectors. *Research Policy*, 39(3), 323-334.
- Smits, R., & Kuhlmann, S. (2004). The rise of systemic instruments in innovation policy. *International Journal of Foresight and Innovation Policy*

3F. TRACK THEME 8: ADVANCING URBAN LIVING LABS

Experimentation and Institutionalization: The case of Urban Living Labs

Lea Fuenfschilling*(CIRCLE) and Niki Frantzeskaki(DRIFT, Faculty of Social Sciences, Erasmus University Rotterdam)

KEYWORDS: -

The question of how to shift towards more sustainable production and consumption processes takes center stage in studies on sustainability transitions (Markard et al., 2012; van den Bergh et al., 2011). A transition is envisioned as a radical transformation of a historically grown, highly institutionalized socio-technical configuration that fulfills a certain function, e.g. energy or water provision (Fuenfschilling and Truffer, 2014; Geels, 2004). However, research has shown that radical change of highly institutionalized structure is quite challenging. It involves the creation and diffusion of new socio-technical configurations as well as the deinstitutionalization of established ones (Fuenfschilling and Truffer, 2016; Turnheim and Geels, 2013). In this paper we want to explicitly address and elaborate on the role of experimentation for such processes of (de-)institutionalization.

Questions of institutional change have been at the heart of institutional theory in many social sciences (Scott, 1995). But also literature on sustainability transition has discussed a variety of mechanisms that lead to radical institutional change, as for instance technological innovation, different forms of agency and entrepreneurship or extreme events, as well as a respective combination thereof (Grin et al., 2010). A particular mechanism for transformation, which you find in research on socio-technical change and innovation, but which is mainly lacking in institutional theory, is experimentation (Hoogma et al., 2002; Kemp et al., 1998; Seyfang and Smith, 2007; Smith and Raven, 2012). Experimentation is often considered a way to seed change that over time may lead to fundamental changes in a system. Experiments are believed to facilitate a process, where rather unclear ideas, practices, expectations, technologies, actors, etc. can develop and align into a more stable socio-technical configuration that, if diffused more broadly, will radically alter an existing system (Berkhout et al., 2010).

Analytically, experimentation is believed to facilitate processes such as networking, collaboration, creating a shared vision as well as various learning processes that are necessary to build up an alternative, potentially more sustainable socio-technical configuration. However, to date, experimentation is not directly linked to the question of institutional change, which is pertinent in transition studies. In what way does or can experimentation contribute to institutional change? What are the mechanisms at play? Furthermore, experimentation has so far mainly been applied to the question of niche formation, whereas the diffusion/institutionalization/mainstreaming process of the niche into a regime has largely been framed in other ways, e.g. as a matter of adequate institutional settings (regulations) or financial incentives. In this paper, we argue that the mechanisms of experimentation that lead to niche formation are also important in further institutionalization this niche. Hence, experimentation and its distinctive mechanisms of facilitating institutional change should be thought of as crucial for the whole transition pathway.

We will illustrate this understanding of experimentation and institutionalization with empirical illustrations from urban living labs (ULL). ULL are believed to generate certain practices and processes that enable structural change, i.e. that foster sustainability transitions. They are considered a form of experiment that can exert or be employed to exercise different forms of power depending on context conditions and momentum of the intervention. They are purposefully fostering learning through an open and engaged experimentation. Additionally, what make urban living labs distinct are the place-explicit (urban) focus and the fact that they experiment with future solutions and/or approaches while addressing a current sustainability problem. They involve multiple actors that seek to intervene with the intention of developing new ways of dealing with contemporary sustainability threats and challenges, innovate with new ways of organizing and critically examine if and how new socio-technical interventions ‘fit’ into specific contexts and can be mobilized beyond specific contexts (Harriet Bulkeley et al., 2015).

We will draw on various examples of ULL to characterize the specific practices and processes enabled through this form of experimentation that influences and affects processes of institutionalization. In so doing, we discuss how experimentation can be organized in order to lead to radical structural change, i.e. transitions.

References

- Berkhout, F., Verbong, G., Wieczorek, A.J., Raven, R., Lebel, L., Bai, X., 2010. Sustainability experiments in Asia: innovations shaping alternative development pathways? *Environmental Science & Policy* 13 (4), 261-271.
- Fuenfschilling, L., Truffer, B., forthcoming. The interplay of institutions, actors and technologies in socio-technical systems - An analysis of transformations in the Australian urban water sector. *Technological Forecasting and Social Change*.
- Fuenfschilling, L., Truffer, B., 2014. The structuration of socio-technical regimes—Conceptual foundations from institutional theory. *Research Policy* 43 (4), 772-791.
- Geels, F.W., 2004. From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research Policy* 33 (6-7), 897-920.
- Grin J., Rotmans J. and Schot J. (Editors), 2010. *Transitions to Sustainable Development. New Directions in the Study of Long Term Transformative Change*. Routledge, New York.
- Harriet Bulkeley, Marija Breitfuss, Lars Coenen, Niki Frantzeskaki, Lea Fuenfschilling, Markus Grillitsch, Christian Hartmann, Annica Kronsell, Kes McCormick, Simon Marvin, Qianqing Mai, Angelika Sauer, Frank van Steenberg, Yuliya Voytenko, 2015. *GUST Working Paper on Urban Living Labs and Urban Sustainability Transitions*.
- Hoogma, R., Kemp, R., Schot, J., Truffer, B., 2002. *Experimenting for Sustainable Transport. The approach of Strategic Niche Management*. E&F Spon Publisher (Routledge), London.
- Kemp, R., Schot, J., Hoogma, R., 1998. Regime Shifts to Sustainability Through Processes of Niche Formation: The Approach of Strategic Niche Management. *Technology Analysis & Strategic Management* 10 (2), 175-195.
- Markard, J., Raven, R., Truffer, B., 2012. Sustainability transitions: An emerging field of research and its prospects. *Research Policy* 41 (6), 955-967.
- Scott, W.R., 1995. *Institutions and Organizations*. Sage Publications, Thousand Oaks.
- Seyfang, G., Smith, A., 2007. Grassroots innovations for sustainable development: Towards a new research and policy agenda. *Environmental Politics* 16 (4), 584-603.
- Smith, A., Raven, R., 2012. What is protective space? Reconsidering niches in transitions to sustainability. *Research Policy* 41 (6), 1025-1036.
- Turnheim, B., Geels, F.W., 2013. The destabilisation of existing regimes: Confronting a multi-dimensional framework with a case study of the British coal industry (1913–1967). *Research Policy* 42 (10), 1749-1767.
- van den Bergh, J., Truffer, B., Kallis, G., 2011. Environmental innovation and societal transitions: Introduction and overview. *Environmental Innovation and Societal Transitions* 1 (1), 1-23.

A comparative analysis of the urban labs in Maastricht and Antwerp

Christian Scholl*, Joop de Kraker, René Kemp, Ron Covers and Nicole Rijkens-Klomp

*christian.scholl@maastrichtuniversity.nl

KEYWORDS: -

TO REVIEWERS: Contains figure. Please find the PDF-version at
<https://www.delegia.com/app/Data/ProjectImages/6857/240.pdf>

This paper compares the different development paths and outcomes of two similar and ongoing initiatives: the M-LAB in the city of Maastricht and the Stadslab 2050 in the city of Antwerp. The central question is how each of these urban labs addresses the challenge of finding new forms of governance enabling co-creation for urban development between various urban stakeholders. What can we learn about engaging societal actors with private material and non-material interests in addressing collective problems? Urban labs are typically a novel form of governance to address this challenge, but these labs come in many different colours and shapes. So far, there is no conclusive answer to the question what would be the best way to organize a lab.

The paper compares the agenda-setting and organizational set-up in terms of structure, process and participation, as well as the position of each urban lab in the wider context of urban governance. It reflects a part of the results of a bigger research project on urban labs and new forms of urban governance called URB@Exp. Next to ex-post evaluation of experiments of these urban labs previous to this research project (with qualitative semistructured interviews), we draw on the data of more than one year of action research in both urban labs. Our action research has followed four steps (a) co-design of the experiments, (b) setting of explicit learning goals for the experiments, based on important issues identified by the actors; (c) identifying what has been learnt through evaluation of processes and achievements (with interviews, surveys and joint reflection workshops); and (d) disseminating lessons to the urban actors concerned and embedding the lessons in urban governance structures.

Maastricht-LAB (M-LAB) was set up in 2012 as a temporary governance platform for local experimentation and learning by doing. Since the start of the economic crisis in 2007, the urban planning and development landscape has changed rather dramatically in Maastricht (and other cities in the Netherlands) with the break-down of several large public-private partnerships as a result of both demographic and economic stagnation. To safeguard the urban quality of Maastricht in the absence of new large-scale plans and projects, the municipality now wants to stimulate a transition towards novel modes of urban development. Key notions of this transition are repurposing of empty buildings, incremental and small-scale development, temporal use, flexibility, sustainability, co-creation, and bottom-up initiatives.

The Antwerp Citylab2050 was set up in 2013 by the City of Antwerp's Department for Environment. The goal behind the lab was to function as a breeding ground for setting up sustainable actions and experiments for and through the urban community (including business, knowledge institutions, etc.) and to learn how the transition towards a sustainable city could take place. The city lab was meant as a broad forum which invited the entire city community to build towards the city's ambitions with respect to sustainability. This forum was also meant to be a frontrunner with regard to a transition program, to enable the city's transformation into a sustainable city for everyone. Bottom-up initiatives were stimulated, looking for breakthroughs and innovative solutions for the city.

Both urban labs are an initiative by the municipality but work at the interface between municipality, society and business. They also both aim to engage societal actors in attempts to address societal problems and create 'public value'. Moreover, they are about equal in

age, size and resources, which makes a comparison also more useful.

The comparative analysis of these two urban labs is of particular interest, because upon closer inspection, as we argue in this paper, it turns out that they represent almost extremes on both sides of the range of approaches to labs. Whereas the M-LAB engages societal actors through an open call, keeps the municipality in the back seat and is less strongly embedded in the sectoral structure of the municipality, the Stadslab 2050 engages societal actors through selective invitation keeps the municipality in the driver seat and is strongly embedded in the sectoral structure. In our explanation of these differences we will pay attention to process and context. The conclusions will offer some first policy –relevant guidelines for best practices for urban labs regarding agenda-setting and organizational setup.

The comparative analysis of two urban labs in this paper can make an important contribution to the panel on “Advancing urban living labs”. Our insights may directly feed into policy ideas on how to best organize experimental settings for finding new governance approaches and how to anchor urban labs in the wider structure of urban governance.

Comparison of approaches

PLEASE SEE THE PDF VERSION

Articulating roles of experiments and infrastructuring as long-term systemic learning in Urban Living Labs

Mette Agger Eriksen*, Anna Seravalli and Per-Anders Hillgren
(Malmö University)

*mette.agger@mah.se

KEYWORDS: Urban Living Labs, Experiments, Systemic learning, Infrastructuring, Reflective practice, Researchers as Intermediaries

1. Relevance:

Urban Living Labs (ULLs) are spreading rapidly in cities as a way to meet complex societal challenges such as sustainable development, segregation, etc. but also to develop new forms of governance (e.g. URB@Exp, EU JPI call, etc.). Sometimes these are phrased differently e.i. city labs, living labs, design labs, innovation labs, governance labs, etc. Yet, despite different names as well as structures, focuses and aims, in most ULL-related literature and practice, experiments are commonly recognized as playing a core role (e.g. Bulkeley & Castan Broto 2012, Van den Bosch 2010, Nevens et al. 2013). From the field of Transition Management, the concept of 'transitioning experiments' amongst others emphasizing the importance of social learning (Van den Bosch 2010) is surely useful to get closer at overall aims of experiments. However, in this strand of literature, often what is actually meant by 'experiments' and the various roles they can play is not particularly elaborated. Yet, depending on when the experiments happen in the lifespan of the ULL, their role and the learning from them can differ greatly. In other words, that the understanding of various complex, rich and socio-material experiments in ULL can be further elaborated.

2. Research aims and questions:

The paper aims at providing a more specific articulation of how to understand experiments in ULL and how experiments can contribute to local as well as systemic learning and knowledge generation throughout the lifespan of a ULL. Moreover it also addresses the issue of what researchers' role may be in those experiments. It aims at doing so by building on theoretical contributions about experiments and ULL approaches developed within the design research and co-design fields, as well as reflect on the experiences of the ULL in the city of M.

3 and 4. Definitions and theoretical framework:

Within the fields of design and Participatory Design research the understanding of experiments as a part of iterative (research) processes and practices, has been much elaborated. Experiments are for example considered as key parts of so called programmatic design research (e.g. Brandt et al. 2011, Bang & Eriksen 2014) or constructive design research (Koskinen et al. 2011), as 'agonistic experiments' (Hillgren 2013) as 'democratic experiments' (Binder et al, 2015), as a part of long-term infrastructuring processes (Hillgren et al. 2011), etc.

Many of these contributions build upon the original work by Donald Schön (1983), who has been elaborating on different roles and nature of experiments in reflective (designerly) practice also understood as situated reflection-in-action and reflection-on-action.

This framing stands in opposition to a linear phase-based processes and calls for a more explorative and iterative understanding of ULL practices and processes. It also opens up for thinking about the different role and knowledge contributions of experiments, both in the beginning, during and towards the end of the time-span of ULLs.

Additionally, the notion of infrastructuring (Björgvinsson et al 2012) will be introduced as a way to discuss how experiments in ULL can be used to mobilize different actors around an issue, which entails that experiments move beyond being punctual intervention initiated by the researchers and/or by other stakeholders. The notion of commoning (Seravalli 2014) will be also introduced to articulate how experiments lead to creation of connections among participants favouring collaboration and mutual learning.

5. Empirical Material

The paper reflects upon ULL cases (long-term experiments) in the Urban Europe project URB@EXP in the city

of M, in which the authors are involved as participatory action researchers (see link).

The first case is the IP a collaboration across city departments, researchers and companies that aims at the physical and social renovation of some of neighborhoods on the city of M. which are tackling a number of social challenges. Here the researchers are supporting the project board and steering committee in reflecting about formats, core values and ways of collaboration among actors belonging to different sectors. A central part of this long-term experiment is that the participants are provided with design-oriented protocols and visual material to negotiate and discuss how the project should move forward.

The second case focuses on how libraries can be seen as local nodes for change in governance and urban transition. In this long-term experiment the researchers collaborate with five local libraries that experiment themselves with new possible everyday practices. Crucial for this experiment is that the participants come from very different positions regarding the possibility to influence policies and strategies. The participants include librarians engaged in local development project but also library managers and the people responsible for strategic library development at the regional council.

The third case is RT a local upcycling station, which aims at working with both environmental and social sustainability in the urban context. The station is a pilot which is run by the municipal waste handling company in collaboration with an NGO working with upcycling activities, university researchers, civil servants and citizens. Here the researchers are supporting learning both on a local level by closely collaborating with the coordinator of RT and local stakeholders, as well as on a more systemic level by supporting the spreading of learnings emerging from RT within the waste handling company.

6. Methodology:

The paper is based on research activities carried out through a participatory action research and design-based approach, which combine the researchers' active engagement in the cases described above as well as theoretical exploration and reflection.

7 Expected outcomes:

With perspectives from design and Participatory Design research, the paper provides a more articulated understanding of the various roles of experiments in ULL as well as how they can be used to reach systemic impact by supporting mutual and ongoing learning in ULLs practices and processes.

Firstly it discusses how it might be fruitful to have ULL experiments spanning between responding to a specific question and being more explorative and "playful" occasions. Secondly, it articulates the nature of "experiments as local interventions" and "experiments as long-term engagements" (i.e. infrastructuring). Local interventions are framed as time-limited, performative and iterative experiments that support local learning and the creation of social connections among participants through specific socio-material actions. Infrastructuring is framed as more long-term experiments that entail a more holistic perspective and aim for systemic change. The intertwining of local interventions and infrastructuring is crucial and enables both situated as well as systemic learning.

Thirdly, it also articulates how the role of and the knowledge generated from experiments is different throughout the lifespan of ULLs.

Lastly, the paper also addresses the challenges that these understandings may entail for ULL practitioners and discusses how researchers may take an "intermediary" role in supporting them in working with them.

References:

- Bang, A. L., & Eriksen, M. A. (2014). Experiments all the way in programmatic design research. *Artifact*, 3(2), 4-1.
- Binder, T., Brandt, E., Ehn, P., & Halse, J. (2015). Democratic design experiments: between parliament and laboratory. *CoDesign*, 11(3-4), 152-165.
- Björgvinsson, E., Ehn, P., & Hillgren, P. A. (2012). Agonistic participatory design: working with marginalised social movements. *CoDesign*, 8(2-3), 127-144.
- Brandt, E., Redström, J., Eriksen, M. A., & Binder, T. (2011). *XLAB*. Copenhagen: The Danish Design School Press.
- Bulkeley, H. and Castan Broto, V. (2012) Government by experiment? Global cities and the governing of climate change. *Transactions of the Institute of British Geographers*, 38, 361-375.
- Hillgren, P.-A. (2013). Participatory design for social and public innovation: Living labs as spaces of agonistic experiments and friendly hacking. In Manzini, E. and Staszowski, E. (Eds.) *Public and Collaborative – Exploring the Intersection of Design, Social Innovation and Public Policy*. DESIS Network, 75-88.
- Hillgren, P.-A., Seravalli, A. and Emilson, A. (2011). Prototyping and infrastructuring in design for social innovation. *CoDesign: International Journal of CoCreation in Design and the Arts*, 7(3-4), 169-183.
- Koskinen, I., Zimmerman, J., Binder, T., Redstrom, J., & Wensveen, S. (2011). *Design research through practice: From the lab, field, and showroom*. Elsevier.
- Schön, D. (1983). *The Reflective Practitioner – How Professionals Think in Action*. New York: Basic Books.

Seravalli, A. (2014). Making Commons (attempts at composing prospects in the opening of production). PhD dissertation. Malmö University, Sweden.
Urb@Exp: www.urbanexp.eu
Urban Europe - JPI call : <http://jpi-urbaneurope.eu/ensuf-call/>
Van den Bosch, S. (2010). Transition experiments. Exploring societal changes towards sustainability. PhD thesis. Erasmus University Rotterdam, the Netherlands.

From an archipelago of urban living labs to integrated urban sustainability transformations?

Colette Bos*(Netherlands Organisation for Scientific Research (NWO)) and Jonas Bylund(IQS (Swedish Centre for Innovation and Quality in the Built Environment))

* co.bos@nwo.nl

KEYWORDS: Urban Living Lab (ULL), Co-creation, Responsible research and innovation (RRI), Transdisciplinary research and innovation, Science funding policy

1. Relevance

By JPI Urban Europe (JPI UE, inaugurated 2010), member countries tackle European the urban societal challenge by coordinating research and innovation. JPI UE works on a voluntary basis, currently including around 30 European funding agencies. Specifically, the ambition is to support urban sustainable transformations by enabling and pooling national resources for transnational use while aligning national programmes and initiatives for the European Research Area (ERA). One of JPI UE's main objectives is to conduct dialogue about how these transformations can be articulated into actual research and innovation practices to go beyond policy buzzwords (Bos 2016).

Within JPI UE projects, 13 Urban Living Labs (ULL) have so far been established. Transdisciplinary co-creation in projects seems to be one of the most fruitful way of performing research and innovation with a positive impact on urban areas. ULL's are valuable for co-creation processes and learning together. They stimulate urban innovation by a problem solving approach to the encountered issues rather than a linear innovation approach, where issues are studied academically and subsequent knowledge is provided to practitioners or policy makers, but where the different groups are not invested in solving the issues together. Currently, ULL's take many different forms and also many different policies, conditions and funding mechanisms have been established to stimulate ULL's: by municipalities, universities, companies, national research funding organisations or large transnational research programmes (e.g. JPI UE, H2020) or combinations thereof. It is however not clear how to programme ULL's well or how to codify learning to exploit outcomes when much of the knowledges produced may be tacit and practical rather than 'laboratory protocol' types of knowledges. Hence, the paper addresses the design and development of ULLs from the point of view of a transnational urban research and innovation programme.

2. Research aim and questions

The aim of the inquiry is to support the current formation of a more systematic learning on the ULL approach and for JPI UE to shape a reflexive interface to better absorb knowledges in the field. ULL's is a methodological flagship, and although not perceived to be a 'silver bullet', it is used as a prototypical and relatively concrete way of communicating the programme overall focus on transdisciplinary co-creation. Particularly to enable a challenge driven approach for urban research and innovation when tackling innovation and implementation in urban settings. The paper thus serves to devise an exploratory framework (in line with RRI) for how to develop urban living labs further. The main questions we strive to answer is:

How can policies stimulate urban innovation by programming living labs? How can we translate what has been learned about living labs into policies and instruments that support transdisciplinary research and innovation?

3. Definitions

Some of the definitions which are most important for this paper are:

- Co-creation: An approach where heterogeneous actors collaborate to produce knowledge, instruments, technology, artefacts, policy, know-how, etc.
- Transdisciplinarity: A collaboration spanning multiple partners, both academic and non-academic, to solve a common problem. Non-academic partners may include civil servants and public/city officials, (non-) governmental agencies and offices, charitable organisations, firms, civil society, grassroots movements etc.
- Urban Living Lab: A forum for innovation, applied to the development of new products, systems, services, and processes in an urban area; employing working methods to integrate people into the entire development process as users and co-creators to explore, examine, experiment, test and evaluate new ideas, scenarios, processes, systems, concepts and creative solutions in complex and everyday contexts.

4. Theoretical frameworks

Although not a systematic or fully fledged framework, a rudimentary theory which could be used to scaffold the ULL approach states that:

a) Externalities (specifically negative ones) in innovation and implementation can be managed in a relatively safe space. On the one hand, since there seems to be no way around experimentation 'in the wild' for innovation and implementation today, urban living labs offer possibilities for co-creation (cf. Callon et al. 2009; Marres 2013; Bulkeley et al. 2015). On the other hand, a possible risk in ULL's and the co-creative approach overall is how they may operationalise post-political developments and 'manufacture consent' (cf. Bylund 2012), similar to how the concept social innovation is sometimes instrumentalised to an expedient delivery rather than a co-creation of policy (Ilie & During 2012). A relevant issue in this is when ULL's are not always motivated by urban sustainable transformations but rather 'motivate their efforts because of improved innovation, employment opportunities or cost savings' (Curtis, 2015a; Curtis, 2015b). The specific issues ULL's are to tackle and explore by an open design approach may thus effect a diversion from 'the real issues' according to local communities and publics concerned with urban development (cf. von Busch & Palmås 2016).

b) This condition together with fragile governance and democracy issues seems to require multi-actor learning (cf. Voytenko et al. 2016). Urban transitions today go far beyond linear understandings of innovation, where plug-and-play solutions are implemented among end users – who will hopefully accept them (cf. Committee of Regions & European Commission 2015: 148). Multi-actor learning is an effect of co-creation, since there is no way around learning and modifying parts of everyday practices in a sociotechnical setting – i.e. for researchers, engineers, and policy makers as well as for publics involved (cf. Marres 2013).

c) Hence ULL's are expected – but not a fail-safe – to 'better the soils' in urban innovation ecosystems as a working concept in JPI UE's recent joint calls. This notion is still conceptual but designed to evoke and enable sensitivity towards the cross-sectoral and diverse set of actors required to make innovations work. In this way, it intends to support a non-linear approach to the urban sustainable implementation gap and fragmentation (cf. Urban-Nexus, 2014). Urban innovation ecosystems foreground the need to connect infrastructures for a plurality of interests and actors, and thus also describes the general ethos in the JPI UE Strategic Research and Innovation Agenda (SRIA) implementation plan by downplaying 'solutionism' and foreground intentional and coordinated activities by stakeholders (JPI Urban Europe, 2015). This is crucial, since research, policy, and industry experiences show that innovation and implementation depend on active participation from many different kinds of actors in order for innovations to reach their full potential or at least a functional compromise (e.g. Shove 2010; Debackere et al 2014; van Winden & de Carvalho 2015). Thus, urban innovation ecosystems focus on settings outside the R&I workshops or laboratories in a stricter sense as sites of knowledge augmentation and generation.

5. Empirical materials

JPI UE currently funds 13 urban living labs (and another 7 recently granted in the latest call (ENSCC)). The 'first five' have been investigated by Voytenko et al. (2015) as 'snapshot case studies'. However, since this is an ongoing activity, the paper will act as an exploratory framework to query empirical materials drawn from JPI UE's experiences with supporting and funding ULLs. These materials stem from different knowledge practices concerned with ULLs in JPI UE. We group the empirical material in three clusters of differing knowledge practices identified by Curtis (2015a):

Social Equity Issues

- Practices 'on the ground' of the ULL's: how do ULL's engage with urban communities and how does the way in which ULL's are supported by JPI UE help or hinder social equity in ULL's?
- Materials: JPI Urban Europe projects experiences and documentation (e.g. articles, reports, progress reports, personal communication)

Funding of Living Labs

- ULL's can be funded in many different ways and JPI UE is one of these ways. This cluster provides insight in how around 30 different European funding agencies work together in joint calls supporting ULL's.
- Materials: Experiences and documentation from the JPI Urban Europe Funding Agencies Working Group (e.g.

minutes of meetings, reports, calls for proposals)

Living Labs for Sustainability

- JPI UE supports ULL's because it is seen as a method of reaching transdisciplinary co-creation which will result in more sustainable and liveable cities. This cluster explores how the overall strategy of a large transnational research program can support initiatives like ULL.
- Materials: Experiences and documentation of the co-creative process of making the SRIA; experiences and documentation from the JPI Urban Europe Governing Board and Management Board (e.g. minutes, strategy papers, status reports)

6. Description of the methodologies

The methodology followed for this paper is similar to the methodology of ULL's themselves: an iterative process of constant learning and comparison. Hereby, we will work with direct feedback loops: we will structure the empirical materials, find patterns in it and act on it or intervene if possible and necessary.

7. Expected outcomes

For urban sustainable transitions, innovation and implementation, ULL's seems to offer a practical and externalities' incorporating approach, but it may still be seen as too cumbersome. For academic research, ULL's seem promising as a transdisciplinary research methodology, but still can meet many barriers from the way the science system is currently organized. Hence, JPI UE wants to see how we can accommodate the stimulation of ULL's by translating experiences and systematised reflexivity into policies and instruments.

References

- Bos, C. (2016). Articulation: How societal goals matter in nanotechnology. PhD-thesis. Articulation: How societal goals matter in nanotechnology, University of Utrecht, Utrecht.
- Bulkeley, H., Castán Broto, V., & Edwards, G. A. S. (Eds.). (2015). An urban politics of climate change: Experimentation and the governing of socio-technical transitions. London, New York: Routledge.
- Bylund, J. (2012). Postpolitical correctness? *Planning Theory*, 11(3), 319-327.
- Callon, M., Lascoumes, P., & Barthe, Y. (2009). *Acting in an Uncertain World: An Essay on Technical Democracy*. Cambridge MA, London: The MIT Press.
- Committee of Regions & European Commission (2015) *OpenDays 2015 Proceedings*. Brussels: European Union.
- Curtis, S. (2015a). Innovation and the triple bottom line: Investigating funding mechanisms and social equity issues of living labs for sustainability. Master Thesis in Environmental Management and Policy, IIIEE, Lund.
- Curtis, S. (2015b). Bylund personal communication.
- Debackere, Andersen, B., Dvorak, I., Enkel, E., Krüger, P., Malmqvist, H., . . . Wellen, D. (2014). Boosting Open Innovation and Knowledge Transfer in the European Union. Independent Expert Group on Open Innovation and Knowledge Transfer, DG Research and Innovation. EC
- Ilie, E. G. & During, R. (2012). An analysis of social innovation discourses in Europe: Concepts and strategies of social innovation. Wageningen: Alterra Institute.
- JPI Urban Europe (2015). Strategic Research and Innovation Agenda: Transition Towards, Sustainable and Livable Urban Futures. < <http://jpi-urbaneurope.eu/downloads/jpi-sria-def-pdf/> >
- Marres, N. (2013). Why political ontology must be experimentalized: On eco-show homes as devices of participation. *Social Studies of Science*, 43(3), 417-443.
- Shove, E. (2010). Beyond the ABC: Climate change policy and theories of social change. *Environment and Planning A*, 42, 1273-1285.
- Urban-Nexus. (2014). Follow-up report: Integrated urban governance. Urban-Nexus WP6 Synthesis Report.
- Van Winden, W. & de Carvalho, L. (2015). New style cluster policy: Riding the waves of San Sebastian's emerging surf economy. *URBACT II Capitalisation*, Sain Denis: URBACT II.
- von Busch, O. & Palmås, K. (2016). Designing consent: Can design thinking manufacture democratic capitalism?. *Organizational Aesthetics* 5(2), 10-24. <<http://digitalcommons.wpi.edu/oa/vol5/iss2/5>>
- Voytenko, Y., McCormick, K., Evans, J., & Schliwa, G. (2015). Urban living labs for sustainability and low carbon cities in Europe: towards a research agenda. *Journal of Cleaner Production*, in press, 1-10.

Identifying Urban Living Labs opportunities in urban initiatives taken in Delhi, India

Neha Tripathi*(School of Planning and Architecture) and Jasprit Kaur(Environmental Planner,SPA)

*nehagtripathi@gmail.com

KEYWORDS: Urban Living Labs, Delhi, Urban initiatives, Sustainable growth, Urban mobility

Whilst India forges new development pathways, there is a need for balanced rapid economic growth which not only improves quality of life of its citizen but also doesn't compromise the urban environment within cities. Urban sustainable development is both a challenge and opportunity for Indian cities especially for Delhi with its population reaching 18.6 million in 2015.

For many years various sustainable initiatives have been undertaken in the city of Delhi by local governments, institutions, non-governmental organizations, resident welfare organizations, individuals etc. This paper attempts to evaluate ongoing urban sustainability experiments and practices especially in the field of urban mobility and urban agriculture in Delhi and conclude if they can be classified as Urban Living Labs projects. Attempt has also been made to identify the scale at which they are currently being practiced and whether they are areal in nature or are adopting a particular approach towards sustainability. The paper attempts to answer the following research questions- who are the role players in the ongoing project and what the funding model/mechanisms of these experiments are. A conceptual and analytical framework is proposed for evaluating the existing initiatives considering indicators like user involvement, use of technology, scalability, methods and tools employed.etc

Urban Living Labs (ULLs) is emerging as a new form of collective governance and addressing sustainability issues in the cities. It is visualized that ULLs should promote economic growth on one hand and inclusive sustainable living on another.

India stands at a crucial point, where in along with the population and spatial growth it's cities experience, challenges pertaining to sustainability might impede social and economic growth in the long run if cities are not planned properly. There are several initiatives being taken by governmental and non- governmental organizations, which if studied, introspected and synthesized on the ULLs platform will help produce important lessons, paving way for sustainable growth. Through the concept of ULLs, the process and outcomes for each of these initiatives can be assessed in a coherent and comparative manner so that the learning derived is holistic and it's applicability is maximized. Analyzing these practices under the ULLs lens will help articulate the role they play in building sustainable cities and their stand from the social, organizational and sustainability point of view. Findings from the study could help policy makers to evaluate the potential impacts of these practices for sustainable living, in the Indian context. The following paper is an attempt to understand the underlying process for each of the practice. Findings from the paper will help plug into the larger urban scenario, thus emerging as guiding steps for these practices to be carried out in other cities. What makes the ULLs mode conducive is the fact that these are based on experiments corresponding to each city's context and characteristics. Collating and analyzing the results of the practices in Delhi will also help enhance the current knowledge base in the urban development and planning fraternity (both institutional and government based).

Parallel session 4

4A. TRACK THEME 4: NEW AVENUES FOR REGIONAL INNOVATION POLICIES (I)

Policies for regional economic change: combining actor-based and system-based strategies

Arne Isaksen*(University of Agder), Franz Toedtling(Vienna University of Economics and Business) and
Michaela Trippl(CIRCLE, Lund University)
arne.isaksen@uia.no

KEYWORDS: Regional innovation policy, New regional industrial path development, Regional innovation systems

There seems to be a widespread consensus in academic and policy circles that the promotion of current economic strongholds and specialisations is no longer sufficient in order to ensure the long-term competitiveness of regions. New policy concepts such as smart specialisation emphasize the need to break with past practices and design and implement innovation strategies that boost regional economic change, i.e. policies that support regional economies to renew their industrial base by diversifying into new but related economic fields or creating entirely new sectors.

This new strategic orientation for regional innovation policies has essentially been informed by evolutionary economic geography, which has offered novel insights into how regional economies transform over time and how new growth paths come into being. Applying a regional innovation system (RIS) perspective, recent work has enhanced our understanding of how such processes of regional economic change vary across different types of regions. RIS differ enormously in their capacity to develop new growth paths due to pronounced differences in endogenous potentials and varying abilities to attract and absorb exogenous sources for new path development.

The policy implications following from these recent findings on the uneven geography of new path development have hardly been thoroughly discussed so far. General claims such as the need to avoid “one size fits all” strategies and develop place-based policies for regional industrial change remain vague and provide little guidance in this regard.

The aim of this paper is to identify opportunities and limitations of regional innovation policies to promote new path development in different types of RIS. We distinguish between (1) organisationally thick and diversified RIS, (2) organisationally thick and specialized RIS and (3) thin RIS. Regarding path development, a distinction is drawn between (1) path renewal, i.e. the diversification of existing industries into new but related ones, and (2) new path creation, i.e. the rise of entirely new industries in a region. The paper offers a conceptual analysis of conditions and influences that enable and constrain new path development in each RIS type and outlines the contours of policy strategies that are suitable for promoting path renewal and path creation in those different types of RIS.

Our point of departure is the well-known distinction between system-based and actor-based policy approaches. The former aims to improve the functioning of the RIS by targeting system failures, promoting local and non-local knowledge flows and adapting the organisational and institutional set-up of the RIS. Actor-based strategies, in contrast, support entrepreneurs and innovation projects by firms and other stakeholders. We argue that both strategies will have only a limited impact on regional economic change when applied alone. However, if they are combined, they are well-suited to promote path renewal and new path creation. The paper discusses which specific combinations of system-based and actor-based policy strategies matter for different types of RIS.

Smart Scientific Specialisation

Gaston Heimeriks*(Utrecht University), Wout Lamers(Leiden University), Alfredo Yegros(Leiden University)
and Ingeborg Meijer(Leiden University)
*Gheimeriks@gmail.com

KEYWORDS: Smart specialisation, Indicators, Science dynamics, Innovation policy.

Introduction

‘Smart Specialisation’ – an innovation policy concept intended to promote the efficient and effective use of public investment in research - was an instant hit with European policy makers. Its goal is to boost regional innovation in order to achieve economic growth and prosperity, by enabling regions and cities to focus on their strengths (Foray et al., 2009). Smart specialisation means identifying the unique innovative characteristics and assets of each region, highlighting each region’s competitive advantages, and rallying regional stakeholders and resources around an excellence-driven vision of their future (McCann and Ortega-Argilés, 2013).

It can be difficult for policymakers to decide how widely to spread their limited investments across the range of leading-edge science and technology fields, especially in regions that are not at the forefront of any specific field. Knowledge production is very unevenly distributed over regions (Florida, 2005), and many regions struggle to replicate the levels of productivity and innovativeness achieved in leading regions. The key to this struggle is the building up of an institutional context that facilitates the production and the exchange of knowledge (Asheim et al., 2006). Getting more knowledge is easier said than done, because regions can offer experience only on the basis of their current activities. How do regions acquire capabilities that do not yet exist? How do they create and mobilise institutions and capabilities in new innovative activities if the requisite tacit knowledge is missing?

While there are many studies to show that regional specialisation occurs, there are few that address the question of how ‘smart’ this specialisation is, and whether all locations can equally benefit from a smart specialisation strategy? Furthermore, it is unclear at what role scientific knowledge plays in these regional specialisation processes? Yet, these questions are vital if we are to make sensible policies towards innovation-driven economic development.

In this study, we explore the regional specialisation patterns of scientific knowledge production in all European regions over a period of time. The aim of this study is to quantify these evolutionary patterns of knowledge production and to show how these different path and place dependent specialisation patterns emerge and contribute to the rise and fall of research locations. Key topics are used as an indication of cognitive developments in all regions over a period of time. While scientific publications only represent a part of the codified knowledge base of a region, they do provide a rich source of information about the local knowledge base that cannot be easily obtained from other sources, especially concerning knowledge developments that are not yet commercially exploited.

Our objective is to understand the specialisation patterns in knowledge production at different locations in Europe (i.e. NUTS2 regions). The starting point of this analysis is the idea that the dynamics of scientific knowledge are path and place dependent (Heimeriks and Boschma, 2014), and that the current research portfolio of a region influences the further capacity to produce knowledge.

Empirical materials

This study focused on the dynamics of knowledge as made visible by scientific journal publications. While the smart specialisation agenda refers to both knowledge and innovation dynamics (Foray et al., 2012), there are good reasons to focus on the localised production and accumulation of scientific knowledge (Heimeriks and Balland, 2015).

First, economic opportunities are relatively invariant across different regions (Breschi et al., 2003), while knowledge bases are more likely to differ according to their geographical locations. Indeed, it has been shown that the knowledge production and accumulation are more geographically concentrated than economic activities (Florida 2005). The unique innovative potential of regions and cities is thus strongly linked to its ability to develop an institutional context that facilitates the production and the accumulation of knowledge. The geographical patterns found here in relation to different evolutionary patterns of the global knowledge base, are consistent with earlier findings that market developments across sectors are largely determined by the level of accumulateness of the knowledge base (Malerba and Orsenigo, 2002).

Furthermore, a policy focus on knowledge dynamics rather than an exclusive focus on innovation reduces the risk of favouring vested economic interests and allows for exploration of new economic opportunities based on unique regional knowledge characteristics. This is especially important for the development of radical technologies. Radical science based technologies rarely originate from industry incumbents because long time frames suppress incumbents' ability to meet short-term goals (Anderson and Tushman, 1990; Christensen, 1997). Consequently, research universities and government labs are expected to initiate new developments (Mazzucato, 2011). Perez and Soete (1988) argue that especially scientific research at universities is essential for contributing to the knowledge base that is needed for new technological paradigms.

Description of the methodologies

Our methodology follows the "product space" framework in order to understand the uneven development of regions (Hausmann and Hidalgo, 2009; Hidalgo et al., 2007). Publication data are retrieved from the Web of Science. The database enables us to specify the number of publications and their topics of all NUTS2 regions over the period 2000-2014. Based on the country and city indicated in the author affiliations, we were able to allocate scientific publications to 271 NUTS2 regions. In order to identify the specific research areas in which the regions are active we relied on a classification system developed at CWTS (Waltman and Van Eck, 2012). Compared to other frequently used classification systems (e.g. the WoS Subject Categories, that classify publications according to the journals where they were published), our classification is much more nuanced, as it is built at the level of individual publications, and it also overcomes the problem of classifying papers published in 'multidisciplinary journals'. As such, the data allows us to study the rise and fall of regions in co-evolution with the changing topics of research.

First, we establish the scientific relatedness among topics using the CWTS classification system. In a second step, we create a region-topic level variable "relatedness density" that combines the information given by the relatedness between CWTS topics with the scientific activity of regions, i.e. the set of topics on which they publish. In a third step, we compute the scientific coherence of each region, which is simply the average relatedness density of all topics that can be found in the scientific portfolio of a given region. We then analyse the dynamics of scientific knowledge with a particular focus on patterns of specialisation and path-dependence in knowledge evolution.

The results contribute to articulating evidence based smart 'smart specialisation' policies that reflect the abilities of regions to diversify their knowledge base.

Expected outcomes

We wish to understand where new scientific knowledge is created, and to what extent new knowledge builds on existing regional knowledge. In the next step, we aim to identify the local (smart) specialisations of regions, as characterised by combined data of policy and innovation developments. Are there obvious general drivers that provide opportunities for diversification in knowledge production? Is the complexity (diversity) of the local knowledge base a good predictor for the ability to absorb and create new knowledge? Can we specify adjacent possibilities, relating knowledge to the existing business or technological priorities portfolio? This next step will be carried out for a selected set of regions to start with. Finally, we will articulate evidence based smart 'smart specialisation' policies that reflect the abilities of regions to diversify their knowledge base.

Regional responses and RIS-building strategies

Stig-Erik Jakobsen*, Rune Njøs and Jens Kristian Fosse
(Bergen University College)
*sjak@hib.no

KEYWORDS: RIS (Regional Innovation System), Policy strategies, Regional responses

Relevance

In line with the theoretical understandings of innovation as a systemic phenomenon, policy makers in several countries have embraced the idea of cobbling system failures through directed policy means. Such policy has to adapt to different regional conditions, and regions have risen to prominence as a pivotal level for innovation policy (Cooke, 2007; Asheim et al., 2011a; Aarstad et al 2016). Hence, national policies for innovation and regional development appear to have experienced a shift from focusing on implementation of nationally developed policy instruments to policies facilitating tailor-made and place-based regional solutions (Lagendijk, 2011; Jakobsen and Høvig, 2014). Thus, this ‘regionalization’ of innovation policy can be seen as an attempt to capture both the ‘functionality’ of innovation system and its political dimension, where especially the concept of Regional Innovation Systems (RIS) has been given special attention both in the scholarly literature and in policy practice. Attempt to establish RIS has taken place both in regions dominated by experience-based knowledge and DUI (Doing, Using, Interacting) mode of innovation and regions dominated by research-based knowledge and the STI (Science, Technology, Innovation) mode of innovation.

Research aim and research questions

In this paper we will elaborate on strategies for building RIS-structures, and we will use the Norwegian VRI-program (Program for Regional R&D and Innovation) as an empirical example. VRI is a public innovation program operated by the Research Council of Norway to stimulate research and innovation at a regional level through cooperation between research and development (R&D) institutions and industry. The program consists of 15 regional initiatives, each with its own organization and projects. The program has been interpreted as a national initiative to facilitate the development of innovation systems at the regional level (Jakobsen et al. 2012). In this article, we will analyse the development of the program and its regional initiatives from the start in 2007 up until the present day status (i.e. 2015) trying to understand how RIS-systems are evolving. We seek to address the following research questions:

- Which type of regional RIS-building strategies has been triggered through the VRI-program?
- How has the VRI-program contributed to development of RIS-structures in Norwegian regions?

Key concepts and theoretical framework

In this paper, we are interested in exploring regional responses to the national VRI program. Given that the program has an ambition of both building RIS-structure and facilitating innovation, for instance through networking and competence brokering, implementation of the program should reflect complexity and differentiated regional responses. There is an extensive literature on RIS (Autio, 1998; Doloreux and Parto, 2005; Asheim et al., 2011b; Tödtling and Trippel, 2005; Cooke, 2001; Lundvall 2010). However, studies on the building and the evolving of these systems over time seems to be lacking. Many analyses are “...snapshots focusing on the characteristics, and strength and weakness of particular systems” (Isaksen and Trippel 2014:5). Thus, inspired by evolutionary thinking (Uyarra 2010, Njøs and Jakobsen 2016), this article intends to understand the implementation and the development of RIS-systems over time.

Several definitions and understandings of RIS exist, but we find Asheim and Gertler (2005) demarcation useful. Asheim and Gertler define a RIS as an “institutional infrastructure supporting innovation within the production structure of a region”. In our study we especially look into strategies at the regional level to develop an ‘infrastructure supporting innovation’ and we put the development and implementation of innovation instruments at the forefront of our research. Linked to this definition is also two different, though interrelated, understandings of RIS. A broad understanding of RIS covers the aspect of the (regional) economic structure and institutional set-up (i.e. all firms and the wider system of organizations and institutions supporting learning and innovation), whereas a narrow understanding considers RIS as interaction between R&D institutions, knowledge-

intensive firms, technology transfer organizations and other supporting institutions (Asheim and Gertler, 2005). Thus, the broad understanding encompass both the regional system per se (its structure) and activity/interaction in these system structures, while the narrow approach emphasize activities and interaction between actors in regional systems. The intention of VRI is twofold, (a) to develop regional system structures, and (b) to initiate/nurture activity and interaction in these systems. As such, VRI represents both a broad and a narrow approach to RIS (Asheim and Mariussen, 2010; Jakobsen et al., 2012). Regional actors are expected both to form partnerships and to generate activities stimulating R&D-industry collaboration.

When discussing RIS-building strategies in different regions we will build on the work of Nahapiet and Ghosal (1998), Malecki (2012) and Fosse and Normann (2016) on social capital and management. We can differ between three types of RIS-building strategies, each linking up to various dimensions of social capital. The first is structural RIS-strategies, understood as strategies for identifying participants (individuals and organization) and motivating them to participate in RIS-activity. The second is relational RIS-strategies. This is strategies for building confidence and trust between the participants. The third is cognitive RIS-strategies. This is the development of knowledge and procedures for solving regional challenges and strategies for creating a common identity and a common understanding among participants. The latter is associated with the building of a well-functioning regional partnership.

Empirical materials and methodology

In order to trace regional responses to VRI, we have conducted text analysis of all applications for the VRI-collaboration projects for the three program periods (15 regions, three program periods, a total of 45 applications) and final reports from VRI1 and VRI2 (30 documents). Coupled with this investigation of all the applications, we also looked in to the VRI policy documents (annual reports, program plans, handbooks etc.). We used NVivo software to synthesize our document analysis.

In addition, we have conducted semi-structured interviews with representatives from the different VRI projects to get a deeper understanding of their strategies and practices. Informants were selected in dialogue with current project leaders, and includes both former and current project leaders, representatives for R&D institutions and representatives for county administration. A total of 25 interviews were conducted. All interviews were transcribed and coded in NVivo, together with the applications and document analysis. We were using the following 'nodes' when coding our data; i) 'innovation policy history' (the precursor to VRI), ii) problem formulation and main goals, iii) choice of innovation instrument, iv) project organization and partnership, v) learning effects for participants.

In our empirical analysis we link these indicators, or nodes, to the three types of RIS-building strategies (structural, relational and cognitive) that we have defined in the theoretical section. We will also see responses in connection with regional or territorial characteristics (rural vs urban region, DUI-dominated regions vs STI-dominated regions).

Expected outcomes

Our analysis will:

- Contribute towards a richer and more nuanced understanding of RIS by linking it to the concept of social capital.
- Provide a more dynamic understand of the establishment of RIS by analyzing how RIS-structures are evolving over time.
- Provide information on RIS-building strategies in different type of regions which is of relevance for the development of a more context sensitive innovation policy (i.e. one size does not fits all)

Litterature

- Aarstad, J., Kvistastein, O. and Jakobsen, S-E. (2016) Related and unrelated variety as regional drivers of enterprise productivity and innovation: A multilevel study. *Research Policy*, vol.46, 844-856
- Asheim BT and Gertler MS. (2005) The geography of innovation: Regional innovation systems. In: Fagerberg J, Mowery DC and Nelson RR (eds) *The Oxford Handbook of Innovation*. Oxford: Oxford University Press, 291-317.
- Asheim BT, Moodysson J and Tödtling F. (2011a) Constructing Regional Advantage: towards state-of-the-art regional innovation system policies in Europe? *European Planning Studies* 19: 1133-1139.
- Asheim BT, Smith HL and Oughton C. (2011b) Regional Innovation Systems: Theory, Empirics and Policy. *Regional Studies* 45: 875-891.
- Autio E. (1998) Evaluation of RTD in regional systems of innovation. *European Planning Studies* 6: 131-140.
- Cooke P. (2007) To construct regional advantage from innovation systems first build policy platforms. *European Planning Studies* 15: 179-194.
- Cooke P. (2001) Regional innovation systems, clusters, and the knowledge economy. *Industrial and Corporate Change* 10: 945-974.

- Doloreux D and Parto S. (2005) Regional innovation systems: Current discourse and unresolved issues. *Technology in society* 27: 133-153.
- Fosse, J.K and Normann, R.N. (2016): Network management strategies in cluster projects – examples and discussion. In Fornahl,D., and Hassink, R. (eds): 'Cluster Policies from a Cluster Life Cycle Perspective' Edward Elgar Publishing.
- Isaksen, A. and Tripl, M. (2014): Regional industrial path development in different regional innovation systems: A conceptual analysis. *Papers in Innovation Studies* 2014/17, Circle, Lund University
- Jakobsen S-E, Byrkjeland M, Båtevik FO, et al. (2012) Continuity and change in path-dependent regional policy development: The regional implementation of the Norwegian VRI programme. *Norsk Geografisk Tidsskrift [Norwegian Journal of Geography]* 66: 133–143.
- Jakobsen S-E and Høvig ØS. (2014) Hegemonic ideas and local adaptations: Development of the Norwegian regional restructuring instrument. *Norsk Geografisk Tidsskrift-Norwegian Journal of Geography* 68: 80-90.
- Lagendijk, A. 2011. Regional innovation policy between theory and practice. Cooke, P., Asheim, B., Boschma, R., Martin, R., Schwartz, D. & Tödtling, F. (eds.) *Handbook of Regional Innovation and Growth*, 597–608. Edward Elgar, Cheltenham.
- Lundvall BÅ. (2007) National innovation systems—analytical concept and development tool. *Industry and innovation* 14: 95-119.
- Malecki, E.J. 2012. Regional social capital: Why it matters. *Regional Studies* 46, 1023–1039
- Nahapiet, J. and Ghoshal, S. (1998): Social capital, intellectual capital and the organizational advantages. *Academy of Management Review* 23, 242-266.
- Njøs, R. og Jakobsen, S-E. (2016): Cluster policy and regional development: scale, scope and renewal. *Regional Studies, Regional Science* 2016, 3.(1), 146-169
- Tödtling F and Tripl M. (2005) One size fits all?: Towards a differentiated regional innovation policy approach. *Research Policy* 34: 1203–1219.

What's the policy logic all about? Contrasting institutional logics in innovation policy in Norway & Finland

Roger Normann*(University of Agder), Yuzhuo Cai(University of Tampere), Rómulo Pinheiro(University of Agder) and Markku Sotarauta(University of Tampere)

*roger.normann@agderforskning.n

KEYWORDS: Institutional logics, Innovation policy, Finland, Norway, Nordic model

Introduction

It is undeniable that, in many domains of social life, from the social to the cultural to the political to the economic, we are currently assisting of what many have characterized as ‘turbulent times’ (Greve and Hodge, 2013, Schulze et al., 2015, Shapiro and Gross, 2013). It has been stressed that the divergence or conflict between institutional logics is particularly salient during periods of radical transformation (Lounsbury, 2002).

Empirically, this is the case of national innovation systems, which are largely concerned with institutional innovation (Edquist, 1997, Lundvall, 2010), and where contesting logics are often observed (Swan et al., 2010, Cai, 2014, Pinheiro, 2011). Although there has been a burgeoning interest in understanding the dynamics of institutional change in innovation systems (Lundvall et al., 2002, Perez, 2013, Martin, 2013, Sotarauta and Pulkkinen, 2011), few studies have, so far, attempted to undertake a systematic institutional analysis of the emergence and institutionalization of the innovation system as a whole, e.g. in the form of the formation, development and diffusion (institutionalization) of innovation policy over time.

In an effort to address a part of this knowledge gap, this paper takes as its unit of analysis institutional logics underlying changes in innovation policies of two Nordic countries, Finland and Norway over the last 20 years. Innovation policy we understand broadly as strategic actions aimed at influencing innovation and research. Institutional logics is defined as “the socially constructed, historical pattern of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality” (Thornton and Ocasio, 1999). Based on this we ask (1) what institutional logics are associated with innovation policy changes?, (2) how these institutional logics have evolved over time?, and (3) what types of tensions (or lack thereof) between institutional logics we can observe? Our analysis is based mainly on secondary data sets; economic statistics, pertinent literature and historical documents related to innovation policies and practices since the 1990s. Our aim is to re-interpret the story from the institutional logics perspective, and account for differences and similarities across the two country cases.

Norway and Finland at a Crossroad

Economic developments in Finland and Norway are often regarded as showing two very different trajectories. Norway has, in the last three decades, developed a resource based economy with a heavy reliance on oil and gas extraction and export (Fagerberg et al., 2009). Finland emerged during the 1990s as an R&D-leader in ICT, and firms such as NOKIA took a dominant global market position. Both the overall economy and the oil and gas industry in Norway are now in decline. Similarly, also the Finnish ICT industry is in decline and the overall economy is stagnant, at its best. In Norway, the current dynamics are largely due to low productivity combined with falling oil prices (NOU, 2016:3). In Finland the reasons for the decline are more complex; falling export revenues from Russia, the global financial crisis since 2008, hardened competition on the ICT market, lack of restructuring and low productivity in key industries (paper and pulp), large public deficits (local government), etc. In both Finland and Norway there are large regional differences related to the consequences of the downturn. In Norway the most affected areas pertain to regions located in the south-west part of the country – the stronghold for the offshore oil explorations - in particular the Stavanger city-region. Nationally, unemployment levels (about 4.5% in the first quarter of 2016) are at the highest since the early 90s, albeit still relatively low in international/European standards. In Finland, the unemployment rate (January 2016) is 9.3%, with Tampere Kainuu (16,7% in 2015), Lapland (16,7%), Northern Karelia (16,6%) and Central Finland (17,2%) being the most affected regions due to their reliance on ICT and production exports. vulnerable industries and/or Russian markets. Also some of the main Finnish cities have been hit hard due to the transformations in the main industries; the unemployment rate in Tampere was 17,7% in 2015, in Oulu it was 17,2% and in Turku 16,8%.

We acknowledge that the economic situation in Finland with respect to e.g. unemployment is significantly different from that in Norway. The long term economical effect of the oil age in Norway has been much more

substantial than what ICT has represented for Finland. What is happening now is that “Norway is going ordinary” (BBC, 2016). However, in this paper we argue that the story of the economic development in Norway and Finland not are dissimilar stories from an institutional logics perspective. In both countries are a story about two relatively small countries that achieved global success in different market niches. Both in Norway and Finland, these niches became so large that they came to characterise the entire national economy, and the dominant specialisations in some of the regions.

Conceptual Backdrop

The institutional logics perspective (Thornton et al., 2012b), which has also been recently used in regional studies (Sotarauta, 2015, Benneworth et al., 2014), can help us to understand why it is so difficult for politicians, bureaucrats, academics, and business insiders to avoid the ‘inherent gravity of industrial specialisation’. In addition, we build upon the seminal work of March (2008), and the distinction between exploration (new discoveries) and exploitation (existing assets and capabilities), as well as the classic concepts of ‘diversification’ and ‘specialisation’ as linked to seminal discussions on path- dependency, extension, renewal and creation (Garud and Karnoe, 2001, Coenen et al., 2015). From these, we developed and test an ‘ideal type’ analytical model in the form of typology, substantiated on four distinct institutional logics (See Figure 1). These logics we suggest are those underlying innovation design, rather than societal logics suggested by Friedland and Alford (1991) and Thornton et al. (2012a).

Figure 1. Typology of institutional logics underlying innovation policies

*figure could not be included

We will provide empirical examples of how these four ‘embedded’ logics manifested themselves – national and regional levels - in our two country cases - elaborating on their consequences for regional development trajectories (a summary as in Table 1). Further, we link our discussions to relevant discussions on different modes of innovation – DUI vs. STI (Isaksen and Karlsen, 2010).

Table 1. Logics in innovation systems in Norway and Finland

*table could not be included

Discussion (very tentative at this stage!)

In both Finland and Norway, government is responding to economic decline and productivity demands with centralization policies. These centralization policies are both in Norway and Finland directed towards developing larger administrative units such as municipalities and counties. But also universities, university colleges, and research institutions are currently being merged in a rapid pace. Additionally, in Finland, the government also has responded to the fiscal austerity with heavy investment in R&D and universities in the 1990s and 2000s as well as the recent cuts in the same sectors after the economic recession. We discuss the implications of R&D-centralization has for making firms and industries with different modes of innovation more R&D-intensive. We here recognize that a resource-based economy characterized by many DUI firms, probably will be negatively affected in terms of access to external R&D-resources if regional R&D-resources are centralized. STI-firms will probably also be negatively affected by lack of geographical proximity to R&D-resources, but this effect will in most cases be mediated by existing proximity/centralization.

References

- BBC (2016). Norway seeks to diversify its economy as oil earnings plunge. Feb. 10th. Online at: <http://www.bbc.com/news/business-35318236>
- BENNEWORTH, P., PINHEIRO, R. & KARLSTEN, J. 2014. Leadership, strategic actor-hood and institutional change: Deconstructing the role of university senior leadership in regional development. Regional Science Association, Annual Conference. 15-18 June. Izmir, Turkey.
- CAI, Y. 2014. Implementing the Triple Helix model in a non-Western context: an institutional logics perspective. Triple Helix, 1, 1-20.
- COENEN, L., MOODYSSON, J. & MARTIN, H. 2015. Path renewal in old industrial regions: possibilities and limitations for regional innovation policy. Regional Studies, 49, 850-865.
- EDQUIST, C. 1997. Systems of innovation approaches--their emergence and characteristics. In: EDQUIST, C. (ed.) Systems of innovation: technologies, institutions and organizations. London: Printer.
- FAGERBERG, J., MOWERY, D. C. & VERSPAGEN, B. 2009. Innovation, path dependency and policy: the Norwegian case, Oxford University Press.
- FRIEDLAND, R. & ALFORD, R. R. 1991. Bringing society back in: Symbols, practices, and institutional contradictions. In: POWELL, W. W. & DIMAGGIO, P. (eds.) The new institutionalism in organizational analysis. Chicago: University of Chicago Press.
- GARUD, R. & KARNOE, P. 2001. Path dependence and creation, Psychology Press.
- GREVE, C. & HODGE, G. 2013. Rethinking public-private partnerships: strategies for turbulent times, Routledge.
- ISAKSEN, A. & KARLSEN, J. 2010. Different Modes of Innovation and the Challenge of Connecting Universities and Industry: Case Studies of Two Regional Industries in Norway. European Planning Studies, 18, 1993-2008.
- LOUNSBURY, M. 2002. Institutional transformation and status mobility: The professionalization of the field of finance. Academy of Management Journal, 45, 255-266.

- LUNDVALL, B.-Å. 2010. Introduction. In: LUNDVALL, B. Å. (ed.) *National Systems of Innovation: Toward a Theory of Innovation and Interactive Learning*. Anthem Press.
- LUNDVALL, B.-Å., JOHNSON, B., ANDERSEN, E. S. & DALUM, B. 2002. National systems of production, innovation and competence building. *Research Policy*, 31, 213-231.
- MARCH, J. G. 2008. *Explorations in organizations*, Stanford University Press.
- MARTIN, B. R. 2013. Innovation studies: AN emerging agenda. In: FAGERBERG, J., MARTIN, B. R. & ANDERSEN, E. S. (eds.) *Innovation studies : evolution and future challenges*. Oxford: Oxford University Press.
- NOU 2016:3. Ved et vendepunkt: Fra ressursøkonomi til kunnskapsøkonomi Produktivitetskomisjonens andre rapport. Oslo: Finansdepartementet.
- PEREZ, C. 2013. Innovation systems and policy for development in a changing world. In: FAGERBERG, J., MARTIN, B. R. & ANDERSEN, E. S. (eds.) *Innovation studies : evolution and future challenges*. Oxford: Oxford University Press.
- PINHEIRO, R. 2011. In the Region, for the Region? A comparative study of the institutionalisation of the regional mission of universities. Ph.D, University of Oslo.
- SCHULZE, A., MACDUFFIE, J. P. & TÄUBE, F. A. 2015. Introduction: knowledge generation and innovation diffusion in the global automotive industry—change and stability during turbulent times. *Industrial and Corporate Change*, dtv015.
- SHAPIRO, J. P. & GROSS, S. J. 2013. *Ethical educational leadership in turbulent times:(Re) solving moral dilemmas*, Routledge.
- SOTARAUTA, M. 2015. *Leadership and the City: Power, strategy and networks in the making of knowledge cities*, Taylor & Francis.
- SOTARAUTA, M. & PULKKINEN, R. 2011. Institutional entrepreneurship for knowledge regions: in search of a fresh set of questions for regional innovation studies. *Environment and Planning C: Government and Policy*, 29, 96-112.
- SWAN, J., BRESNEN, M., ROBERTSON, M., NEWELL, S. & DOPSON, S. 2010. When Policy meets Practice: Colliding Logics and the Challenges of 'Mode 2' Initiatives in the Translation of Academic Knowledge. *Organization Studies*, 31, 1311-1340.
- THORNTON, P. H. & OCASIO, W. 1999. Institutional Logics and the Historical Contingency of Power in Organizations: Executive Succession in the Higher Education Publishing Industry, 1958-1990. *American Journal of Sociology*, 105, 801-843.
- THORNTON, P. H., OCASIO, W. & LOUNSBURY, M. 2012a. *The institutional logics perspective : a new approach to culture, structure and process*, Oxford, Oxford University Press.
- THORNTON, P. H., OCASIO, W. & LOUNSBURY, M. 2012b. *The Institutional Logics Perspective: A New Approach to Culture, Structure, and Process*, Oxford, Oxford University Press.

4B. SMART SPECIALIZATION

Regional Characteristics and Smart Specialization Strategies: Comparative Analysis of European Regions

Adrian Healy(School of Geography and Planning, Cardiff University), Michaela Trippl(CIRCLE, Lund University) and **Elena Zukauskaite***(CIRCLE, Lund University)

*elena.zukauskaite@circle.lu.se

KEYWORDS: Smart Specialization, Regional Innovation System, Comparative Analysis

Smart specialization strategies rank at the top of public policy agendas in many European regions. This new strategic policy approach “is about specialising in a smart way, i.e. based on evidence and strategic intelligence about a region’s assets and the capability to learn what specializations can be developed in relation to those of other regions” (European Commission 2011, p.7). In sharp contrast to old policy practices, which were often characterized by replicating successful policies adopted in other regions and “one-size-fits all” strategies (Tödtling and Trippl 2005), smart specialization emphasizes the need for place-based policy strategies to promote economic diversification of regions (McCann and Ortega-Argilés 2013, Boschma 2014) by building on unique regional characteristics and assets. Although the ambition to take regional characteristics into account is clearly stated in the policy goals, theoretical conceptualization relating regional capacities to the smart specialization strategies are lacking (see also Foray, David et al. 2011). This in turn limits the development and applicability of the concept in different regional context.

Aim and Research Questions

The aim of this paper is to advance theory-building and gather empirical evidence related to a better understanding of the role of regional characteristics in the development and implementation of smart specialization strategies in European regions.

More concretely we are interested in:

- What is the role of organizations in the region when developing and implementing smart specialization strategies?
- How does institutional and systemic characteristics of the region influence smart specialization strategy?
- What is the role of policy actors and previous experiences of policy making in the region when developing and implementing smart specialization strategies?

Definitions and Theoretical Framework

Foray (2015) distinguishes between smart specialization process and strategy. Smart specialization process refers to a transformation of a regional economy due to new competences, resources, and technologies, leading to related or totally new productive structures. Smart specialization strategy is a policy document and action plan aimed at supporting in a preferential way the most promising new activities in terms of discovery, experimentation, potential spillovers and structural changes. Although Foray emphasizes the differences between the strategy and the process, the two are closely interrelated. Smart specialization strategy needs to recognize the potential for, facilitate and guide smart specialization processes in the region. In other words, implementation of the strategy, if successful, should lead to the emergence of smart specialization processes. In this paper we analyze smart specialization strategies developed in different European regions in relation to their potential to foster smart specialization processes.

Smart specialization strategies are expected to be based on entrepreneurial discovery processes, be inclusive, aggregated and experimental in nature (Foray 2015). In other words, the literature on smart specialization highlights the inclusion of the actors from many different domains (universities, policy makers, representatives from private and civic sectors, and non-governmental organizations) in the region in the development of the strategy. Based on the analysis of regional economic structures, those actors should reach the consensus about the priority areas to be promoted in the strategy in order to foster regional development processes. Those areas should not be sector specific, but rather focus on the possibilities for cross-sectoral interactions. Finally, mechanisms should be established for redefinition of the areas if needed.

The development and implementation of such a strategy requires a better understanding of regional characteristics. First, organizational structures in the region such as presence and quality of the actors to be included and possibly promoted in the strategy need to be defined. Second, institutional conditions such as trust,

willingness to exchange knowledge, recognition of the value of innovation are crucial for the actors to collaborate in the development of a strategy and even more so in the further promotion of cross-sectoral areas. Third, a smart specialization strategy is a policy document. Thus, it depends on the policy making processes in the region such as previous experience in regional development issues and the ability to mobilize other actors. The level of autonomy from national level as well as access and power over regional funds also play an important role in the development and implementation of the strategy. Finally, smart specialization argues for a place-based and evidence-based strategy. As a theoretical framework it faces a challenge to balance between the empirical uniqueness of regional characteristics on the one hand, and the need to provide theory based generalization, on the other hand.

As indicated above, a theoretical framework allowing for the better inclusion of such regional characteristics into smart specialization needs to be further developed. We believe that the advancements made in the literature on Regional Innovation Systems (RIS) could serve as a point of departure for conceptualizing regional characteristics in the framework of smart specialization. The studies on regional innovation systems (RIS) have made in-depth analysis of the role of different organizations and relations among them in the processes of regional development (Coenen 2007, Martin and Moodysson 2013). The importance of institutions is recognized in the RIS framework and advancements in theoretical underpinnings of the concept in a regional context have been suggested in some recent work (Asheim and Gertler 2005, Gertler 2010, Rodríguez-Pose 2013, Zukauskaitė 2013). Different authors have also used RIS as a tool for analyzing regional innovation policies (Martin, Moodysson et al. 2011). Furthermore, RIS approach provides categorization of regional diversity allowing taking uniqueness of the regions into account while still providing the scope for generalization (Cooke 2001, Isaksen and Trippel 2014).

In this paper, regional characteristics are further specified based on the typologies suggested in RIS literature (Cooke 2001, Tödtling and Trippel 2005, Isaksen and Trippel 2014). In relation to those, challenges and opportunities for the development and implementation of smart specialization strategies are identified. The sources of these challenges and opportunities are organizational and institutional structures of the region and policy making and governance capacities. More concretely, they refer to number of industries, knowledge generation and support organizations, type of networks (organizational structures); level of trust, attitudes towards innovation (institutional structures); inclusive vs exclusive policy making; level of autonomy in terms of designing regional strategy or in terms of regional funding (governance capacity).

Empirical materials and methodology

The empirical material of this article consists of 16 case study reports on the development and implementation of smart specialization strategies in European regions. The case region include well developed regions such as Southern Sweden and Tampere in Finland as well as less developed as Lodzkie region in Poland. The case study reports include information on socio-economic characteristics of the region, the account on different organizations and their involvement in regional and non-regional networks, institutional infrastructure of the region and the description of the process on how smart specialization strategy has been developed and the potential for its implementation. The case study reports are based on extensive text analysis of different regional policy documents, previous studies, and semi-structured interviews with regional stakeholders involved in the development and implementation of smart specialization such as policy makers, private and public sector representatives, researchers among others.

Expected outcomes

We expect to gain a more nuanced understanding of the role of regional characteristics in the development and implementation of regional smart specialization strategies. We will advance the scientific development of the literature of smart specialization in several ways. First, we will strengthen its theoretical foundation by incorporating the insights from the RIS framework. Second, will make an empirical contribution by applying the framework for the analysis of 16 case studies. Third, based on theoretical development and empirical analysis we will identify the mixes of challenges and opportunities for smart specialization depending on the organizational and institutional structures and policy and governance capacities in the region. These scientific contributions can be further used for making sound policy recommendations. More concretely, identification of the challenges is a necessary precondition for better understanding what kind of policy support is needed for different types of regions in order to achieve the full potential of smart specialization strategy. Furthermore, our analysis identifies at which geographical level (regional, national, EU) the challenges need to be addressed.

Relevance

Smart specialization is a new and fast growing domain the area of regional innovation policies. The advancement of theory building and collecting of empirical evidence goes well in-line with the overall theme of the conference 'Exploring New Avenues for Innovation and Research Policies'. Furthermore, smart specialization is also

identified as one of the emerging themes and topics relevant for the conference.

Reference list

- Asheim, B. and M. S. Gertler (2005). *The Geography of Innovation: Regional Innovation Systems*. The Oxford Handbook of Innovation J. Fagerberg, D. S. Mowery and R. R. Nelson. Oxford New York, Oxford University Press: 291-317.
- Boschma, R. (2014). "Constructing regional advantage and smart specialisation: comparison of two European policy concepts." *Scienze Regionali*.
- Coenen, L. (2007). "The role of universities in the regional innovation systems of the North East of England and Scania, Sweden: providing missing links?" *Environment and Planning C: Government and Policy* 25: 803-821.
- Cooke, P. (2001). "Regional Innovation Systems, Clusters, and the Knowledge Economy." *Industrial and Corporate Change* 10(4): 945-974.
- European Commission (2011). *Regional policy for smart growth in Europe 2020*. Brussels, EU Publication Office.
- Foray, D. (2015). *Smart specialization: Opportunities and challenges for regional innovation policies*. Abingdon, Routledge.
- Foray, D., P. A. David and B. H. Hall (2011). *Smart specialisation From academic idea to political instrument, the surprising career of a concept and the difficulties involved in its implementation*, EPFL.
- Gertler, M. S. (2010). "Rules of the Game: The Place of Institutions in Regional Economic Change." *Regional Studies* 44(1): 1-15.
- Isaksen, A. and M. Trippl (2014). *Regional industrial path development in different regional innovation systems: A conceptual analysis*. Papers in Innovation Studies. Lund, CIRCLE, Lund University.
- Martin, R. and J. Moodysson (2013). "Comparing Knowledge Bases: On the Geography and Organization of Knowledge Sourcing in the Regional Innovation System of Scania, Sweden." *European Urban and Regional Studies* 20(2): 170-187.
- Martin, R., J. Moodysson and E. Zukauskaitė (2011). "Regional innovation policy beyond 'best practice': Lessons from Sweden." *Journal of the Knowledge Economy* 2(4): 550-568.
- McCann, P. and R. Ortega-Argilés (2013). "Modern regional innovation policy." *Cambridge Journal of Regions, Economy and Society* 6(2): 187-216.
- Rodríguez-Pose, A. (2013). "Do institutions matter for regional development?" *Regional Studies* 47(7): 1034-1047.
- Tödtling, F. and M. Trippl (2005). "One Size Fits All? Towards a Differentiated Regional Innovation Policy Approach." *Research Policy* 34: 1203-1219.
- Zukauskaitė, E. (2013). *Institutions and the Geography of Innovation: A Regional Perspective*. Lund, Lund University.

Energy in smart specialization strategies: an exploratory study

Eli Fyhn Ullern*(SINTEF Technology and Society), Markus Steen(SINTEF Technology and Society) and Fabian Faller(Kiel University)

*eli.fyhn.ullern@sintef.no

KEYWORDS: Smart specialization, Policy, Regional development, Energy, Europe

1 Relevance

This article relates to the conference sub-theme of sustainability transitions, green innovation and smart specialization (under "Emerging themes and topics"). More specifically, the article explores the role of energy (deployment and technological development) in smart specialisation strategies.

2 Research aims and questions

Few studies have thus far been conducted on smart specialisation and energy. We see it as an important topic of investigation due to the high policy importance attached to energy in the European context on the one hand, and the introduction of the smart specialisation strategy as a framework for regional development on the other.

Decarbonization of the energy sector is crucial to limiting global temperatures to 2C above pre-industrial levels (Messner et al., 2010) and one of the 'grand challenges' confronting policy makers on all scales (Coenen et al., 2015). The European Union (EU) has set ambitious targets of reducing its GHG emissions by 40% (compared to 1990) and to achieve at least 27% share of renewables in its energy mix by 2030.

At the same time the EU has recently introduced a new research and innovation strategy for national and regional development. This strategy – Smart Specialization (RIS3) – has key features in considering knowledge and innovation as main drivers of regional development, and in seeing public policy as crucial in promoting knowledge assets and innovation processes (Boschma, 2013). Energy is alongside digital growth, key enabling technologies (KETs), "Blue Growth" and "Value Chains" a priority area in the RIS3 policy strategy. To support this priority area, an S3P Energy platform was recently launched. This platform is "planned to become an enabling tool for regions to coordinate, rationalise and plan their respective energy strategies, develop a shared vision on knowledge-based energy policy development, and set up a strategic agenda of collaborative work."

In developing RIS3 strategies, which is an ex ante conditionality for receiving EU structural funds, a key aim is to arrive at a set of priorities which are built on region-specific assets. The governing idea behind smart specialisation is that regions – and less advanced and transitions regions in particular – need to develop both generic and specific capabilities (linked to particular technologies and industries) that will enable them to achieve competitive advantages in certain market niches.

Against this background, the aim of the article is to explore the extent of RIS3 strategies incorporating energy, the key priority rationales for choosing energy as a strategic area, and finally to analyse how RIS3 strategies relate to broader EU energy policy targets.

These aims translate into the following research questions:

1. What is the role of energy in RIS3 strategies?
2. How do RIS3 strategies (incorporating energy) relate to key priority rationales?
3. What are the rationales for prioritizing energy (in one way or the other) in RIS3 strategies?
4. How do these RIS3 strategies relate to broader EU policy targets for the energy sector?

3 Definitions and theoretical frameworks

Our theoretical discussion and literature reviews will cover the following topics:

1. Trace the history of the RIS3 framework and review the burgeoning literature addressing its merits and weaknesses.
2. Review the literature on the role of regions in promoting renewable energy technologies (developing, deploying, influencing national/EU level policy).

3.1 Smart specialisation

According to Foray (2014, 492), whom by many is regarded as the 'father' of the smart specialisation concept (Morgan, 2015), "the idea is neither to narrow down the development path of a region nor to produce some sort

of technological monoculture, [but rather to] generate new options or new specialities in order to diversify the structures of the regional economy." Thus, smart specialisation entails a shift from focusing on a particular industry or knowledge domain towards nurturing ((re)combinatory) innovations at the intersections of related sectors with complementary capabilities (McCann and Ortega-Argilés, 2013, Hansen and Coenen, 2015).

A central part of the development of RIS3 strategies is the concept of entrepreneurial discoveries. The entrepreneurial discovery process "assembles different actors and will lead to the development of a new activity – at the cross-roads between a new technology and a traditional sector – and structural changes (modernisation and diversification)" (Foray, 2014, 494). If successful, RIS3 agendas may contribute significantly to the development and deployment of more sustainable energy technologies.

A smart specialization strategy should therefore include the following core principles (of which 1-4 are of relevance to this article):

1. Place based approach (based on regional assets)
2. Strategic priorities
3. Entrepreneurial discoveries
4. Broad perspective on innovation
5. Evaluation and revision system for updating strategic choices.

As noted by Valdaliso et al. (2014) however, developing RIS3 strategies is no easy task. One particular challenge is that new strategies for specialisation may be strongly shaped by the past. Pugh (2014, 152), for instance, found that the Welsh smart specialization strategy largely follows a past policy approach based on cluster-rationales, omitting "the important entrepreneurial discovery process to identify the real strengths of the region." This suggests that the success or otherwise of a smart specialisation agenda will be strongly shaped by institutional context and quality of governance (McCann and Ortega-Argilés, 2014). As argued by Kroll (2015, 5) "political habits, practices and routines matter substantially for the degree of efficacy and efficiency with which new initiatives such as RIS3 can be implemented."

Another challenge is that RIS3 strategies (i.e. prioritized areas) may be in conflict with other policy strategies. In the domain of energy, for instance, some regions may choose to prioritize fossil fuel based industries (coal, oil, natural gas), which may be at odds with EU targets linked to emission reductions and increasing shares of renewable energy in the total energy mix.

3.2 The role of regions in promoting renewable energy

We suggest that regions can be seen as important for promoting renewable energy (RE) in (at least) three basic ways (Essletzbichler, 2012, Martin and Coenen, 2014, Mattes et al., 2015, Dewald and Fromhold-Eisebith, 2015). First, regions, or more specifically region-specific clusters or innovations systems, are important for the development of RE technology. Second, regions as administrative/political units can promote the deployment of RE technologies through setting ambitious targets within the local or regional market or by creating demand (market formation). Third, regions, or regionally embedded networks of actors, can influence national or even EU levels of policy to provide more favourable framework conditions for REs. It is beyond the scope of this article to address the third issue, but studies by (Faller, forthcoming) suggests that this is an important topic for further studies. However, what we will shed light on is how regional level RIS strategies align with EU energy policy targets.

4 Empirical material and methods

Our research questions will be based on the following empirical materials and methods:

1. The role of energy in Smart Specialization strategies: This will be based upon data from the EYE@RIS3 Smart Specialisation platform (i.e. an extensive mapping exercise).
2. How energy in RIS3 strategies relate to key priority rationales: Here we will conduct a more in-depth analysis of three case studies (Nordland in Norway, Schleswig-Holstein in Germany, and Galicia in Spain). This will be based on analysis of relevant policy documents and key stakeholder interviews.
3. How 'energy SS strategies' correspond with broader EU energy policy targets: this will be based on document analysis.

5 Expected outcomes

This article will shed light on both the extent of RIS3 strategies incorporating energy, the nature of these priorities (e.g. what types of energy technologies), and how these priorities relate to the key priority setting rationales in RIS3 strategies. As such, this article will contribute to enhanced understandings of the key RIS3 topics or processes of 'priority-setting' and 'entrepreneurial discovery.'

6 References

- BOSCHMA, R. 2013. Constructing regional advantage and smart specialization: Comparison of two European policy concepts. *Papers in Evolutionary Economic Geography*. Utrecht: Utrecht University.
- COENEN, L., HANSEN, T. & REKERS, J. V. 2015. Innovation Policy for Grand Challenges. An Economic Geography Perspective. *Geography Compass*, 9, 483-496.
- DEWALD, U. & FROMHOLD-EISEBITH, M. 2015. Trajectories of sustainability transitions in scale-transcending innovation systems: The case of photovoltaics. *Environmental Innovation and Societal Transitions*, 17, 110-125.
- ESSLETZBICHLER, J. 2012. Renewable Energy Technology and Path Creation: A Multi-scalar Approach to Energy Transition in the UK. *European Planning Studies*, 20, 791-816.
- FALLER, F. forthcoming. A practice approach to study the spatial dimensions of the energy transition. *Environmental Innovation and Societal Transitions*.
- FORAY, D. 2014. From smart specialisation to smart specialisation policy. *European Journal of Innovation Management*, 17, 492-507.
- HANSEN, T. & COENEN, L. 2015. The geography of sustainability transitions: Review, synthesis and reflections on an emergent research field. *Environmental Innovation and Societal Transitions*, 17, 92-109.
- JESSOP, B. 2001. Institutional Re(turns) and the Strategic – Relational Approach. *Environment and Planning A*, 33, 1213-1235.
- KROLL, H. 2015. Efforts to Implement Smart Specialization in Practice—Leading Unlike Horses to the Water. *European Planning Studies*, 23, 2079-2098.
- MARTIN, H. & COENEN, L. 2014. Institutional Context and Cluster Emergence: The Biogas Industry in Southern Sweden. *European Planning Studies*, 1-19.
- MATTES, J., HUBER, A. & KOEHRSEN, J. 2015. Energy transitions in small-scale regions – What we can learn from a regional innovation systems perspective. *Energy Policy*, 78, 255-264.
- MCCANN, P. & ORTEGA-ARGILÉS, R. 2013. Smart Specialization, Regional Growth and Applications to European Union Cohesion Policy. *Regional Studies*, 1-12.
- MCCANN, P. & ORTEGA-ARGILÉS, R. 2014. Smart specialisation in European regions: issues of strategy, institutions and implementation. *European Journal of Innovation Management*, 17, 409-427.
- MESSNER, D., SCHELLNHUBER, J., RAHMSTORF, S. & KLINGENFELD, D. 2010. The budget approach: A framework for a global transformation toward a low-carbon economy. *Journal of Renewable and Sustainable Energy*, 2, 031003.
- MORGAN, K. 2015. Smart Specialisation: Opportunities and Challenges for Regional Innovation Policy. *Regional Studies*, 49, 480-482.
- PUGH, R. E. 2014. 'Old wine in new bottles'? Smart Specialisation in Wales. *Regional Studies, Regional Science*, 1, 152-157.
- VALDALISO, J. M., MAGRO, E., NAVARRO, M., ARANGUREN, M. J. & WILSON, J. R. 2014. Path dependence in policies supporting smart specialisation strategies: Insights from the Basque case. *European Journal of Innovation Management*, 17, 390-408.

How outward looking is smart specialisation? Mechanisms, drivers and barriers to interregional collaboration in research and innovation policy.

Chiara Marzocchi(Manchester Institute of Innovation Research), Manchester Business School, **Jens Sörvik***(JRC-IPTS)and Elvira Uyarra(Manchester Institute of Innovation Research, Manchester Business School)

* jens.sorvik@ec.europa.eu

KEYWORDS: Inter-regional collaboration, Smart Specialisation, Innovation policy, Regional development, Transnational collaboration

Relevance and definitions

Research and innovation networks are increasingly global, as evidenced by growing shares of international R&D projects, co-patenting and co-publications (see e.g. Wagner and Leydesdorff, 2005). Notwithstanding the contribution of proximity and place to knowledge spillovers and local buzz (Bathelt et al., 2004) innovation networks are rarely contained within regional boundaries and often transcend regional and national borders. This contrasts sharply with the dominant practice of designing and implementing regional innovation policies solely within the restricted boundaries of administrative regions (OECD, 2013).

The importance of global innovation networks calls for a type of regional innovation policy that goes beyond regional borders and takes into account the degree to which actors in a region are able to connect to, and benefit from, such networks and resources. The recent advocacy for place-based approaches to regional development (Barca, 2009) and the development of research and innovation strategies for smart specialisation (RIS3) as an ex-ante conditionality within the new European Union cohesion policy framework have further stressed this need.

Smart Specialisation (S3) is a place-based policy that aims to engage stakeholders in valorising existing assets and local specificities and their future potential, and then mobilising key actors of economic change to realise that potential, including linking to extra regional assets and resources (Foray et al., 2009; Foray, 2015). The policy advocates a process of selecting prioritised areas of economic activities with high transformative potential for the economy, and that regions specialise in these domains (EC, 2012). In S3 there is an increased focus on identifying niches, specialisation, cross-sectorial innovation and on solving societal challenges. With this comes an increased need for collaboration in order to deliver through value chains, to address international markets and to solve these challenges jointly with actors outside the regions. The RIS3 guide (EC, 2012) indeed emphasises the need for regional strategies to adopt an ‘outward looking’ approach in terms of their orientation towards global value chains, the assessment of priorities vis-à-vis other regions, as well as the consideration of cross regional projects and networks.

The knowledge base around collaboration in Smart Specialisation which is limited, points to the reasons for why regions might collaborate being multiple and including: to widen the pool of resources and knowledge bases; to access complementary assets; to compensate for competence or capability failures; to share cost; to counteract lock-in; and to facilitate policy coordination and policy learning. Furthermore, depending on competencies and capabilities, regions collaborate nationally and internationally, across borders and with non-contiguous regions. Partners depend on purposes and context and include public sector organisations (national and regional), industrial enterprises, academic institutions and non-governmental organisations (NGOs). The intensity of collaboration varies from sharing information on a one-off basis to joint strategies. The tools and mechanisms include information sharing, joint financing of projects and programmes, joint R&I infrastructure, demand-side tools such as innovation procurement, standard setting and alignment of activities and strategies.

Previous research on inter-regional collaboration for innovation has identified that regions face challenges in collaborating as a result of factors related to geographical or cultural proximities (Boschma, 2005); different levels of innovation and institutional systems; and engagement from key stakeholders (Lundquist and Trippel, 2013). There are also challenges with, lack of competences and skills necessary to work at cross-border and inter-regional levels and lack of clarity of the aims of collaboration and mismatch of incentives (OECD, 2013).

Research aim and questions

Yet, the motives and conditions for transnational and inter-regional policy collaboration in smart specialisation remains are so far underexplored (Uyarra et al., 2014). This paper seeks to address this gap by exploring the multiple rationales and dimensions underpinning inter-regional collaboration in research and innovation policy, mainly in the context of RIS3. The paper maps existing collaborative efforts across EU regions, including the geography of these emerging experiences, forms of collaboration, economic activity areas, perceived benefits, as well as drivers and barriers associated to such cooperation processes.

The focus is on four main research questions:

1. What can we learn from the mapping of the collaborative efforts?
2. What are the drivers and barriers to collaborative efforts across regions?
3. What is the perceived impact of past collaborative efforts?
4. How do regions intend to implement collaboration within the RIS3 framework?

Empirical materials and description of the methodologies

The paper draws on primary data collected via a dedicated survey to regional development agencies and managing authorities of 151 EU and associated countries' regions and 14 member states (Sörvik et al., 2016). The targeted survey respondents were those in charge of developing and implementing RIS3. The sampling frame was drawn from the population of regions registered with the Smart Specialisation Platform. The survey was sent to 455 members of the platform and 118 answered.

We used an on-line semi-structured survey that comprised both closed questions (developed according to the appropriate Likert scale, based on the previous working paper) and open questions to capture elements and factors arising from individual experience. The methodology followed a circular approach; specifically, the survey questionnaire linked different experiences of collaboration to drivers and barriers. Respondents who reported that they had participated in collaboration were first asked about the collaboration itself, about the main drivers and the perceived impact or outcome of the collaboration, and then about the barriers they encountered. Conversely, respondents who reported that did not participate in inter-regional or transnational collaboration were asked only about the barriers preventing their participation.

Initial findings and expected outcomes

Of the surveyed regions 54 % have past experience of collaboration in R&I, and in 69% of those, collaboration has increased in the last two years. Regions from the North of the EU collaborate the most and southern ones the least, whereas east European regions are in the middle.

The responses to the survey points to that the factors driving collaboration in R&I policy and the perceived benefits of collaboration include:

- policy learning (interregional learning and other 'soft' benefits);
- to enhance the build-up of critical mass in research (e.g. access to broader research base and knowledge networks);
- and to support businesses (to improve connectivity, service provision and access to markets).

Collaboration largely involves low-intensity activities that bring direct and immediate benefits; and it is most prominent in the initial steps of a RIS3 process, i.e. analysis, design and decision-making. The criteria underlying the choice of partners are in line with the RIS3 concept; they are based on industry composition (similar or complementary), research capabilities that are complementary or similar, as well as similar societal challenges. The survey findings regarding the geographical location of partnering regions can potentially contrast this, as regions most often collaborate with other regions in their own country.

The main barriers to collaboration seem to be inter-related and include lack of resources, insufficient political commitment, insufficient engagement of regional stakeholders and lack of clarity of objectives. One interpretation is that it is challenging to communicate clearly to stakeholders and politicians the outcomes of an intervention, with the result that stakeholders are unwilling commit or mobilise resources. The rationale for innovation policy interventions quite often is to support activities that provide indirect and dynamic benefits that are not easily measured, divisible or attributable to individual actors or activities. In contrast, the least

problematic barriers are socio-cultural issues, legal or administrative barriers and lack of trust.

With regard to the barriers there are some geographical differences:

- Lack of resources is the most relevant barrier across all the EU regions (North, South and East).
- Insufficient engagement of regional stakeholders and asymmetric levels of competence, are more prominent barriers in North and East, than in the South.
- Lack of trust between potential partners and socio-cultural mismatch are perceived more strongly as barriers in North Areas, than in East and South.
- Legal or administrative barriers, asymmetric levels of policy competence and lack of previous experience in policy collaboration are more perceived as challenges in East, than in South and North.
- South European regions more strongly are challenged by insufficient political commitment, and asymmetric incentives / mismatch of objectives.
- A lack of clarity of the objectives of collaboration is more strongly felt in South and East, than in the North.

The smart specialisation agenda seems to be a strong driver for interregional collaboration. However, collaboration is still mainly around ‘soft’ policy learning tools and there are limited collective efforts in the design, implementation and joint funding of S&I instruments beyond national borders. The drivers and perceived benefits differ across countries, with a continued emphasis on a place based approach taking into account each regions unique needs and opportunities. Objectives connected to inter regional seem unclear – and there is a need for more efforts in developing the knowledge base around the benefits and challenges of inter-regional collaboration in research and innovation.

References

- Barca, F. (2009), An Agenda for a Reformed Cohesion Policy: A place-based approach to meeting European Union challenges and expectations, Independent Report prepared at the request of Danuta Hübner, Commissioner for Regional Policy, European Commission, April 2009.
- Bathelt, H., Malmberg, A. and Maskell, P. (2004), Clusters and Knowledge: Local Buzz, Global Pipelines and the Process of Knowledge Creation. In: *Progress in Human Geography* 28(1), 31-56
- Boschma R. A. (2005) Proximity and innovation: a critical assessment, *Regional Studies* 39, 61-74.
- European Commission (2012), Guide to Research and Innovation Strategies for Smart Specialisation (RIS3), CEC, Brussels
- Foray, D. (2015), Smart specialisation: opportunities and challenges for regional innovation policy, Routledge, Abingdon, UK.
- Foray, D., David, P., and Hall, B. (2009), Smart specialisation — the concept, *Knowledge Economists Policy Brief*, No 9.
- Lundquist, K.-J., Trippel, M. (2013), Distance, Proximity and Types of Cross-border Innovation Systems: A Conceptual Analysis. *Regional Studies* 47, 450–460.
- OECD (2013), *Regions and Innovation: Collaborating across Borders*, OECD Reviews of Regional Innovation, OECD Publishing.
- Sörvik, J., Midtkandal, I., Marzocchi, C. and Uyarra, E. (2016), How Outward-looking is Smart Specialisation? Results from a survey on inter-regional collaboration in Smart Specialisation Strategies (RIS3), S3 Policy Brief Series No. 16/2016, Luxembourg (Luxembourg): Publications Office of the European Union; JRC100813
- Wagner, C. S., and Leydesdorff, L. (2005), Mapping the network of global science: comparing international co-authorships from 1990 to 2000. *International Journal of Technology and Globalisation*, 1(2), 185-208.
- Uyarra, E., Sörvik, J. and Midtkandal, I. (2014) ‘Interregional Collaboration in Research and Innovation Strategies for Smart Specialisation (RIS3)’ S3 Working Paper Series no 6/2014. JRC-IPTS Working Papers

Current status and future prospects of evidence-based research & innovation policy: the case of smart specialisation

Mafini Dosso*(European Commission, JRC-IPTS) and Sjoerd Hardeman(CPB Netherlands Bureau for Economic Policy Analysis)

* mafini.dosso@ec.europa.eu

KEYWORDS: Evidence-based policy, Research and innovation, Smart specialisation

1-2. Relevance and research question

Despite calls for evidence-based research and innovation policy (EBR&IP) becoming ever more vocal, its meaning and prospects remain more often than not in the midst. Going from its main antecedents, evidence-based medicine (EBM) and evidence-based policy (EBP) at large, the paper seeks to clarify the main steps and bottlenecks in practicing EBR&IP-making, taking smart specialisation as a case to illustrate our points. As a main European Union's innovation policy tool, smart specialisation is about how R&D and innovation policies can steer changes in the technological and economic territorial development through supporting entrepreneurial discoveries and focusing on selected priority areas and activities embedded into the existing industrial base (Foray et al 2012, 2015). More, the formulation of smart specialisation strategies has now been set as an ex-ante conditionality to access the structural funds, "this means that every Member States and region have to have such a well-developed strategy in place, before they can receive EU financial support through the Structural Funds for their planned innovation measures" (p. 9, Foray et al 2012). Hence, our aim is to fill the gap in the literature on evidence-based research & innovation policymaking by offering a critical appraisal of EB(R&I)P and questioning on these grounds the smart specialisation policy approach.

3-4/6. Definitions, theoretical background and methodological approach

Our reflection initiates upon a parallel between EBM and EBP, where they refer to - "the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients" (Guyatt et al 1992, Sackett et al, 1996) (about progressing individuals or groups), respectively - . Here it is mainly shown that like EBM, evidence-based policy (EBP) is grounded in and clearly formulated on the hierarchical structure of and relationships among various pieces of evidence brought about by different kind of studies. Similarly, the EBP has not entered the stage without criticisms pointing to its empiricism, a narrow interpretation of the best evidence, a limited use in policy practices and the unproven superiority as a decision-making process.

In order to identify practical challenges or bottlenecks, we move further by adopting a step-based approach grounded in evidence-based practices (Davies et al, 2000, Petrosino et al, 2001, Pawson et al, 2011) and argue that practicing EBP-making comes to building bridges between the evidence and policy making cycles (for this latter see Bridgman & Davis, 2004) with the aim of producing evidence to support the policy decision and making. In other words for EBP these two cycles are explicitly meant to intersect and it is at these intersections that the main bottlenecks emerge. Finally the research and innovation strategies for smart specialisation or RIS3 are discussed in light of the bottlenecks identified. In doing so, the key concepts and principles of the approach are reviewed and the implications of adopting an evidence-based approach to S3 policy making are examined.

7. Science/policy advances: practical challenges of EBR&IP/EBRIS3

Key challenges for EBR&IP (EBRIS3) are identified at the science-policy interface. A first one concerns the identification of a problem requiring policy action or bringing in evidence on a problem or its significance. A second challenge consists in the definition of desired end-states and outcomes and in relating the former ones to the latter ones. The third challenge, appraise the available evidence, raises two related issues. A positive issue consists in identifying the evidence base on the desired cause(s)-effect(s) mechanisms, their outcomes and contexts of application. The normative issue anticipates on RIS3 not yet being fully evidence-based and pertains to the prospects of EBR&IP (i.e. to which extent smart specialisation strategies can be evidence-based?). Two other related challenges are the design of policy interventions and the translation of prior evidence into particular contexts.

The case study confirms the relevance of these challenges, also for the prospects of evidence-based smart specialisation.

First, as stated in the RIS3 Guide, the stated problem or cause of the treatment resides in the deficiencies of regional innovation strategies reflected in the lack of efficiency in the identification of priorities and the

interregional cooperation (Foray et al., 2012). As for the target group, smart specialisation is said to apply both to countries and regions.

Second, consider the broader goal of smart, innovation-driven, growth (see also Foray, D. Goenaga, 2013 for a dedicated brief). Whilst from the works of Solow (1956) and others it might be well accepted that innovation is good for welfare increases whenever interpreted as GDP growth, this does not imply that all innovation need be good for a generally accepted interpretation of welfare growth per se. As of now however, alternative welfare theoretic frameworks are hardly elaborated upon (but see Schubert, 2015) and evidence on the exact relation between innovation and such alternative welfare conceptualizations is generally absent (e.g. Dolan and Metcalfe 2012). Yet it is clear that, as it is questionable that “novelty is always a good thing” (Schubert, 2012), smart specialisation strategies need to account for the downsides to innovation first if it is to play a substantial role in increasing people’s welfare at large. As to the prospects of having a clearly specified end state at hand, a main issue holds whether such an unambiguous end state is, and in fact can be specified for smart specialisation.

Turning to the evidence base of smart specialisation, as noticed by its own proponents: “Many statements and arguments about smart specialisation have not been yet based on a sound base of empirical work so that the plea in favour of smart specialisation and the tools and instruments to support a smart specialisation strategy are made of more wishes and hopes than of empirical (stylized) facts. There is therefore a growing gap between the policy practice and the theory.” (Foray et al., 2011, p. 1). This also means that from its offspring, smart specialisation strategies have not been abundantly embedded within the academic literature. This is not say that no empirical work has been offered thus far that can be related to the notion of smart specialisation; much more the contrary. What is more is that, in as far as the idea has been embedded within the academic literature, it does not follow the same line entirely (De Groot et al 2015); especially its focus on systemic elements seems to be added on later and cannot be explicitly traced back to its sole academic antecedent, Hausmann and Rodrik (2003). Indeed, for one thing, there has been a lively debate, grounded in empirical work, on the role of regional specialisation (as opposed to diversification) in steering regional economic performance. On the one hand, albeit largely inconclusive, the evidence from this literature seems to point more in the direction of diversification, not specialisation as such, as the main driver of regional performance (De Groot et al., 2015). On the other hand, however, this literature arguably is not concerned with the “true” nature of the smart specialisation concept as (i) smart specialisation involves a recombination of activities from different sectorial or technological backgrounds and hence does not refer to a simple notion of specialisation as such and (ii) the smart specialisation concept intends to address both the emergence and evolution of regional development paths whilst the studies focusing on the distinction between diversification and specialisation focus primarily on agglomeration advantages in a static sense. In fact, it can even be said to be in line with smart specialisation in as far as it argues that not specialisation in existing activities but diversification into newly emerging activities which steers economic performance. Indeed, as for example stressed by McCann and Ortega-Argilés (2015) there is some evidence in support of related diversification as an important driver of regional economic development. Yet, as recognized by some of the most vocal exponents of this concept, the empirical puzzle is far from solved (Boschma and Frenken, 2011). In particular, the effects of what they call related variety differ when considering either innovation quantity or innovation quality (Castaldi et al., 2015), differ when considering either productivity growth, employment growth or unemployment growth (Frenken et al., 2007) and differ across sectors (Bishop and Gripaos, 2010). Although the importance of the insights gained from the various studies dealing with this issue cannot be denied, what holds is that thus far no solid evidence base has emerged that has been put under systematic scrutiny. Although sometimes referred to as being based on such a strong evidence base, it seems that in offering smart specialisation strategies as a policy tool it is sometimes too easily glossed over that the evidence around in the academic literature (be these grounded in theory or empirics) is still far from settled. Fourth, as for the resulting treatment - entrepreneurial discovery -, perceived as the original source of uncertainty reduction, its operationalization requires the analysis of diverse information most often held by entrepreneurs themselves. Further bottlenecks, actually hampering the current implementation of RIS3, relate to the specificity of regional innovation contexts and the definition of related industries within regional spaces.

Selected references

- Bishop, P., Gripaos, P. (2010). Spatial externalities, relatedness and sector employment growth in Great Britain. *Regional Studies (RS)*, 44(4), 443-54.
- Boschma, R., Frenken, K. (2011). The emerging empirics of evolutionary economic geography. *JEG*, 11(2), 295-307.
- Bridgman P & Davis G. (2004). *The Australian Policy Handbook*. Sydney, Allen & Unwin, 3rd ed.
- Castaldi, C., Frenken, K., Los, B. (2015). Related variety, unrelated variety and technological breakthroughs: an analysis of US state-level patenting. *RS*, 49(5), 767-81.
- Davies H. T. O., Nutley S. M. & Smith P. C. (eds) (2000). *What works? Evidence-based Policy and Practice in Public Services* Policy Press. 380 p.
- De Groot H. L., Poot, J., Smit, M. J. (2015). Which agglomeration externalities matter most and why? *JES*.
- Dolan, P., Metcalfe, R. (2012). The relationship between innovation and subjective wellbeing. *RP*, vol. 41(8), 1489-98.

- Foray D. (2015). *Smart Specialisation - Opportunities and Challenges for Regional Innovation Policy*. Routledge, Regions & Cities.
- Foray, D. Goenaga, X. (2013). The goals of smart specialisation. JRC, S3 Policy Brief Series No. 01/13.
- Foray, D., Goddard, J., Goenaga Beldarrain, X., Landabaso, M., McCann, P., Morgan, K., Nauwelaers, C., Ortega-Argiles, R. (2012). *Guide to Research & Innovation Strategies for Smart specialisation (RIS 3)*.
- Foray, D., David, P. A., Hall, B. (2011). Smart Specialisation: From academic idea to political instrument, the surprising career of a concept and the difficulties involved in its implementation. MTI Wp, 2011-001, EPFL.
- Frenken, K., Van Oort, F., Verburg, T. (2007). Related Variety, Unrelated Variety and Regional Economic Growth. RS, 41:5, 685-97.
- Guyatt G., et al. - Evidence-Based Medicine Working Group (1992). Evidence-based medicine. A new approach to teaching the practice of medicine. JAMA, 268,2420-5.
- Hausmann R., Rodrik, D. (2003). Economic development as self-discovery. JDE, 72(2), 603-33.
- McCann, P., Ortega-Argiles, R. (2013). Smart Specialization, Regional Growth and Applications to European Union Cohesion Policy. RS, 49(8),1291-1302.
- Pawson R., Wong G. & Owen L. (2011). Known Knowns, Known Unknowns, Unknown Unknowns: The Predicament of Evidence-Based Policy, AJE, 32, 518-46.
- Petrosino, A., Boruch, R. F., Soydan, H., Duggan, L., Sanchez-Meca, J. (2001). Meeting the challenges of evidence-based policy: the Campbell Collaboration. The Annals of the American Academy of Political and Social Science, 578(1), 14-34.
- Sackett, D. L., Rosenberg, W., Mc Gray, J.A., Haynes R.B, Richardson W.S. (1996). Evidence-based medicine: what it is and what it isn't. BMJ, 312, 71-2.
- Schubert, C. (2015). What Do We Mean When We Say That Innovation and Entrepreneurship (Policy) Increase Welfare? JEI, 49(1), 1-22.
- Schubert, C. (2012). Is novelty always a good thing? Towards an evolutionary welfare economics. JEE, 22(3), 585-619.
- Solow, R. (1956). A contribution to the theory of economic growth. QJE, 70 (1), 65-94.

4C. TRACK THEME 9: FOSTERING INNOVATION AND INDUSTRIAL DEVELOPMENT IN GLOBALIZED INNOVATION SYSTEMS: POLICY CHALLENGES IN A MULTIPOLAR WORLD ECONOMY (I)

Capturing local value creation in the MENA region by integration into global solar value chains

Sylvia Borbonus
(Institute for Advanced Sustainability Studies)
sylvia.borbonus@iass-potsdam.de

KEYWORDS: Solar energy, Local value creation, Global value chains

1. Relevance for the conference theme and for track theme 9

Global Value Chains (GVC) are geographically differentiating: The majority of developing countries, including the poorest, are increasingly participating in GVCs (UNCTAD, 2013). This trend towards a multi polar world economy has also become highly relevant to renewable energy technologies.

As costs fall, renewable energy markets continue to diversify geographically (REN21, 2015). While Europe remained an important regional market and a center for innovation, activity continued to shift towards other regions. China again led the world in new renewable power capacity installations in 2014, and Brazil, India, and South Africa accounted for a large share of the capacity added in their respective regions. At the same time, the number of developing countries across Asia, Africa, and Latin America that were manufacturing and deploying renewable energy technologies continued to expand.

By opening up access to new – and often higher value – markets, participation in GVCs offers emerging and developing economies an opportunity to add more value within their local industries, expand employment and raise income. There is growing interest in developing the renewable energy value chain in the MENA region, and several countries already have developed policies to stimulate local manufacturing and innovation, and to generally promote higher local content in both renewable energy hardware and ongoing maintenance of plants and equipment (REN21, 2013). Apart from the need to maximize the local value-added from renewable energy deployment, the countries all have an interest in creating more skilled employment and more business opportunities for local entrepreneurs.

Egypt, Morocco, and Tunisia provide examples of different approaches to developing a local solar energy value chain, with considerable scope for appropriate policies and instruments to localize the value chain despite the various challenges related to global competition, intellectual property rights, and capacity needs.

2. Research aims and questions

While extensive research has been undertaken to identify what constrains the competitiveness of the developing countries in international trade, less focus has been placed on understanding the parameters of these constraints within the value chain setting specifically (Bamber et al., 2014). The paper has the objective to contribute to the existing literature by investigating the factors that affect competitiveness of developing countries in the context of value chains. It aims at answering the analytical question which key factors influence the ability of developing countries to participate in given GVC activities and under what conditions they can retain significant returns or benefits.

The paper intends to shed light on the analytical question by exploring the following empirical question: Which factors affect the competitiveness in global solar value chains in Egypt, Morocco and Tunisia?

The paper delves into the following questions:

- In how far has integration into GVC enhanced local value creation and employment?
- How do the factors differ according to technology (concentrating solar power CSP, photovoltaics PV and solar water heaters), products and country characteristics?
- Under which preconditions, e.g. in terms of workforce development, are exports or local developments expected to play a major role in component demand in the future?

3. Definitions of the most central concepts

Global value chains are defined as the range of activities required to bring a product from its conception to the final consumer (globalvaluechains.org, 2011). In the context of globalization, the activities that constitute a value chain have generally been carried out in inter-firm networks on a global scale. By focusing on the sequences of tangible and intangible value-adding activities, from conception and production to end-use, GVC analysis provides a holistic view of global industries – both from the top down (for example examining how lead firms ‘govern’ their global-scale affiliate and supplier network) and from the bottom up (for example, asking how these business decisions affect the trajectory of economic and social ‘upgrading’ or ‘downgrading’ in specific countries and regions) (Gereffi and Fernandez-Stark, 2011).

4. Outline of the theoretical framework to be used

The paper draws on theoretical frameworks of the Global Value Chain (GVC) and Global Production Network (GPN) literature. Global value chain analysis has been helpful in mapping out the value chain of emerging industries based on key new technologies to gauge the possibilities for job creation in a “green” economy and to analyze energy efficiency best practices for industry (Gereffi and Fernandez-Stark, 2011).

There are four basic dimensions that GVC methodology explores: (1) an input-output structure, which describes the process of transforming raw material into final products; (2) a geographical consideration; (3) a governance structure, which explains how the value chain is controlled; and (4) an institutional context in which the industry value chain is embedded (Gereffi, 1995). Using these four fundamental dimensions, contributions from Gereffi (1999) and Humphrey and Schmidt (2002) developed an additional element of analysis referred to as upgrading, which describes the dynamic movement within the value chain by examining how producers shift between different stages of the chain.

5. Description of the empirical materials to be used

The paper relies on an extensive review of case literature on local solar manufacturing. The following case studies are exemplified: A study by the World Bank assesses the competitive positioning and potential of MENA countries, i.e. Morocco, Algeria, Tunisia, Egypt and Jordan, and companies in the manufacturing of key CSP components (e.g. concentrating mirrors, tracking systems, absorber tubes and storage systems) (World Bank, 2011). A follow-up study concentrates on the local manufacturing potential for solar technology components in Egypt (World Bank, 2015). Borbonus et al. have conducted a value chain analysis of solar energy technologies in order to investigate the component manufacturing potential in Tunisia (Borbonus et al., 2013). Lehr et al. explore employment, qualification and economic effects of renewable energy and energy efficiency in Tunisia (Lehr et al. 2012). Achieving inclusive competitiveness in the emerging solar energy sector in Morocco has been investigated by Vidican et al. (Vidican et al., 2013).

6. Description of the methodologies applied

The paper is based on secondary information collected through a survey on the existing literature about GVC in developing countries. It draws on scientific as well as non-academic (grey) literature. The literature review will be enriched by trade statistics.

A combination of macro-trade-level analysis with meso-level value chain analysis – two concepts central to GVC analysis – is likely to explain how gains and benefits from GVC integration can be captured. An analytical framework based on these two concepts will be developed. It combines the basic dimensions of the GVC methodology with a detailed solar sector analysis in the selected countries.

7. Expected outcomes (scientific and policy advances)

Insights from this analysis would provide a starting point for the discussion of the domestic policies and actions needed to promote and support developing countries beneficial participation in value chains. For example, GVCs can be an important avenue for MENA countries to build productive capacity and skill building opening up opportunities for longer-term industrial upgrading. The results are expected to help advance enabling policies for a sustained participation in these value chains.

Vertical and horizontal dimensions of upgrading in global value chains: insights from the establishment of local manufacturing of wind turbine components in South Africa

Thomas Hebo Larsen* and Ulrich Elmer Hansen

(UNEP DTU Partnership)

* thelar@dtu.dk

KEYWORDS: Global value chains, Industrial policy, Wind turbine industry, South Africa, Upgrading

1. Introduction

An inherent feature of globalization is the increasing relocation of production activities across developed and developing countries. The literature on global value chains (GVC) addresses how this restructuring of production is organized focusing specifically on implications for developing country firms (Gereffi et al., 2005). The concept of upgrading is used to describe how competitiveness of developing country firms may be improved by capturing a higher share of value-added from their insertion in GVCs (Humphrey and Schmitz, 2002). The predominant orientation in the literature is to focus on the vertical dimension that influences the prospects for the insertion and upgrading of local suppliers. The vertical dimension includes the relationships between buyers and suppliers, the movement of goods and services and the flow of material resources along the value chain. In particular, research on upgrading in GVCs focus on the key role of lead firms in creating the conditions for upgrading (Kaplinsky 2000).

This focus on the vertical dimension has been criticized for its lack of attention to the horizontal dimension that could be of equal importance in creating the conditions for the insertion and upgrading of local suppliers in GVCs (Bolwig et al., 2010). The horizontal dimension includes such things as the local institutional structure, economic and political framework conditions, physical infrastructure etc. While these chain external conditions may have significant influence on value-chain governance and processes of upgrading, a thorough understanding of the interplay between the vertical and horizontal dimensions of upgrading is currently lacking.

This paper contributes to addressing this knowledge gap by exploring the role of industrial policy as an important horizontal dimension influencing the insertion and upgrading of local suppliers in GVCs. The main research question guiding the paper is: what is the relative importance of (internal) vertical value chain dynamics and (external) horizontal industrial policies in the insertion and upgrading of local suppliers in GVCs? This question is analysed empirically in relation to the establishment of local production of key wind turbine components in South Africa.

2. Analytical framework and research methods

To address the vertical dimension of upgrading, this paper draws on the GVC literature, which posits that opportunities for upgrading depend upon the governance structure of the chain (Humphrey & Schmitz, 2002). The governance structure varies across industries according to the complexity of transactions, the ability to codify transactions and the capabilities of lead firms and suppliers (Gereffi et al., 2005). Therefore, variability in governance structure conditions the prospects for upgrading (Humphrey & Schmitz, 2002). The literature has generally established that product and process upgrading is likely to occur in captive value chains while functional upgrading is more likely to take place in relational value chains (Guiliani et al, 2005).

As a way of addressing the horizontal dimension of upgrading we draw on the literature on infant industries, which focuses on the active role of industrial policy in orchestrating upgrading (Amsden, 1989; Kim, 1997; Wade, 1998; Mathews and Cho, 1999). This literature draws particularly on the experience from the so-called 'Asian miracles' during the 1990s, which were generally shown to require a highly committed state apparatus closely involved in industry development (Angel and Rock, 2009). We draw specifically on the framework proposed by Schmitz (2007) to address the ability of industrial policies to support local industries in overcoming marketing and technology-related gaps.

These analytical perspectives are combined in an explorative way to analyze the establishment of local production of key wind turbine components in South Africa. Data has been collected through nine semi-structured interviews with key stakeholders within the government of South Africa, the domestic wind turbine industry and the global industry. In addition, data from a number of documentary sources such as policy documents, industry reports and news articles was applied to add depth to the analysis.

3. Key findings

3.1. Vertical dimension

Lead firms within the global wind turbine industry are increasingly focusing on key activities in the value chain and leaving the manufacturing of components as a "window of opportunity" for external suppliers. However, lead firms have high concerns over the quality of components and rely on a small group of established suppliers. The industry is witnessing increasing global integration through market-seeking FDI, which results in regional production hubs emerging in places of significant demand. Historically, the provision of a large and stable long-term demand has been critical for attracting lead firms to localize production.

The governance structure in the industry varies across components. The production of towers is most often offshored due to its bulky nature and the lower technological requirements for production. Blades require significant technological capacity and lead firms rely on either in-house production or external supply from a single, globally-operating supplier. Nacelle components such as the gearbox, generator and converter are likewise produced in-house or outsourced to a small group of trusted suppliers. However, some nacelle components are beginning to be sourced from China due to significant cost advantages.

3.2. Horizontal dimension

The South African government has identified the renewable energy sector as a strategic area promising upgrading of domestic capabilities. The aim is to establish South Africa as a regional production hub. The government has planned to expand renewable energy supply by almost 10,000 MW of wind power by 2030 through a phased procurement program initiated in 2011. The first pilot project was constructed as late as in 2007 and the procurement program caused an expansion from practically zero to almost 600 MW of installed capacity from 2013 to 2014. The main industrial policy component of the program is the inclusion of local content requirements that are intended to increase gradually. Other criteria that were applied to evaluate bids include local ownership, enterprise development and job creation. Towers and blades were identified as the components most relevant for local production. Results from the third and latest procurement round revealed how as much as 75% local content was secured through towers and the balance of plant for the turbines.

The South African wind turbine industry faces a wide technology gap but a relatively narrow marketing gap. As such, encouraging licensing and joint ventures would be the most optimal industrial policy in order to acquire technology. However, for blades and nacelle components the marketing gap is higher because of lead firms' reliance on suppliers with proven track records and thus attracting FDI becomes relevant.

4. Discussion

The findings show that one local and one foreign company have initiated local production of towers. This can be explained by the local content requirements adopted by the government and the tendency of lead firms to outsource the production of this component due the ease of codifying transactions. The local firm has acquired access to the technology through a technology partnership with a lead firm, but the modular governance structure within towers does not encourage further upgrading. However, the narrow marketing gap within towers does suggest that a policy of acquiring technology through licensing and joint ventures would be most optimal and, hence, the industrial policy does follow this prescription.

Concerning blades there has only been one local attempt at producing such components. However, the local company did not manage to achieve the necessary certification for its technology and was liquidated. This example reflects the high complexity of transactions of key components. Further, since South Africa is facing wide technology and marketing gaps when it comes to blades, attracting FDI is crucial. However, the demand in the local market is insufficient to attract the leading supplier of blades to localize production in South Africa. While the lead firm was close to starting construction of a blades factory, these plans were put on hold due to insecure political signals regarding the future allocations of wind power.

For nacelle components there have been no attempts at local manufacturing. This is due to high transaction complexity and insufficient market. Also, for the more easily codified nacelle components, such as power converters and transformers, South Africa does not present a cost-competitive alternative to Chinese suppliers. This could have presented an opportunity to enter into captive governance structures, which would potentially facilitate process and product upgrading.

The findings show that the horizontal dimension is highly important in accounting for the establishment of local tower production. This is clear from the way industrial policy has created demand through local content requirements. At the same time, the vertical dimension reveals how this component is often outsourced by lead firms due the ease of codifying it. Hence, a local firm possessing relatively high capabilities has been able to initiate production of towers. For both blades and nacelle components the vertical dimension explains the absence of local production. The high complexity of transactions coupled with a low ability to codify

transactions constitutes an extremely high entry barrier for new entrants. Nevertheless, the horizontal dimension show how the industrial policy nearly succeeded in attracting a lead firm within blades to set up local production. However, despite the inclusion of local content requirements, the rather large demand in South Africa does not suffice to attract localization of the most strategic components. Hence, the findings from this paper argue for the importance of considering both vertical and horizontal dimensions when assessing the emergence and/or absence of local production as an initial step for forming globally competitive industries.

Strategic Innovation Policy-Notes from a System-Evolutionary Perspective

Morris Teubal
(The Hebrew University of Jerusalem)
msmorris76@gmail.com

KEYWORDS: Strategic Innovation Policy, System Evolutionary perspective, Complex priority-related System Failures, Non market and market coordination, Dynamic links between innovation policy and other policies, Lack of country adaptation and Valleys of Death

The Context

The notion of Strategic Innovation Policy (SIP) is, to some extent, the outcome of the existing global crisis and the obstacles encountered in overcoming it. In the EU a key focus seemed to have been macroeconomic, e.g. repaying debt (like in the Greek case, initially without considering effects on aggregate demand and thereby capacity to pay debt in the future) coupled with 'structural reforms' in the area of wage policies and Pensions and elimination of other 'distortions' negatively affecting market forces. These policies have been justly criticized extensively by Krugman and others, from a variety of perspectives.

The key point concerning the existing critique, while interesting and worthwhile, has not gone far enough to incorporate key components of what could become a 'recovery and country adaptation' perspective. Thus countries currently face violent changes in their global and domestic environments, many of them qualitative changes involving strong links among different areas [linking e.g. innovation with social resilience, poverty reduction, immigration and personal security] in the short, medium and long term; radical uncertainty (i.e. involving non-calculable risks) and high rate of change of new (many of them, disruptive) technologies with potentially strong unemployment implications in the short run and, correspondingly, new strategic challenges for the medium and long term. Such challenges might have to consider further 'promotion of entrepreneurship', 'upgraded' vocational training and the generation of policy targeting options[weak, strong; direct and/or indirect- the latter through the reinforcement of the National Innovation System, see Galli and Teubal 1997]. for new or upgraded industries or clusters Thus Immanuel Wallerstein's criticism of the 'neo-liberal' approach and the almost exclusive focus on 'the market' or 'market forces'; and his requirement of "political action at the level of the states"—while true might not be enough for "sustaining aggregate demand" and thereby growth of Employment.

The proposed paper on Strategic Innovation Policy is based on the assumption that both i) an explicit, updated and sufficiently broad National and Government Strategy, i.e. a set of knowledge based priorities leading to broad/general policy objectives for 'downstream policy makers' to incorporate in their specific policy design and implementation efforts; and ii) broad-based Entrepreneurship at all levels (high, mid and low tech; and in Government)-- are necessary not only to assure market demand but to generate options & 'selection' of new market creation options including continuing structural change and growth with potentially strong implications for "country adaptation" (although, due to radical uncertainty - not 'sufficient' to assure effective country adaptation at all times).

Definition of SIP

A new way of looking at Innovation Policy at the national level termed Strategic Innovation Policy (SIP) is emerging. It is bound to substitute for what could be termed Traditional Innovation Policy which - in the presence of Market Failure (MF) - focuses on support of R&D/innovation undertaken by various organizational types within the Business Sector (BS) such as innovative SMEs, entrepreneurship and Start Ups, and other firms and corporations.

SIP is a broader concept focusing on multi-dimensional innovation support including support of pre-conditions such as absorption of new technologies, engineering, training of personnel, invention and even applied science. Such broad support is given across Key (Strategic) Priority Areas of the country concerned particularly those related to innovation and innovation policy (such as the Medical and Educational areas in many Advanced Countries), whether the activity is being undertaken by business firms or by other entities such as Technology Institutes, Research Organizations; Applied Research or Business Associations, and Universities & other institutions of higher learning. The SIP concept also includes identification and support of mutual links and

Division of Labor between innovation- support of the business sector and the above mentioned broad support of invention, other innovation pre-conditions and innovation in other institutions/organizations active in the above-mentioned KSPAs.

A key distinctive characteristic of SIP will be its strong impact on the continuous structural evolution of the National Innovation Systems (see Galli and Teubal chapter in Edquist et al 1997 book) and its potential co-evolution with key elements of country adaptation. Thus, the resultant broad-based promotion of innovation capabilities and eventually of innovation-related entrepreneurial clusters [both key elements of the National Innovation System] may generate options for SC-based economic growth which would also strengthen employment, inclusiveness, poverty reduction, and other KSPAs affecting country adaptability.

Another important difference between SIP and traditional Innovation policy concerns the justification for Government Intervention. Thus, the guiding justification of SIP is not only Market Failure (MF) but also an expanded concept of System Failure (SF-for basic concepts see Nelson and Metcalfe, various papers) which includes failures in the formulation and implementation of National & Government priorities ((Teubal 2016a) of which the above mentioned Key Priority Areas are a subset.

Other Characteristics

The first thing to note is that policymakers need to deal not only with current problems/issues & opportunities but also future ones. Given the radical uncertainty, he must attempt to go beyond his current 'knowledge' or perception both about opportunities and threats as well as concerning possible mechanisms to exploit/address/ them.

Three additional point should be clarified. First, qualitative analysis: is an important initial effort of SIP policymaking. Second, policy areas are interrelated. i.e coordination with priority setters and policy making in other KSPA, is important; Third, the time dimension should include both short term and middle & long term.

Note that a short term perspective and/or 'politics' may distort the 'implementation of SIP.

Key Strategic Priority Areas (KSPA) and Dynamic Links between SIP and other Policies

We mentioned that SIP should directly and indirectly support innovation across the various KSPA within an increasingly holistic perspective one which reflects the enhanced connectedness or interrelationships among the key strategic priority areas (KSPA) of a country. In what follows we show that the KSPA also "mediate" between SIP and other areas of policy e.g. innovations in a particular areas might set the base for effective Policy Targeting of Structural Change (SC) e.g. a new meso level entity like a new sector, industry or cluster (see example below). Therefore, effectively, the KSPA are part of the National Innovation System (Edquist 1997 and other papers)

The KSPA shown below includes Innovation as a key strategic priority area (see *0 below).

*0. Innovation

*a. Structural Change [SC]

*b. Education and (Vocational) Training;

*c. Health

*d. Employment

*e. Immigration

*f. Science and Invention

*g. Absorption of new Technologies;

*h. Entrepreneurship

*i. Social Welfare

*j. Personal Security

*k. Macro-economic Variables (Growth, Debt, etc).

An example of dynamic links between innovation policy and other policies the process leading to successful Policy Targeting of an Entrepreneurial, ICT oriented high tech cluster (EHTC) in Israel during 1993-7/9 (Avnimelech and Teubal 2004,6,8; Teubal 2014). The evolutionary process started with a problem namely, the Office of the Chief Scientist (OCS-the agency in charge of subsidizing business sector R&D) who--through R&D subsidies, had successfully supported innovative SMEs since the early 1970s-- was failing during the late

1980s in its efforts at supporting the wave of new high tech start up companies (SUs) that began operations since the early 1980s. The situation triggered a System Learning process involving the heads of the OCS and of Treasury/MOF. After numerous meetings at Silicon Valley, Boston, etc, they arrived at the following conclusion: the problem was absence of early stage Venture Capital (VC) i.e. a SU 'support' organization who could complement its financial support with effective added value in terms of strategic advice, management help, links to key agents in export markets, reputation effects, manpower & headhunting, etc. The resulting System Learning, however, had another implication: it helped policy makers both at the OCS and at the Treasury/MOF to visualize the possibility of policy targeting a new start-up oriented entrepreneurial cluster in Israel by focusing on creating a domestic early stage VC industry (which in fact became the key driver of emergence). The outcome was the well known Yozma Program which targeted domestic early stage VCs in the country, and which triggered and sustained a co-evolutionary, SU & VC-led emergence process. By the year 2000 Israel had a well developed EHTC involving an early stage VC industry.

4. Concluding Remarks

Enhanced Importance of

- *SIP which is a knowledge intensive and inter-priority linked view of innovation policy
- *Coordination and fruitful interaction between innovation policy making and policy making in other areas
- *Structural Evolution of National Innovation Systems
- *Flexibility and 'openness' in the priority and policy system.
- *Without strong Government Restructuring, existing political systems in some Advanced and Middle Income countries might not be up to the job
- * The outcome might be imperfect country adaptation to the changing environment.
- *Failures to Adapt and Valleys of Death which countries may fall into might lead to Failed States where 'politics' substantially interfered with the application of Knowledge [as expressed by the set of strategic priorities] in policy decision making (including innovation policy).

4D. TRACK THEME 5: INCLUSIVE INNOVATION POLICIES: RESEARCH AND POLICY INSIGHTS FROM THE GLOBAL NORTH AND SOUTH (I)

Democratizing innovation – stimulating consumer innovation in Sweden

Lars Bengtsson*(Lund University) and Peter Svensson(Vinnova)

*lars.bengtsson@iml.lth.se

KEYWORDS: Consumer innovation, Diffusion, Policies to stimulate consumer innovation

Most people know that companies develop new products and services or new ways to produce, distribute and doing business, which we call innovation when they successfully come into use. But that individuals, in their role as users, also develop various forms of innovations is less known. There is a lack of research on user innovation in a Swedish context and its importance for the Swedish economy. This research project aims to increase the empirical knowledge of consumers' user innovation in the Swedish population. In the study, we used a method that was obtained from a similar Finnish study (Kuusisto et al, 2013) and based on previous experience from investigations in Canada (Gault & von Hippel, 2009), the Netherlands (de Jong & von Hippel, 2009) , UK (von Hippel et al, 2010) as well as Japan and the United States (Ogawa & Pongtanalert, 2011). A random sample of 1000 Swedish persons, age 18-65 years of age, was interviewed to inquire about their innovative activities as users. The project results are important for user innovation theory and the Swedish innovation policy. The project also aims to propose innovation policies to stimulate and increase consumer innovation.

The survey of consumer innovation in Sweden, as in previous surveys of consumer innovation in Finland, Japan, the Netherlands, the UK and the US, has shown that there is extensive activity. The survey established that 7.3% of the Swedish population between 18-65 years were consumer innovators, equivalent to some 435.000 persons . This is a slightly higher rate than that reported in previous studies and countries, i.e., Sweden has one of the world's most active consumer innovation. This is good news for the Swedish creative economy. Consumer innovation contributes significantly to raising the experimental activity that also companies, public organizations, universities and independent inventors stands for. In addition, our investigation has confirmed that the typical consumer innovator is a highly educated man with a technical background. The most frequent areas of innovation are household products, computer and software, clothing and personal health, automotive and transport, as well as tools and equipment in the home.

Less good news is that the survey also confirmed, in line with previous surveys, that only a small proportion, about 20% of consumer innovations diffused beyond the innovator himself. This is despite the innovators itself estimates that approximately 60% of innovations are potentially useful for large or specific groups in society. 89% of the innovators are prepared to freely diffuse their innovations but in only 20% of cases it happened. In most cases, the diffusion occurred in personal networks, and only in a handful of cases through their own companies or through established companies.

The results indicate that the lack of diffusion of consumer innovations implies welfare losses for Swedish society and that policy measures are motivated primarily to stimulate and support a wider diffusion of consumer innovations but also to stimulate increased consumer innovation activity. We propose three main policy proposals and six concrete support measures. The general policy proposals are:

1. Design innovation policies that support consumer innovators in the development and diffusion activities.
2. Open up the society's various forms of innovation support also for individuals or in various forms of open and collaborative collaboration.
3. Develop incentives for consumer innovation so to stimulate and strengthen supply, demand and networks .

The proposals for the specific support measures are:

1. Provide support to the development of research and measurement of user innovation so that the phenomenon becomes more visible and increase understanding of its function in society.
2. Provide support and encouragement of supporting infrastructure and eco-system of consumer innovation by opening up existing support systems for individuals and invest in infrastructure-type Makers Spaces, Hacker Spaces and similar structures, and let the authorities and public organizations work with more competitions and innovation procurement where individuals are allowed to participate.
3. When regulations are introduced ensure that they are neutral in relation to the innovator's background and does not unfairly affect innovative individuals or independent inventors.
4. Provide support to the development of the capacity of consumer innovation by stimulating innovation

activities in the school system and in various forms user groups.

5. Increase the knowledge and use of Creative Commons licenses, i.e., government agencies and public organizations use these licenses to stimulate the use of data and other resources.

6. Consumer Innovation is relatively unknown. Vinnova and other innovation support organizations should increase awareness of consumer innovation in general by highlighting successful consumer innovation case.

There is every reason to believe that consumer innovation is not a transient phenomenon or declining. On the contrary, the increased consumer innovation activity measured in this study among younger generations, combined with a strong "Do It Yourself" - the norm about a growing phenomenon. In addition, the increased ability to develop and diffuse consumer innovations through technological advances and new fast and cheap communication options such as e-mail, the Internet, social media, open-source project, open databases of texts, images, data, and increased opportunities for the use of software development tools.

In this light the national innovation policy should consider a more balanced mix of support measures and regulations so that it also promotes independent innovation and not just established companies and universities. Even established businesses will benefit from this development because it creates more innovative employees and offers more opportunities to reorganize and streamline innovation activities through more extensive use of open innovation.

Innovation and productivity in a S&T intensive sector: the case of Information industries in Spain

Ibrahim Kholilul Rohman
(Institute for Prospective Technological Studies, European Commission.)
ibrahim.rohman@gmail.com

KEYWORDS: R&D, Innovation, ICT sector, Productivity, Firm level data, Panel

Néstor Duch-Brown, Andrea de Panizza and Ibrahim Kholilul Rohman

This paper adds to the empirical literature on the relationships between R&D, innovation and productivity at the firm level. The focus is on Spanish enterprises in Information industries, which are acknowledged to be at the forefront for both innovative activity and R&D performance. The analysis is performed on ca. 1800 enterprises included in the PITEC database (the Spanish source of the EU Community Innovation Survey) for the period 2004-2013. Using a three-stage "CDM" model we consider: (i) factors affecting the decision to conduct R&D, including the role of perceived importance of innovation on firm's R&D performance, (ii) the impact of the predicted R&D effort on companies' effective undertaking of product, process, organisational and marketing innovations, as well as their simultaneous occurrence and (iii) whether and to what extent such innovations boost productivity. In the specific context of this R&D intensive array of industries, the decision of undertaking R&D appears to be strongly influenced by the importance attributed to enhancing existing products or creating new ones, as well as by the size of the company, the fact of being young and local, and the availability public funding. These elements also greatly impact on enterprises' R&D effort, thus providing some arguments in favour of R&D promotion policies, in particularly addressed to start-ups. Expected R&D performance, in turn, appears to be strongly related to the actual achievement of such innovations, including non-technical ones. By focusing on innovation patterns, it was possible to ascertain a strong complementarity between different families of innovation (as expected, given these industries' specificities), as well as to qualify existing evidence on the innovation-productivity conundrum. Indeed, we show that results depend on the way innovation types are modelled and combined. Controlling for complementarities, enterprises performing focused non-technical innovations and joint technical and non-technical ones (mixed-mode innovators) are likely to be more productive (in terms of sales per capita) than their peers, while stand-alone technical innovations give inconclusive results.

Inclusiveness in innovation – what does it take to make it happen?

Mika Kautonen*, Nadja Nordling and Mika Raunio
(University of Tampere)
mika.kautonen@uta.fi

KEYWORDS: Inclusion, Inclusive innovation, Innovation policy, Sustainable economic development

1. Introduction: Relevance and key concepts

Recent years have witnessed an enlarged conception of participation into innovation activities, as well as emergence of policies with attempts to encourage new kind of stakeholders and interest groups to generate innovations, whether these are commercial or social by character. This inclusive approach concerns both the global north and south, although to somewhat different ways. To simplify, in less advanced economies of global south innovation activities are acquiring the form that is illustrated with definitions like inclusive, frugal, informal, pro-poor and so forth (e.g. Heeks, et al 2014; Cozzens & Sutz 2014; OECD 2012). These conceptions aim to capture the essence of the innovation activities in the environments where inequality, low skill level and/or lack of supportive institutions prevail. These conditions make innovative activities less likely and their impact on economic development weak or biased as they exclude the poor and/or other less advantaged groups from the process and its profitable outcomes (e.g. based on ethnicity, social strata, religion, gender). In advanced economies of global north the participation mode, or inclusive approach, has emerged from different reasons; open innovation, user-driven innovation or democratization of innovation (e.g. von Hippel 2005; Chesbrough 2003) are based on a view that innovativeness may be significantly increased by openness and including the users or other stakeholders to the co-creation and innovation process.

Consequently, a new perspective for the innovation policy seems to be a global attempt to link various groups to innovation processes in order to make it more equal or more profitable, or both. The social and equality aspects of the agenda are visible in the fact that key actors who are included and whose interaction is fostered are not limited to scientific communities, R&D labs or users only, but include various less advantaged groups as well. For example, the BOP approach clearly conceive poor in the developing countries (Prahalad 2004) as a market potential. However, as users, they have to be included to the innovation processes in order to develop products that have demand in those various BOP markets.

In advanced economies erosion of industrial employment in many countries; effects of digitalization also on many white-collar jobs; rise of competences, and increasing share of excluded population especially in form of long-term-unemployed and immigrants have generated conditions where inclusive innovation policies have developed beyond ideas of “wisdom of the crowd” (Surowiecky 2004) or broad-based innovation policies (e.g. Edquist et al. 2009) and inclusion do not refer only to users, but also to those excluded from innovation processes and their outcomes. Also frugal innovation mode that emerged in poor countries has moved to the context of advanced economies where it is seen as a disruptive growth strategy (Radjou & Prabhu 2015). In sphere of practitioners (e.g. companies, governments), several concepts bear this enlargement within themselves: Living Labs, open innovation platforms, crowdsourcing, open source software, and co-creation and co-design, to name just a few.

2. Aim and research questions

The paper aims at contributing to a scholarly discussion on inclusive tendencies in innovation policies. It specifically asks, first, what are the major differences in stylized “traditional” innovation policies vis-a-vis “inclusive” innovation policies and, second, what kind of new requirements and preconditions there seems to emerge along a more inclusive innovation policy – what does it take to make inclusiveness happen? As outlined above, inclusion is a multidimensional concept in relation to innovation and consequently its requirements for innovation policies may vary to a great extent regarding characteristics of excluded groups, national institutions, policy evolution, and so forth. Therefore, the paper should be conceived as an attempt to outline main contours of development.

3. Methodology

The paper is based on a literature study, enabled by an article search conducted in the Web of Science (Thomson-Reuters). This search will be used to form a database of a relevant literature. Because of a fairly large number of literature that have been published during the recent years*, much emphasis will be put on those

articles that are cited the most as they usually form a basis of scholarly understanding in their fields. Nevertheless, concentrating only on them would to a great extent mean concentrating on the articles published relatively long time ago as it is known that citations take many years to accumulate. For this reason, those more recent articles with less citations will be scrutinized in some detail that seem to come up with newer findings relevant to our goal in the paper.

A preliminary search in the WoS using topics “inclus” and “innov*” and refining the search into broadly conceived social sciences indicates there is approximately 1,000 publications. There has been a considerable growth of publications from 20-30 in a period of 2004-2007 to more than 120 publications in 2015. Similarly, number of citations has grown from about 200 in 2005 to more than 2,000 in 2015.

4. Expected outcomes

It can be expected that along with new kind of stakeholders and interest groups, policies and management practices face new challenges of which one concerns incentive system; not only economic incentives are relevant but also social incentives related to, for example, identity, belonging, learning, recognition and meaning (c.f. Zwass 2010). Another challenge related to an enlarged conception of participation into innovation activities concerns competences required in innovation processes; to gain access, to contribute and to reap benefits from innovation may demand a lot from new kind of stakeholders. However, there is a research gap regarding incentives and competences in relation to innovation policies. Yet another aspect that can be expected to stand out from the analysis is related to power and policy-making; for example, it cannot be simply assumed that once research knowledge is at place, it will be put into practice. Overall, innovation policy as well as research seems to be in need of profound reconsideration: inclusion has gained, until very recently, only very limited attention by scholars and policy-makers (see e.g. Altenburg 2009, Heeks et al. 2014).

European Integration and the attraction of skilled individuals to Sweden

Yannu Zheng* and Olof Ejermo
(Lund University)

* yannu.zheng@circle.lu.se

KEYWORDS: Selection, Education, Inventor, Innovation

Migration policies can have a strong impact on the selection of immigrants. In turn, this selection can impact on the host country's innovation development. The European Economic Area (EEA) agreement between EU and EFTA countries in 1994 allowed for the free movement of individuals within the EEA and in 1995 Sweden became a member of the European Union (EU). The EEA marked a changing emphasis on the role of immigrants to Sweden. Over the period 1975-1994, refugees dominated immigration, but since 1994 immigration for work reasons has become an increasingly important source of immigration. However, it is still not well investigated how the change in migration policy affected the selection of immigrants from other EU countries and its further implications on Sweden's inventive capabilities. Based on a new Swedish database of inventors between 1985 and 2007, this paper explores this question. The study focuses on immigrants from the EU-15 countries (excluding Sweden, Denmark and Finland) that were subject to the policy change. We employ difference-in-difference regressions in order to compare educational attainment and inventive capabilities through patent records of EU-15 immigrants before and after 1994 with immigrant capabilities from other originating regions. We indicate inventive capability through the probability of becoming an inventor, total number of patents per inventor attributed and forward citations of the patents filed.

4E. POLICY MIX FOR INNOVATION

Improving the innovation policy mix for SMEs in traditional industries

Rene Wintjes
(UNU-MERIT, Maastricht University)
r.wintjes@maastrichtuniversity.nl

KEYWORDS: Innovation policy, SMEs, Traditional sectors, Low-tech, Policy evaluation

Innovation support measures in the EU are mostly designed to support product innovation in R&D intensive sectors. To increase the still considerable contribution to regional employment and competitiveness from SMEs in traditional manufacturing industries a broader innovation (policy) mix is more appropriate. This paper draws data from a survey of over 300 SMEs from seven regions within the European Union, to address the question: How can innovation policy interventions be improved to support SMEs in traditional manufacturing industries more effectively. We claim that innovation support should be sensitive to the way SMEs in traditional manufacturing sectors innovate and grow. We find that product innovation (and support used for product innovation) is less likely to generate growth, than (support used for) process innovation. Also (support used for) marketing innovations and organisational innovations are of particular importance – together with internationalisation, design and cooperation.

1. Introduction

This paper focuses on the impact of innovation support measures for SMEs in traditional manufacturing industries across 7 regions in different European countries.

Traditional industries include inter alia the manufacture of food products and beverages, textiles and textile products, leather and leather products, ceramics or other non-metallic mineral products, mechanical/metallurgy or basic metals and fabricated metal products, and automotive or motor vehicles, trailers and semi-trailers. Our definition of a traditional manufacturing sector is slightly different from the OECD classification of “high”, “medium” and “low-tech” industries, which is based on the R&D intensity of the industries. Instead we defined as “traditional” those manufacturing industries with the following characteristics: long established; once a main source of employment at the (sub-)regional level; recent decline; still a major source of wealth creation, employment and exports; and retention of capacity for innovation.

The regional economic importance of innovative SMEs in traditional manufacturing sectors is often neglected (Robertson 2009). Most attention goes to SMEs in research intensive sectors and innovation policy support is focused on supporting the most innovative and R&D intensive firms. Maskell (1998) stated that “The prevailing ethos of high-tech production makes it easy to forget that low-tech industries are not synonymous with low growth or low profitability”(p.99). Hirsch-Kreinsen (2008) refers to low-tech industries as a forgotten sector in innovation policy.

2. Literature

According to Soete (2009) the focus on R&D and high-tech SMEs in EU policy (e.g. in the Lisbon agenda and the Barcelona target to spend 3% of GDP on R&D) was rooted in the idea that the lagging EU productivity was caused by a failure in structural change towards R&D intensive high-tech sectors. According to Mason & Brown (2013) policy makers also favour high-tech sectors because they would generate more high-growth firms than low-tech sectors, but several studies show that high-growth firms are not overrepresented in high-tech sectors (Henrekson & Johansson 2010; Bleda et al. 2013). For instance in the UK high-growth firms are almost equally present in high-tech and low-tech sectors (Nesta 2009). High-growth firms are not necessarily R&D intensive (Brown et al. 2014).

Studies of innovating firms have revealed that the multiple sources of knowledge creation, learning and innovation have become broader and more complex, regardless of the R&D intensiveness of their industry. Innovation surveys show that R&D is indeed not the sole source of innovation for firms (Arundel et al. 2008; Mairesse and Mohnen 2010). Potters (2009, p.13) shows that this is especially the case for companies in ‘low-tech’ sectors, for which: “Important inputs to innovation output – other than R&D – are technology acquisition, organisational and managerial innovation, design and marketing”. Therefore, R&D policy needs to be complemented with specific measures targeting business innovation according to the needs of the existing industries and firms (Nauwelaers & Wintjes 2002).

Rejecting the notion of a single best practice instrument for every type of ambition or need, we rather aim to explain the difference between interventions: which kind of support is good for which kind of innovation and which kind of impact?

3. Methodology

Most of the scientific literature on the impact of innovation policy support focus on a single attribution question: does ‘treatment’ in the form of R&D subsidies make a difference. Since the literature questions the relevance of product R&D for SMEs in traditional manufacturing industries, and suggests that many other innovative activities matter, we evaluate the various contributions from different interventions. In counterfactual evaluations, many questions concerning why, how and for whom the different interventions work or do not work, are often ignored. For the sake of accountability it might be sufficient when an econometric evaluation can assess to a high level of certainty if policy intervention worked or not, however for improving policy more insights are needed.

The survey sample includes 312 SMEs, comprising 145 firms that have participated in an innovation policy support measure and 167 firms which did not participate in any innovation support measure. The first part of the survey largely followed the questions and definitions as used in the Community Innovation Survey, e.g. concerning innovation input, output and concerning product innovation, process innovation, organisational innovation and marketing innovation. The second part of the survey addressed public support for innovation. Those who had received support were asked a few questions for a maximum of two support measures: e.g., for which kind of innovation they had used the support, and to rate themselves the importance of 20 predefined, possible impacts from the concerning support.

4. Survey analysis: comparing types of innovation support measures on impact

Based on the survey data we can indicate the extent of impact from participation in various types of schemes. The responding participants gave a score on a wide range of possible impacts for one or two of the most important programmes they participated in. The impact from Collaborative programmes and especially the support measures concerning Internationalisation seem to be the ones generating relatively high impacts in certain fields of impact. For the largest group of measures: ‘internal innovation’ the impact-scores are often close to average, with less outstanding fields of impact. The high impact-fields are often not very surprising. For example, collaborative schemes generate specifically high impacts on ‘Formation of new partnerships and networks’, and Internationalisation measures specifically score well on ‘Internationalisation of activities’.

The information captured by the answers on the 20 impact questions have been reduced into four impact factors, with the use of principal component analysis. The main factor (which explains the largest share of the explained variance) consists amongst others of the impacts on ‘access to markets’, increased profitability, increased turnover, commercial linkages and internationalisation. This impact factor has been labeled ‘access to markets’. The second factor includes, amongst others ‘R&D linkages and improved research competence and is labeled ‘R&D links’. The third factor includes the impact on: business and innovation strategy, improved internal organization, skills and design & marketing capabilities, and has been labeled ‘Strategy, organization & skills’. The fourth factor has been labeled ‘Certification’.

The first three self-claimed impact factor scores are significantly different for the various types of support measures. Firms that participated in an internationalisation scheme have on average the highest impact factor score on ‘access to markets’. The participants in collaborative programmes have a high score on the impact factor ‘R&D links’, which is much higher than for participants in ‘Internal innovation’ schemes, which to a large extent consists of R&D subsidies. This suggests that collaborative measures are more effective in generating impact in terms of R&D.

The support is mostly used for product innovations, but impact in terms of innovation input, realized innovations, increased innovation capacities, and economic output seems less than could have been achieved when the support was used for process innovation, organizational innovation or marketing innovation.

5. Conclusions

For SMEs in traditional industries we can conclude that for all four types of innovations, improved capabilities matter for innovation output, but that realizing a product innovation is less likely to generate growth. A second conclusion is that firms which are supported more frequently are most likely to take the innovative step anyhow, irrespective of programme support. A third conclusion is that the support is mostly used for product innovations, but impact in terms of innovation

input, realized innovations, increased innovation capacities, and economic output seems less than could have been achieved when the support was used for process innovation, organizational innovation or marketing innovation.

The innovation measures have a limited, or not optimal, impact in terms of additionality, which is due to: lack of marketing for innovation support measures to recruit a wide range of potential beneficiaries; restricted programme access and “cherry picking” selection procedures, which means that support goes (and goes more frequently) to firms that are most likely to innovate in any case; too narrow focus within support measures on product innovation.

There is potential for improving the overall innovation outcomes of innovation support programmes for SMEs in traditional manufacturing industry by selecting firms with the most to gain from support rather than selecting those with the greatest propensity to innovate but the least to gain from support.

Policymakers should rather support a broadened discovery and experimentation processes than a narrow, one-size-fits-all subsidized prescription focussing on R&D for product innovation, which merely steers the outcome of a cost-benefit analysis, incident by incident, towards only this specific type of innovation. In this respect both the SME and the policy maker should engage in a discovery process which goes beyond the ‘dominant logic’ of product innovation.

Characterizing the policy mix and its impact on eco-innovation in energy-efficient technologies

Valeria Costantini (Roma Tre University), **Francesco Crespi*** (Roma Tre University) and Alessandro Palma (Bocconi University)

*francesco.crespi@uniroma3.it

KEYWORDS: Policy mix, Eco-innovation, Policy spillovers, Energy efficiency, Sustainable transition

The analysis of how different technological domains broadly classified as the eco-innovation field have evolved in recent years is attracting growing attention both at academic and policy level. The current debate has adopted distinguished analytical perspectives in order to better understand the dynamics, characteristics, and determinants of eco-innovation (Arundel and Kemp, 2009; Beise and Rennings, 2005; Berkhout, 2011; Cainelli and Mazzanti, 2013; Kemp and Oltra, 2011; Marin, 2014; Markard et al., 2012; OECD, 2011; van den Bergh et al., 2007; Wagner, 2007). These studies suggest that a variety of factors drive eco-innovation but also highlight the primary role played by public policies (environmental regulation, energy and technology policies) that are increasingly used to foster the rate of introduction and the diffusion of new environmental technologies to meet sustainable development goals (del Río, 2009a; Horbach et al., 2012; Johnstone et al., 2010; Mowery et al., 2010; Newell, 2010).

The bulk of previous literature has focused attention on the impact of single (though different) policy instruments mainly belonging to the two broad categories of demand-pull and supply-push instruments (Bergek and Berggren, 2014; Horbach et al., 2012; Kemp and Pontoglio, 2011; Peters et al., 2012; Rennings, 2000). Recent empirical contributions demonstrate that these instruments have differentiated impacts on the diverse types of innovative activities such as those related to the introduction of incremental or radical innovations (Nemet, 2009) or associated with technological exploitation or exploration activities (Costantini et al., 2015; Hoppmann et al., 2013). However, there is growing interest in understanding the role played by the different combinations of the available policy instruments in stimulating and directing technical change. In particular, the literature has recently focused on the role of policy mix and the consequences of policy interactions and interdependencies between different policy instruments (Flanagan et al., 2011; Rogge and Reichardt, 2013). In this respect, policy mix studies applied to eco-innovation domains tend to be limited in examining the effects of the mix design and instrument interactions (del Río and Hernández, 2007; IEA, 2011a,b) and further empirical analysis is required in order to assess the contribution of policy instrument interaction in a systemic view (Coenen and Díaz López, 2010).

Following recent contributions based on detailed case studies or firm level surveys that explore the possibility of analysing the impact on eco-innovation produced by the policy mix and its characteristics (Mattes et al., 2014; Reichardt and Rogge, 2014), here we propose a quantitative analysis based on a large sample of OECD countries aimed at measuring some relevant characteristics of the policy mix and quantifying their impact on innovation activities through panel data econometrics. In doing so, we contribute to the literature by developing a characterization of the policy mix that attempts to be both informative and measurable in order to analyse the innovation effects not only of policy mix elements but also of its characteristics, thus deriving new policy insights into how to design policy mix in order to foster the development of environmental-friendly technologies. This analytical perspective is applied to the Energy Efficiency (EE) technological domain, which appears to be particularly relevant since it is characterized by the interplay of a wide range of agents and policy instruments involved, acting in different directions and with different objectives. As a matter of fact, the pervasiveness of energy consumption in the whole socio-economic context (from private consumers to large scale manufacturing production) confers to this technological domain some specific features that should be carefully investigated when a complex policy strategy is designed (Costantini and Mazzanti, 2012). The complexity of this domain deserves a specific effort in developing an appropriate analytic framework in order to capture the large number of linkages influencing the dynamic pattern of technological activities (del Río and Hernandez, 2007; Florax et al., 2011). For this purpose, our approach aims to complement standard policy innovation inducement analyses with a deeper investigation of how the characteristics of the policy mix influence the technological trajectories in this domain.

Our analysis shows that different policy types, including the soft instruments represented here by information and education, policy and RD&D support and voluntary approaches, are effective in influencing innovation dynamics in the energy efficiency domain. While the direct impact of individual instruments is confirmed, the analysis of the characteristics of the policy mix allows us to make a step further with regard to existing studies by revealing new insights into how to design an effective combination of different instruments.

First, the empirical analysis shows that a more comprehensive policy mix is able to enhance innovation activities in the domain of EE technologies. However, our results also reveal that the simple addition of an indiscriminate number of simultaneous policy instruments may create inconsistencies. These are associated with coordination problems, mainly in terms of potential conflicting effects determined by the co-existence of too many policy instruments, potentially reducing the innovation inducement capacity of the overall policy effort. In this respect, an implication that arises from our analysis is that an active role by governments in coordinating the complex interaction between different instruments in order to fully exploit its innovation inducement effect is certainly needed.

Second, a more balanced use of the different policy instruments adopted at the domestic level seems to be a good policy strategy to be adopted since, *ceteris paribus*, it has a positive influence on innovation dynamics. When the intensity of policy efforts is not concentrated in just one or few instruments, relevant agents may perceive the overall policy strategy as more stable and characterized by a long-term view. This may lead to the innovation system reacting positively to lower uncertainty and reduced risks.

Third, together with the role played by the characteristics of the domestic policy mix, the policies adopted by foreign countries also influence innovation patterns by interacting with the internal policy mix. Our findings confirm previous evidence on the relevance of policy spillover effects on domestic innovation activities which seem to play a role both in the demand-pull and technology-push dimensions as well as in complementary policy instruments. Moreover, the empirical results highlight that the inducement effects of domestic policies are reinforced when the external balance of the policy mix design is higher. Interestingly, this effect is detected for complementary qualitative instruments which seem to amplify their potential role when they are aligned with similar accompanying policies adopted by other countries.

Addressing the challenges of innovation governance – what role for research and innovation policy councils?

Sylvia Schwaag-Serger(VINNOVA and University of Lund), Emily Wise(University of Lund) and **Erik Arnold***(Technopolis and Universiteit Twente)
* erik.arnold@technopolis-group.com

KEYWORDS: Innovation governance, Research and innovation councils, Holistic innovation policy, System innovation

Relevance

This paper tackles the role of research and innovation advisory councils in addressing challenges to the governance of national (and regional and continental) research and innovation systems. Inspection of the literature suggests these challenges arise in two ways.

- Changes in reality, in the sense of the growing complexity of innovation processes, the need to adapt and transition between socio-technical systems and the grand or societal challenges, which are increasingly seen as posing existential challenges to society
- Changes in theory and perception, from a simple, linear view of an essentially self-organising relationship between research and societal change to a more complex, systemic view in which different parts of the research and innovation system need partly to be coordinated in order to exploit the full potential of research and innovation to trigger economic and social development and growth

Since about the 1970s, there has been a change in the ‘social contract’ between science and society, which has shifted from ‘blind delegation’ (Braun, 1993) of responsibility for research to the scientific community to a strong and still growing desire for societal influence over the direction of research and demands for research to have beneficial societal impacts (Elzinga, 1997) (Shove, 2003) (Hessels, van Lente, & Smits, 2009) (Ernø-Kjølheide & Hansson, 2011). This desire coincides with the rise of the ‘new public management’, increased use of agencies in implementing policy and growing monitoring and measurement of government performance. The rise of ‘innovation systems’ thinking (Freeman, 1987) (Lundvall, 1992) (Nelson, 1993) led naturally to questions about how the component parts of these systems should best be coordinated, especially given the tendency of government ministries to operate in separate ‘silos’. Mechanisms for vertical coordination (ie relations between principals and agents) and horizontal coordination across the silos were needed, and research and innovation councils appeared at various levels, especially to tackle the latter (Arnold & Boekholt, 2003) (Pelkonen, 2006).

The emergence of the grand challenges as central policy concerns only served to strengthen the need for horizontal coordination (OECD, 2012). But their solution is almost certainly connected to transitions among socio-technical systems, depending not only upon the coordination of research and innovation policy but also a wide range of other policies and the integration and cooperation of many additional stakeholder groups (Geels, 2010) (OECD, 2015).

Research and innovation councils therefore need to address at least the following challenges

- The demands for transparency, results orientation, accountability and inclusiveness of the ‘new social contract’
- Horizontal coordination across the silos of government, in order to produce holistic research and innovation policy
- Activating and coordinating across a growing number of parts of society, in order to address the grand challenges

Research aim and questions

The aim of this paper is to better understand the role that different types of research and innovation policy councils play in addressing the increasing complexity and challenges of innovation governance. Building on previous analyses of national innovation councils (OECD 2009, 2012a; Pelkonen 2006; Pelkonen et al. 2014; Schwaag Serger et al. 2015), this paper aims at addressing two main questions:

1. What are the different types of mandates and structures of national innovation councils?
2. To what extent do each of these “council types” have the necessary preconditions to address the challenges of innovation governance?

Definition of central concepts and analytical framework

Early literature on innovation systems established innovation as an interactive learning process involving various actors, and highlighted that innovation policy (aimed at improving the functioning of innovation systems) must stretch across various policy fields (see e.g. Edquist 1997 and Lundvall 1992). A decade later, academic

literature and policy strategies acknowledged a further transition from this “2nd generation of innovation policy” to a “3rd generation of innovation policy” that underlined the need for maintaining a core emphasis on innovation across policy areas – establishing ways of building analysis and action relevant to innovation into all of these policy areas (see e.g. EU 2003 and Edler et al. 2003). Governance structures stressed horizontal coordination and the need to develop “integrated innovation policy” strategies (Pelkonen 2006).

More recently, with the increased participatory nature of innovation and a re-orientation of innovation strategies toward addressing societal challenges, we witness the need for governance structures that can direct even more complex systemic action and change. The term “system innovation” is used to refer to broader socio-technical systems, and the system-wide change and policies that are necessary to make economies socially, economically and environmentally sustainable (Geels 2004, Borrás and Edler 2014, Edquist 2014, OECD 2014a).

We have thus witnessed a transition from horizontal coordination and “integrated innovation policy” to “system innovation” (i.e. innovating the way societal functions are fulfilled). It is no longer enough just to coordinate across policy areas. Rather, innovation governance structures should now foster a holistic perspective on innovation processes and ensure that policy drives systemic change. A holistic innovation policy is defined as a policy that integrates all public actions that influence or may influence innovation processes (Edquist 2014). These changes in innovation policy and processes are situated within a wider and more fundamental change in the relationship or ‘social contract’ (Guston, 2000) between research or science on the one hand and the state on the other. Addressing the societal challenges demands much more than research and innovation policy: it requires a number of large-scale changes or transitions in socio-technical systems such as energy production and distribution. Managing these transitions involves more actors and an extending scope for governance (Geels, 2010).

Crucially, under this new social contract, the role of government extends beyond reactively tackling ‘failures’ and into the proactive organization of responses to the societal changes. These simply cannot be addressed through the kind of reactive policies envisaged in economics and seen as politically legitimate in the late 20th Century. While in reality the state has always been a proactive driver of innovation (Mazzucato 2013), the grand challenges and the new social contract legitimize this activity.

Empirical material

In this paper, we review 14 national research and innovation councils from Europe, North America and Asia. We describe how their approach addresses the evolving demands on innovation governance, propose a categorisation of three fundamental types and structures, and analyse how each “council type” contributes to holistic innovation policy.

Data have been collected from a review of documents and websites from 14 councils in 12 countries, and from semi-structured interviews from 9 councils in 8 of these countries. The overall international comparison includes eight countries reviewed in other analyses of innovation councils (OECD 2009, 2012a; Pelkonen et al. 2014), as well as four additional countries (Germany, US, China and Korea). The eight countries included in the more detailed case studies (Austria, Denmark, Finland, Germany, Netherlands, Canada, US and Korea) were selected based on two main factors:

- Representation of different types of innovation councils and different national contexts around the world
- Extended history of the council (to have some reference point of influence/impact and changes over time)

Description of methodologies

The exploratory research questions are addressed through a three-step mixed method approach. Firstly, we draw on key literature to draw insights on the key challenges of innovation governance, and highlight potential consequences on the expected role of innovation councils. Secondly, we use a review of key documents and websites (from all 14 councils) and more detailed case studies (from 9 councils) to propose a categorisation of three fundamental types and structures of innovation councils. Finally, we analyse each “council type” in relation to the key innovation governance challenges highlighted in the literature review.

Expected outcomes

In setting up innovation councils, governments often have high expectations that these bodies will provide useful advice, or evaluate, coordinate or even plan science, technology and innovation policy. Our analysis shows that these expectations are not easily met. Regardless of their primary task or approach, councils face challenges and sometimes conflicting demands or pressures. Our analysis highlights a number of risks and rewards with each “council type” and some general challenges that research and innovation councils face.

A council’s ability to influence policymaking relies on a conducive environment defined by a willingness and ability of government to take in advice, by a receptiveness for and tradition of evidence-based decision-making and a vibrant evaluation culture, and by a sufficient amount of trust and social capital within the system.

Coordination and implementation don’t happen on their own. There is a need for mechanisms (e.g. political

leadership from the Prime Minister, linking councils to agencies and/or budgets) to help this occur. These observations offer implications for policymakers working to develop regional, national or multilateral innovation councils – helping them both to set clear mandates and reasonable expectations, and to design mechanisms that help ensure councils’ contribution to holistic innovation policy.

References

- Arnold, E., & Boekholt, P. (2003). *Research and Innovation Governance in Eight Countries A Meta-Analysis of Work Funded by EZ (Netherlands) and RCN (Norway)*. Brighton: Technopolis.
- Braun, D. (1993). Who governs intermediary agencies? Principal-agent relations in research policymaking. *Journal of Public Policy* , 13 (2), 135-162.
- Borrás, S., and Edler, J. (2014). “Introduction: on governance, systems and change” in Borrás, S., and Edler, J. (eds.) *The governance of socio-technical systems*, Edward Elgar Publishing.
- Edler, J., Kuhlmann, S., & Smits, R. (2003). *New Governance for Innovation: The Need for Horizontal and Systemic Policy Coordination*. Karlsruhe: Fraunhofer Institute for Innovation Research.
- Edquist, C. (1997). *Systems of innovation: Technologies, institutions and organizations*. London, England: Pinter Publishers.
- Edquist, C. (2014). “En helhetlig innovationspolitik – varför, vad och hur?” in Mats Ögren Wanger (ed) *Position Sverige: Om innovation, hållbarhet och arbetsmarknad*, pp.59-80, Ekerlids Förlag, Falun.
- Elzinga, A. (1997). The science-society contract in historical transformation: with special reference to ‘epistemic drift’. *Social Science Information* , 36 (3), pp. 411-455.
- Erno-Kjølheide, E., & Hansson, F. (2011). Measuring research performance during a changing relationship between science and society. *Research Evaluation* , 20 (2), 131-143.
- European Commission (2003). *Innovation Tomorrow*. Luxembourg: European Commission.
- Freeman, C. (1987). *Technology Policy and Economic Performance: Lessons from Japan*. London: Frances Pinter.
- Geels, F. (2004). “From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory” in *Research Policy*, 33 (2004): 897-920.
- Geels, F. (2010). “Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective” in *Research Policy*, 39 (2010): 495-510.
- Guston, D. (2000). *Between Politics and Science: Assuring the Integrity and Productivity of Research*. Cambridge: Cambridge University Press.
- Hessels, L. K., van Lente, H., & Smits, R. (2009). In search of relevance: the changing contract between science and society. *Science and Public Policy* , 36 (5), pp. 387-401.
- Lundvall, B. A. (1992). *National systems of innovation: Towards a theory of interactive learning*. London, England: Pinter.
- Mazzucato, M. (2013). *The Entrepreneurial State: debunking public vs. private sector myths*. Anthem.
- Nelson, R. R. (1993). *National Innovation Systems*. New York: Oxford University Press.
- OECD (2009). *Chile’s National Innovation Council for Competitiveness – Interim Assessment and Outlook*.
- OECD. (2012). *Meeting Global Challenges through Better Governance: International Cooperation in Science, Technology and Innovation*. Paris: OECD.
- OECD (2012a). “STI Policy Profiles: Innovation Policy Governance” in *OECD Science, Technology and Industry Outlook 2012*.
- OECD (2014a). *OECD Science, Technology and Industry Outlook 2014*.
- OECD. (2015). *System Innovation: Synthesis Report*. Paris: OECD.
- Pelkonen, A. (2006). “The problem of integrated innovation policy: analyzing the governing role of the Science and Technology Policy Council of Finland” in *Science and Public Policy*, 33(9): 669-680.
- Pelkonen, A., Nieminen, M. and Lehenkari, J. (2014). *Evaluation of the Research and Innovation Council of Finland*. Ministry of Education and Culture of Finland 2014:6.
- Schwaag-Serger, S, Wise, E and Snrold, E (2015), *National research and Innovation Councils as an Instrument of Innovation and Governance: Characteristics and Challenges*, VA 2015:07, Stockholm: VINNOVA
- Shove, E. (2003). Principals, agents and research programmes. *Science and Public Policy* , 30 (5), 371-382

Towards a Taxonomy of Science and Innovation Policy Instruments

Abdullah Gök*, Yanchao Li, Paul Cunningham, Jakob Edler and Philippe Laredo
(Manchester Institute of Innovation Research, University of Manchester)

* abdullah.gok@manchester.ac.uk

KEYWORDS: Science and innovation policy, Instrument, Classification, Methodology

One of the fundamental indicators of the maturity of a scientific discipline is the development of the classification of the object of its analysis through typologies and taxonomies. While “policy” is increasingly becoming a central object of analysis in science and innovation studies, there has not been a comprehensive and rigorous classification of science and innovation policies (SIPs). In this paper, we formulate a methodological approach to develop a classification of policy instruments. By applying this approach to SIPs, we also formulate a comprehensive taxonomy of SIP instruments and illustrate its usefulness to the community. In doing so we contribute to and link the literature on SIP instrumentation and the literature on policy instrumentation and taxonomy more broadly (Hood 2007; Lascoumes and Le Gales 2007; Salamon).

Classification (i.e. ordering entities into groups or classes on the basis of similarity) is one of the main processes of social science. There are two general types of classification. First, typology classifies entities driven by conceptual or qualitative understanding which are inherently subjective. Second, taxonomy refers to classification of empirical entities often in a hierarchical and mutually exclusive way (Bailey 1994). There has been considerable discussion in the political science literature on how to classify policies following Lowi's (1964, 1972) seminal attempt in 1960s. Lowi created four categories of public policy consisting of distributive policy, regulatory policy, redistributive policy, and constituent policy. Subsequently a number of attempts have been made to produce other policy typologies for instance by adding more categories to Lowi's original categorisation and to create classifications in the instrument level. However, some political scientists (Smith 2002) argue that creating typologies is an inherently flawed process as it is subjective (based on the personal judgement, not clear-cut, changing by time and overlapping in most cases). Other scholars also put the attempt of classification of policies and policy instruments at the centre of political conflict and advocated that policy researchers should abandon rigid classification schemes. The understanding converged in 2000 to the idea that taxonomies which are based on empirical observation are more useful than typologies which are based on subjective theoretical constructs which exert political positions and influences (Smith 2002).

In the field of SIP, there have also been numerous attempts in developing a classification of policy instruments. Rodriguez and Montalvo (2007) provide an extensive review of literature and practices that attempted to classify innovation policy instruments in the EU context. They draw upon biological and neo-functionalist approaches and offer an in-depth understanding of the nature, hierarchy and evolution of science, research, technology and innovation policies and related instruments. While their work is enlightening in clarifying some of the conceptual ambiguity of SIPs, the classification they proposed is very rigid in terms of its narrow coverage and simplistic hierarchy (i.e. economic policy > industrial policy > innovation policy > technology policy). Another attempt was made by Borrás and Edquist (2013), who proposed to use a trichotomy of regulations (obligatory), economic transfers (incentives), and soft instruments (complementary) to broadly group SIP instruments, they then link those categories to identified activities and problems existing in a given innovation system. Edler and Georghiou (2007) on the other hand proposed to classify innovation policy instruments according to a demand-supply dichotomy, whereby further differentiation has been made according to the modalities of instruments. Edler et al. (2016 (forthcoming)) further elaborated on demand-based innovation policy instruments which differentiate according to the nature of demand, framework conditions and systemic approaches. This dichotomy has been influential on practice, for instance, in serving as a classification basis for the Innovation Policy Platform jointly developed by the World Bank and OECD. In the EU, there has been a series of attempts to classify SIPs starting from the European Innovation Monitoring System (EIMS) suggested the three broad areas (fostering innovation culture, establishing conducive framework conditions and gearing research to innovation) which were set out in the 4th Framework Programme for RDTI and the 1993 Action Plan for Europe. Subsequently, INNO-Policy Trendchart and ERAWATCH initiatives followed and extended this line of classification. In each function there are thematic priorities related to particular groups of actors and processes; however, it is hard to justify the mutual exclusiveness and conceptual consistency of those priorities. In a recently published book by Edler et al. (2016), the contributors made a substantial attempt in categorizing SIP

instruments in a systematic way, mostly against the criterion of modality. They then provide a conceptual assessment of different instruments regarding their orientation (supply or demand) and goals. While this classification is useful for the expressed purpose (i.e. to categorise policy instruments to be able to synthesise evidence on their effectiveness), it is not comprehensive.

Objectives of these categorisations in SIP field range from to provide conceptual background for a particular discussion (Rodriguez and Montalvo (2007), Edler and Georghiou (2007), Borrás and Edquist (2013)), to divide literature to meaningful chunks to be able to synthesise (Edler et al. 2016 (forthcoming), to monitor political priorities (EU initiatives). While these various classifications offered alternatives to deal with the complexity of SIPs and instruments to suit different purposes, we argue that they appear to be too rigid to serve as generic tools to facilitate research and practice in this field. Attempting to classify all varieties of SIPs and instruments according to one single dimension, these typologies/taxonomies are not effective in capturing the characteristics of different SIPs and instruments in a comprehensive and logically consistent way.

Our taxonomy is based on an empirical analysis of over 1,000 policy documents such as policy evaluation reports, policy reviews and academic articles which provide a discussion of policy instruments collected as part of the Compendium of Innovation Policy (Edler et al. 2016 (forthcoming)) and Science and Innovation Policy Repository (SIPER) projects. On that basis we created a multi-dimensional, multi-attribute taxonomy for SIPs (Table 1). The term ‘multi-dimensional’ refers to the fact that our taxonomy is hierarchical on two levels. Our taxonomy is based on three basic features of a policy as dimensions: objective, modality and target group. Each of these features as well as their sub-features are also mutually exclusive of each other. Objective refers to the basic policy purpose of the instruments. In most of the existing classifications of SIPs, policy objectives are not considered as a stand-alone dimension but as a feature of other dimensions. Modality is about the operation and the means of delivery of the policy measure. While most of the existing classifications are almost exclusively based on modalities, it forms just one of the three dimensions for our taxonomy. Finally, target group refers to the main beneficiaries or focus of an instrument. These three dimensions serve as three axes of a three dimensional SIP space and the location of a particular policy is represented by its coordinates in these three axes (i.e. objective, modality, target group). This Euclidian space accommodates a total of 1,200 possible coordinates whereas alternative classifications are bound by a very small number of possibilities. An example would be (objective: “A.5. Strengthening/improving research management practices”; modality: “B.6. Non-financial support”; target: “C.1. Individuals”).

Another feature of our taxonomy is that it is multi-attribute which refers to the fact that policy instruments can take more than one attribute on level 2 due to their complex natures. For each dimension (i.e. objective, modality, target group), there might be more than one relevant point forming a polygon on a dimension. An example would be a policy targeting individuals, universities and research organisations at the same time (target: “C.1. Individuals”, “C.2. Universities”, “C.3. Research Organisations”).

Table 1 A two-level, multi-attribute taxonomy of science and innovation policy instruments

Level 1 Level 2

A. Policy objectives (Why the support is provided)

- A.1. Enhancement of education and initial/further training
- A.2. Facilitating personnel mobility
- A.3. Internationalisation of (research, technology, development and innovation (RTDI) activities
- A.4. Awareness raising and promotion of public acceptance
- A.5. Strengthening/improving research management practices
- A.6. Improving absorptive capabilities and capacity
- A.7. Supporting collaborative interactions for the production of new knowledge and/or innovation (including project focused approaches, innovation vouchers, etc.)
- A.8. Supporting broader (multiple) interactions (e.g. through clusters or networks)
- A.9. Supporting the protection of IP
- A.10. Mobilising additional (non-public) financing for innovation (e.g. support of business angels, VCTs, equity schemes, etc.)

- A.11. Stimulation of additional RTDI activity (e.g. increasing R&D expenditures)
- A.12. Strengthening the quality of RTDI activities (promotion of excellence)
- A.13. Creating new RTDI capacity (e.g. new organisations, start-ups, technology-based companies)
- A.14. Generation or diffusion of innovation targeting the demand for innovation or the interaction between demand and supply (e.g. programmes to support public procurement of innovation, demand subsidies for innovation and awareness raising measures)
- A.15. To support priority setting (e.g. foresight exercise)
- B. Modalities (How support is provided)
 - B.1. Direct financial support: grants, loans, guarantees, contracts, etc.
 - B.2. Direct financial support: scholarships, fellowships, etc.
 - B.3. Direct financial support: (non-project specific) institutional block grants including large centres
 - B.4. Indirect financial support: tax & fiscal incentives (e.g. R&D credits)
 - B.5. Infrastructure support (e.g. provision of access to and construction/upgrading of research infrastructure)
 - B.6. Non-financial support (e.g. training ,coordination and advisory/information support/provision)
 - B.7. Prizes and awards (ex-ante inducement, ex-post performance recognition, etc.)
 - B.8. Indirect financial support – norms, standards, regulations
- C. Targets (Recipient of the support)
 - C.1. Individuals (researcher, student, manager, entrepreneur, investor, etc.)
 - C.2. Universities (including sub-departments and institutions)
 - C.3. Research Organisations (including the spectrum from public (PROs) to private (RTOs))
 - C.4. Public organisations (governmental or quasi-governmental agencies, policy making organisations – not directly involved in R&D)
 - C.5. Intermediaries (such as science parks, business incubators, technology parks, knowledge brokers, TTOs, etc.)
 - C.6. Firms (SMEs focused)
 - C.7. Firms (no size-specific focus)
 - C.8. Other funding organisations (NGOs, NPIs, Not-for-Profit, Charities.)
 - C.9. Specific industrial sector targeted
 - C.10. Specific S&T field targeted

Our taxonomy offers an approach of systematically and comprehensively, yet flexibly, classifying SIP instruments. Through this taxonomy a specific group of SIP instruments can be easily captured. Users can approach a particular policy from various starting points as needed, e.g. starting from the problem being addressed (objectives), the beneficiaries targeted (targets), or the most explicit design features (such as modalities). This enables to be much more concrete and specific when it comes to the analysis and design of instruments and when it comes to learning from instruments. Conceptually it offers a better understanding of science and innovation policies by appreciating and characterizing the various dimensions of SIP. It moves away from the traditionally over-simplistic delineation of policy instruments. In practice, this offers easier navigation across the vast varieties of SIPs, which could facilitate the design, analysis and evaluation of policies. This taxonomy is also highly flexible to allow extension. It can serve as a basis for deriving various taxonomies to suit needs in various contexts.

References

- Bailey, K.D. 1994. *Typologies and Taxonomies: An Introduction to Classification Techniques*. vol. no. 102: SAGE Publications.
- Edler, J., P. Cunningham, A. Gök, and P. Shapira. 2016 (forthcoming). Introduction: Making sense of innovation policy In *andbook of Innovation Policy Impact*, eds. J. Edler, P. Cunningham, A. Gök, and P. Shapira. Cheltenham: Edward Elgar.
- Hood, Christopher. 2007. Intellectual Obsolescence and Intellectual Makeovers: Reflections on the Tools of Government after Two Decades. *Governance* 20 (1):127-144. doi:10.1111/j.1468-0491.2007.00347.x.
- Lascoumes, Pierre, and Patrick Le Gales. 2007. Introduction: Understanding Public Policy through Its Instruments—From the Nature of Instruments to the Sociology of Public Policy Instrumentation. *Governance* 20 (1):1-21. doi:10.1111/j.1468-0491.2007.00342.x.
- Lowi, Theodore J. 1964. American Business, Public Policy, Case-Studies, and Political Theory. *World Politics* 16 (04):677-715. doi:doi:10.2307/2009452.
- Lowi, Theodore J. 1972. Four Systems of Policy, Politics, and Choice. *Public Administration Review* 32 (4):298-310. doi:10.2307/974990.
- Salamon, Lester M. The New Governance and the Tools of Public Action: An Introduction(2001). *Fordham Urban Law Journal* 28:1611.
- Smith, K. B. 2002. Typologies, taxonomies, and the benefits of policy classification. *Policy Studies Journal* 30 (3):379-395. doi:10.1111/j.1541-0072.2002.tb02153.x.

Parallel Sessions 5

5A. TRACK THEME 4: NEW AVENUES FOR REGIONAL INNOVATION POLICIES (II)

Regional cooperation: evidence from European cooperative innovation networks

Sara Amoroso*, Alexander Coad and Nicola Grassano
(European Commission)

*sara.amoroso@ec.europa.eu

KEYWORDS: R&D network, Regional innovation policy, European Framework Programmes, Knowledge diffusion

1. Relevance

Cooperative agreements for innovation have an important role to play in terms of facilitating specialization across Europe, because they can bring together distant partners and provide them with opportunities to further develop capabilities in their areas of specialization. The promotion of consortia between firms, universities, research centres and public entities has gained prospects for further development of Science and Technology Policy in Europe. In particular, cooperative research has been extensively supported through European Framework Programmes. The Framework Programmes for Research and Technological Development (FP1 through FP7 and Horizon 2020, ongoing from 1984) are European medium-term planning instruments for research and innovation created by the European Commission.

In the early 1980s, the first cooperative programmes focussed mainly on ICT and energy, as these were the fields where Europe was losing competitiveness vis-a-vis the US and Japan. Over time, the priority of gathering resources and strengthening the capabilities in high-tech fields wove the policy objective of achieving economic, social and territorial cohesion. This resulted in the progressive integration of lagging regions to the European research network.

Concerns have been raised regarding possible conflicts between the two policies objectives. In fact, supporting the competitiveness by strengthening research and innovation capacities may generate disproportionate benefits for richer regions, given that R&D funds are concentrated in advanced regions as they have a higher density of researchers as a share of employment.

The European Commission has changed approach to reinvigorate the European research infrastructure and to reflect the most recent theoretical and empirical debate about R&D networks. From FP6, policy actions are devoted to creation of a crucial "centres of excellence", that would act as catalysts for marginal actors. The more recent policy approach encourages regional actors to identify their competitive advantages in an international setting and to network in order to tap into knowledge sources located outside of the region.

In this respect, networking and cooperation usually involves heterogeneous actors, bringing together their particular knowledge bases, and complementing each other's strengths and capabilities. Cooperating partners will differ in many ways, according to a number of dimensions of distance, such as geographical proximity, institutional and cultural proximity, and technological proximity, which accounts for the relatedness of the technology fields.

2. Research aim and 3. Methodology

The paper intends to provide a contribution to the debate about the effectiveness of network policies at the EU level. More specifically, adopting a gravity model framework, this study analyses the effects of physical, institutional and technological proximity on the intensity of inter-regional research collaboration across Europe.

4. Empirical material

Data on the cooperative agreements from the EU Seventh Framework Programme (FP7, i.e. the European Commission's Seventh Framework Programme, which provided more than Euro 50bn funding for research and technological development, 2007-2013) allow us to construct a measure of inter-regional cooperation, using the location of the participants in a collaborative project. To compute the technological proximity, we merge the FP7 dataset with data from Eurostat and OECD on patents and regional statistics, to derive the technological specializations of regions. In particular, we distinguish between specialization by FP7 thematic areas (health, biotechnology, ICT, etc.) and specialization by International Patent Classification (IPC) technological fields. Moreover, we are able to differentiate among types of organizations participating in the research projects, i.e. universities, research organizations, firms, and public bodies.

5. Preliminary outcomes

The preliminary findings from gravity equations confirm the importance of technological, geographical and institutional proximities on research collaboration. We also find evidence of the existence of heterogeneous regional cooperation patterns among universities, firms, research centres and public bodies. Moreover, results show that collaborations born in the framework of FP7 funding scheme are very heterogeneous in terms of project size, research theme and geographical regions. Universities are often found to play a pivotal role in collaborative projects, with private firms, public bodies and research organizations also playing important roles. Many universities collaborate on more than one project, while firms are more likely to collaborate on one project only. Southern and Eastern European partners participate on projects with more participants (but with a shorter project duration). The findings and conclusions are framed within the context of European research policies.

Location of Knowledge-Intensive Entrepreneurship in Developing Countries: The Case of the State of São Paulo, Brazil

Bruno Fischer (University of Campinas), Sergio Queiroz (University of Campinas) and **Nicholas Vonortas***
(George Washington University)
*vonortas@gwu.edu

KEYWORDS: Knowledge-intensive entrepreneurship, Agglomeration economies, Geography of innovation, Developing countries

I. Introduction

Knowledge-intensive entrepreneurship (KIE) is considered a key socio-economic phenomenon that drives innovation and economic growth and is a fundamental source of macroeconomic competitiveness and innovative capabilities (AUDRETSCH et al., 2006). Knowledge is, however, frequently subject to increasing returns to scale as a function of agglomeration economies and the existence of multidimensional socio-economic environments that foster heterogeneous location of innovation (ROMER, 1990). This leads to uneven distributions of entrepreneurial activity across geographical space, resulting in regional concentrations (FELDMAN, 2001). Consequently, the significant impacts on social welfare and wealth creation arising from this sort of entrepreneurial activity are mainly felt at the regional level (ÁCS and ARMINGTON, 2004).

Understanding the determinants and dynamics of emergence of entrepreneurial ecosystems represents a fundamental aspect of defining public policies to reinforce existing structures and facilitating the rise of latent systems. This is particularly complex for developing economies, which have been inadequately addressed by the literature dealing with the spatial dynamics of economic and innovation systems. Our overarching research interests in this work are as follows: i) What regional factors influence the location of KIE in a developing country? ii) Are the dynamics of agglomeration economies observed in developed nations applicable to the context of a developing nation?

This paper reports an exploratory evaluation of the geography of knowledge-intensive entrepreneurship in the State of São Paulo, Brazil, with focus on the determinants of KIE density at the city-level. Four core dimensions of interest are established, namely: Urban Environment, Centrality/Peripherality, Infrastructural Conditions, and Economic Structure. The rationale behind this approach is that KIE is a systemic phenomenon, being affected by market, technological and institutional opportunities (Radosevic and Yoruk, 2013).

II. Location Determinants of Knowledge-Intensive Entrepreneurship

The first determinant of entrepreneurial location in geographical space is related to urban environments. Proximity is often understood as an important feature of urban agglomerations, providing access to markets and ideas (GLAESER, 2011). Densely populated areas provide a larger pool of individuals who can engage in innovation, entrepreneurship and creative endeavors (FLORIDA and MELLANDER, 2014). As a result, large metropolitan areas are expected to have a disproportionately stronger activity of inventors than smaller cities (BETTENCOURT et al., 2007).

Nonetheless, in cities with very large populations, congestion costs increase, affecting negatively gains associated with agglomeration economies (BERLIANT and WANG, 2005). These issues are particularly sensitive in the context of rapid urbanization trends in developing countries, essentially in large agglomerations (KRUGMAN, 1995). These geographical structures often represent entities that harm their respective "host economies", while generating environmental, social and traffic congestion problems in greater levels than big cities located in the developed world (BAIROCH, 1988). Taking into account these observations, our first hypothesis is developed:

H1. Highly dense urban agglomerations in the context of developing country mega-cities may hamper the potential of KIE activity.

Another dimension of interest is the infrastructural conditions available for entrepreneurial activities. In terms of physical and knowledge infrastructure, geographical proximity to research-oriented universities is often seen as a valuable source of expertise for high-tech entrepreneurial activity (ETZKOWITZ, 1998). Moreover, regions better endowed with physical and human capital, as well as universities, are more prone to create virtuous cycles of innovative activity (FITJAR and RODRÍGUEZ-POSE, 2011). Our second research hypothesis takes the following shape:

H2. Infrastructural conditions, mainly represented by knowledge infrastructure, have positive impacts on the

location of KIE activity within the context of developing countries.

The economic conditions of cities are also expected to affect the location of KIE. A first indicator expected to relate to entrepreneurial strengths is income per capita (RADOSEVIC and YORUK, 2013). Income levels provide systemic feedback that allows a continuous evolution of innovation systems over time, as wealthy economies have more financial resources available for reinvesting in new ventures. Complementarily, credit availability is a fundamental feature of economic systems and is related to the upsurge of entrepreneurial activity (ÁCS et al., 2014). Based on these propositions the third hypothesis follows:

H3. The economic structure of a given location, proxied by the level of income per capita and by the existence of localization economies, exert a positive impact upon the location of KIE activity within the context of developing countries.

Usually, large distances from political and economic centers of power functions as an indicator of peripheral regions (IAMMARINO, 2005). Fritsch (2002) finds evidence supporting the existence of an efficiency gap of innovative activity in peripheral regions, indicating the existence of agglomeration economies. Also, peripheral regions have difficulties to translate innovation into regional growth due to reduced levels of interconnectedness with innovation networks located elsewhere and due to low exposure to knowledge spillovers from central areas (CRESCENZI and RODRÍGUEZ-POSE, 2012). Thus, the fourth hypothesis is defined:

H4. The conditions of geographical centrality/peripherality of a given location, represented by its distance from economic centers, affect the location of KIE activity within the context of developing countries.

III. Methodology

The empirical analysis is based on data from the PIPE program (Innovative Research in Small Enterprises) managed by the São Paulo Research Foundation (FAPESP). The PIPE program subsidizes entrepreneurial projects with high levels of knowledge-intensity and innovative potential. The program was created in 1997, inspired by the Small Business Innovation Research (SBIR) program in the United States.

This dataset offers an interesting source of "certified" knowledge-intensive entrepreneurs for 1130 winner projects selected after careful expert review. This makes possible to work with high-quality micro-level data, instead of resorting to the analysis of knowledge-intensive sectors and inter-sectoral heterogeneities. These projects are divided among 114 cities in the state of São Paulo. Although the dataset was originally composed of 1196 proposals, 66 of them represented projects in different stages of support by FAPESP, so they were merged into single observations. Data are mainly oriented towards the geographic location of ventures.

This information is supplemented by additional information on the overall conditions of firm location as indicators of the socioeconomic environment in which these new ventures are embedded was also gathered. The following variables have been constructed and are divided into the following groups:

1. Dependent variables:

- a. Number of projects per 100 thousand inhabitants aged 25-54;
- b. A binary variable applied to the comparison between cities with PIPE projects and an extended random sample;

2. Explanatory -- Urban environment indicators:

- a. Demographic density;
- b. City-level HDI;
- c. Percentage of urban territory;
- d. Ratio of inhab./cars;
- e. Theft per thousand inhab.

3. Explanatory -- Centrality/Peripherality indicator

- a. Distance in km from the economic center, São Paulo.

4. Explanatory -- Infrastructural conditions indicators:

- a. Credit operations per capita;
- b. Municipal investments in infrastructure;
- c. Local presence of research-oriented universities with focus on STEM;
- d. Percentage of households connected to the electrical grid.

5. Explanatory -- Economic structure indicators:

- a. GDP per capita;
- b. Patents per 100 thousand inhabitants;

- c. Weight (%) of city-level businesses in the State's total;
- d. Weight (%) of city-level labor force in the State's total;
- e. Weight (%) of knowledge-intensive jobs in cities' total labor force.

The paper does two things. First, it provides a detailed mapping of the geographical spread of knowledge-intensive entrepreneurship in the state of São Paulo. Second, it provides an empirical appraisal of the determinants of such location. In particular, econometric estimation focuses on: 1) analyzing the role of predictors in establishing a difference between cities with and without KIE activity, regardless of its level, and 2) evaluating the role of predictors in influencing the density of KIE activity.

IV. Results

In line with the existent literature on entrepreneurship location in developed countries, our findings identify the incidence of agglomeration economies in the assessment of a developing nation. Proximity to the economic core of the State is always positively correlated with KIE. Local population density is also positively related to KIE emergence. Additionally, a high level of spatial correlation in the frequency of PIPE projects was identified, with the core located around the metropolitan area of São Paulo. Moreover, local presence of research-oriented universities functions as a determinant of both KIE emergence and density.

However, and in conflict with much of the relevant literature, our research provides indications of strong agglomeration diseconomies affecting the levels of knowledge-intensive entrepreneurship in the geographical area analyzed. This finding of a more balanced picture of agglomeration economies and diseconomies in densely populated areas offers important insights for perhaps partially different factors playing an important role as determinants of the geographic location of innovative activity in developing countries. For instance, population concentration is negatively related to KIE density. This highlights the complexity behind potential sources of agglomeration diseconomies in developing regions that involve mega-cities.

An overall perspective of our research underscores the relevance of innovation ecosystems in driving KIE activity. Tangible and intangible factors at the regional level shape the balance between agglomeration economies and diseconomies. As our results have shown, the current situation of urban centers in developing nations pose limits to the appropriation of insights generated from the assessment of developed countries.

References

- ÁCS, Z. and ARMINGTON, C. (2004). Employment growth and entrepreneurial activity in cities. *Regional Studies*, 38(8), 911-927.
- ÁCS, Z., AUTIO, E. and SZERB, L. (2014). National systems of entrepreneurship: measurement issues and policy implications. *Research Policy*, 43(3), 47-494.
- AUDRETSCH, D., KEILBACH, M. and LEHMANN, E. (2006). *Entrepreneurship and Economic Growth*. New York: Oxford University Press.
- BAIROCH, P. (1988). *Cities and economic development: from the dawn of history to the present*. University of Chicago Press: Chicago.
- BERLIANT, M. and WANG, P. (2005). Dynamic urban models: agglomeration and growth. In: Capello, R., & Nijkamp, P. (eds.). *Urban dynamics and growth: advances in urban economics*. Elsevier: Amsterdam, 533-581.
- BETTENCOURT, L., LOBO, J., HELBING, D., KUHNERT, C. and WEST, G. (2007). Growth, innovation, scaling, and the pace of life in cities. *Proceedings of the National Academy of Sciences of the United States of America*, 104 (17), 7301-7306.
- CRESCENZI, R. and RODRÍGUEZ-POSE, A. (2012). An integrated framework for the comparative analysis of the territorial innovation dynamics of developed and emerging countries. *Journal of Economic Surveys*, 26(3), 517-533.
- ETZKOWITZ, H. (1998). The norms of entrepreneurial science: cognitive effects of the new university-industry linkages. *Research Policy*, 27(8), 823-833.
- FELDMAN, M. (2001). The entrepreneurial event revisited: firm formation in a regional context. *Industrial and Corporate Change*, 10(4), 861-881.
- FITJAR, R. and RODRÍGUEZ-POSE, A. (2011). Innovating in the periphery: firms, values and innovation in Southwest Norway. *European Planning Studies*, 19(4), 555-574.
- FLORIDA, R. and MELLANDER, C. (2014). Rise of the startup city: the changing geography of the venture capital financed innovation. [Working Paper n. 377]. Centre of Excellence for Science and Innovation Studies.
- FRITSCH, M. (2002). Measuring the quality of regional innovation systems: a knowledge production function approach. *International Regional Science Review*, 25(1), 86-101.
- GLAESER, E. (2011). *Triumph of the city: how our greatest invention makes us richer, smarter, greener, healthier and happier*. New York: Penguin Press.
- IAMMARINO, S. (2005). An evolutionary integrated view of regional systems of innovation: concepts, measures and historical perspectives. *European Planning Studies*, 13(4), 497-519.
- KRUGMAN, P. (1995). Urban concentration: the role of increasing returns and transport costs. *The World Bank Economic Review*, 8(1), 241-263.
- RADOSEVIC, S. and YORUK, E. (2013). Entrepreneurial propensity of innovation systems: theory, methodology and evidence. *Research Policy*, 42(5), 1015-1038.
- ROMER, P. (1990). Endogenous technological change. *Journal of Political Economy*, 98(5), 71-102.

Policy models and rationales of science, technology and innovation in Central America: an alternative look to the integration process

Victor Gómez-Valenzuela
(Instituto Tecnológico de Santo Domingo)
victor.gomez@intec.edu.do

KEYWORDS: Central America, Science Technology and innovation policies, Rationales

1. Introduction

An analysis of the policy-making process related to science, technology and innovation (STI), in developing countries demands a clear perspective about the main historical, political and socioeconomic milestones that have defined a given path of industrialisation and technological changes (Intrakumnerdi & Chaminade, 2007; Lee & Kim, 2008).

However, when the analysis is taken to the level of economic openness and economic integration in a relatively 'multi-scaled' regional context (national level, regional level, supranational level), with socioeconomic asymmetries and different degree of institutional development (Magro & Wilson, 2013), few tools are left to determine which STI policy rationales would support certain policy designs and the niche in which STI policy fits (Arocena & Sutz, 2005; Laranja, Uyarra, & Flanagan, 2008).

Therefore this paper aims to explore the role of STI policies in the economic integration process of the relatively small and open economies of Central America and the Dominican Republic (DR). In order to do so, this paper focuses on answering two research questions: 1) what role has the definition of STI policies played in the frame of the Central American integration process? 2) What lessons can be derived from the attempts to build a regional STI policy in Central America, in the frame of the Central American Integration System (SICA)? Six countries members of the DR-CAFTA (free trade agreement between Central American countries, the Dominican Republic and the United States of America), plus Panama, have been included in this analysis: Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, and Panama.

2. Methodological approach.

This paper utilises two complementary methodological approaches: 1) interviews with key informants (regional STI policy-makers); and 2) a literature review including selected input and output indicators of STI. The key informant interviews were carried out in the format of structured interviews, which consist of a set of predetermined questions asked in the same order within a verbal interchange, to explore the perceptions about science, technology and innovation policy models at the national and regional levels, understanding by 'region' the CTCAP's influence area (Miles, 1994).

3. STI Policy in Latin American and the Caribbean: an overview.

Although this paper focuses on the relatively small economies of Central America and the DR, it is framed in the broader context of the science and technology policy of Latin America and the Caribbean (LAC). In LAC countries, STI policies have been of little relevance from the perspective of conventional input and output indicators such as budget assignment from the public sector, patenting and publications, despite relative recent efforts to increase the global investment in both STI and R&D in the last decades (Cimoli, Ferraz, & Primi, 2005).

According to some authors, there are at least two periods in the development of STI policies in LAC. The political evolution process can be summarised as before and after the period of structural reforms that were implemented in the late '80s and early '90s of the twenty century (Alcorta & Peres, 1998; Vonortas, 2002), as a consequence of the failure of protectionist policies between the '60s and the late '80s known as the 'import substitution period', which led to an aggressive period of industrialisation through the intervention of the public sector in most of the LAC countries.

The structural reforms led to an aggressive process of economic liberalisation, deregulation, and privatisation, which supported the emergence of two patterns of production: the 'labour-intensive activities' such as tourist services and various types of free zone parks mainly of textiles in the Central America and the Caribbean, and

activities based on natural resources exploitation such as mining and metallurgy, together with a relatively strong industrial sector in the Southern Cone (Cimoli et al., 2005).

During the import-substitution period, the prevailing political approach to STI was the ‘technology push’ (Hands, 2002). In this period, the pioneering organisations in the region were created: (i) the National Institute for Scientific Research (INIC) of Mexico in 1958, which was the forerunner of the National Council for Science and Technology (CONACYT); (ii) the Brazilian National Research Council (CNPQ) in 1951; and the National Council for Science and Technology of Argentina in 1958. Also, the basic scientific and technological infrastructure was initiated in the biggest LAC economies (Alcorta & Peres, 1998).

The political approach of this period implied a vision of knowledge as a public good to be provided by the state, so the policy emphasis was fundamental research, with a predominant participation of public universities and associated research centres inspired by the ‘breakthroughs’ derived from the Manhattan Project experience (Arocena & Sutz, 2001; Kline & Rosenberg, 1986; Unger, 2005). During the period of structural reforms and adjustments, and partially as a result of the changes in specialisation patterns mentioned above, STI policies were affected in different ways. The first major change of this period was the new emphasis on the linear demand-side approach or ‘market pull’ approach, rooted in the Schmookler works (Nemet, 2009; Schmookler, 1966). This change happened in the Southern Cone countries, while in Central America and the Caribbean a more conservative and traditional policy approach to STI was consolidated, taking the shape of a mix between Mode 1 of knowledge production and the linear supply-side model on innovation, affecting the specific influence of STI policy in relation to other public policy domain.

4. STI mental models, rationale and regional integration

The clue to understanding the poor role of STI policy in the Central American integration process and its limited influence in relation to other policy domains, may rest on the understanding of the STI policy in promoting long term development, more than a specific STI policy rationale (Flanagan, Uyarra, & Laranja, 2010). At this point, the distinction between mental models and STI policy rationale arises. According to North (North, 1994), mental models ‘are the internal representations that individual cognitive systems create to interpret the environment; institutions are the external (to the mind) mechanisms that individuals create to structure and order the (Denzau & North, 1994; Mathieu, Goodwin, Heffner, Salas, & Cannon-Bowers, 2000; Richardson, Andersen, Maxwell, & Stewart, 1994). STI policy rationales may range from a neoclassical perspective to an evolutionary/systemic perspective (Magro & Wilson, 2013).

The neoclassical perspective is based in the ‘market failure’ analysis, emphasising the sub-optimal production of scientific and technical knowledge, and the evolutionary perspective which tends to point out the accumulative learning process and institutional performance (Fagerberg & Verspagen, 2009).

At the same time, the STI policy rationale could be analysed from a more theoretical perspective covering several fields such as the economics of innovation and technology in relation to economic growth, the management of industrial innovation, organisations and innovation, and systems of innovation, among other academic perspectives (Martin, 2012). In terms of STI policy models in the Central American context and as it was suggested previously, two main perspectives could be found interacting in a particular policy mix: 1) the mode 1 knowledge production approaches and 2) the linear supply-side model on innovation.

5. Concluding remarks.

Answering the first research question, it could be concluded that the Central American integration process does not yet have a specific rationale that supports the design of STI policies for integration, and therefore, STI policies have played a marginal role in the overall setting of policies for integration. In fact, it is possible to find some specific STI policy rationales at the national level but not at the regional level.

The absence of a regional STI policy rationale related to the Central American integration process is historically determined by an STI institutional setting with a very narrow perspective about knowledge production, regardless of the personal characteristics of policy makers. Fortunately, there are some clues about new dynamics of policy changes on STI that would move the regional organisations towards an STI policy mix that would allow managing the regional variability, supporting organisational synergies and harnessing national STI capabilities, a partial and encouraging answer for the second research question.

Finally, current regional STI mechanisms such as the CTCAP and the main economic policy mechanism SIECA should increase their formal collaboration in order to build a regional and comprehensive STI policy frame. This collaboration could include the design of a sort of new policy mix approach to deal with the regional variability and especially to overcome the 'policy of things', which would imply the definition of a more structural and comprehensive perspective on STI policy and development. A first step could be to create a sort of steering committee to 1) promote the high level STI's interagency dialogue, starting with the SICA and its integration organisations, and 2) identify specific mechanisms and resources to build the new technical regional setting on STI, including agencies, universities, business schools and the business sector. Further research is required emphasising the analysis of STI policy rationales in relation to other policy domain at multi-scaled level in Central American and the DR.

6. References.

- Alcorta, L., & Peres, W. (1998). Innovation systems and technological specialization in Latin America and the Caribbean. *Research Policy*(26), 857-881.
- Arocena, R., & Sutz, J. (2001). Changing knowledge production and Latin American universities. *Research Policy*(30), 1221-1234. doi:[http://dx.doi.org/10.1016/s0048-7333\(00\)00143-8](http://dx.doi.org/10.1016/s0048-7333(00)00143-8)
- Arocena, R., & Sutz, J. (2005). Innovation systems and developing countries. Retrieved from Aalborg:
- Cimoli, M., Ferraz, J. C., & Primi, A. (2005). Science and technology policies in open economies: the case of Latin America and the Caribbean. In Cepal (Ed.), (Vol. CEPAL-ECLAC-GTZ). Santiago, Chile: CEPAL-ECLAC-GTZ.
- CONACYT. (2013). Tecnología e Innovación Retrieved from http://www.conacyt.gob.mx/TecnologiaInnovacion/CooperacionBilateral/Documents/Terminos_de_Referencia_2013_CDTI-CONACYT.pdf
- Denzau, A. T., & North, D. C. (1994). Shared mental models: ideologies and institutions. *Kyklos (International Review for Social Science)*, 47(1), 3-31. doi: <http://dx.doi.org/10.1111/j.1467-6435.1994.tb02246.x>
- Fagerberg, J., & Verspagen, B. (2009). Innovation studies- The emerging structure of a new scientific field. *Research Policy*(38), 218-233. doi:10.1016/j.respol.2008.12.006
- Flanagan, K., Uyarra, E., & Laranja, M. (2010). The 'policy mix' for innovation: Rethinking innovation policy in a multi-level, multi-actor context. Retrieved from Manchester, U. K.:
- Hands, D. W. (2002). The sociology of scientific knowledge Science: bought and sold (pp. 515-548). Chicago: The University of Chicago Press.
- Intrakummerdi, P., & Chaminade, C. (2007). Innovation system policies in less successful developing countries: the case of Thailand. Retrieved from Lund, Sweden:
- Kline, S. J., & Rosenberg, N. (1986). An overview of innovation. In R. Landau & N. Rosenberg (Eds.), *The Positive Sum: Harnessing Technology for Economic Growth* (pp. 275). Washington, D. C.: The National Academy Press.
- Laranja, M., Uyarra, E., & Flanagan, K. (2008). Policies for science, technology and innovation: translating rationales into regional policies in a multilevel setting. *Research Policy*(37), 823-835. doi:10.1016/j.respol.2008.03.006
- Lee, K., & Kim, B.-Y. (2008). Both institutions and policy matter but differently for different income groups of countries: determinants of long-rung economic growth revisited. *World Development*, 37(3), 533-549.
- Magro, E., & Wilson, J. R. (2013). Complex innovation policy systems: Towards an evaluation mix. *Research Policy*(42), 1647-1656. doi:<http://dx.doi.org/10.1016/j.respol.2013.06.005>
- Martin, B. R. (2012). The evolution of science policy and innovation studies. *Research Policy*(41), 1219-1239. doi:10.1016/j.respol.2012.03.012
- Mathieu, J. E., Goodwin, G. F., Heffner, T. S., Salas, E., & Cannon-Bowers, J. A. (2000). The influence of shared mental models on team process and performance. *Journal of Applied Psychology*, 85(2), 273-283.
- Miles, M. B. (1994). *Qualitative Data Analysis* (Vol. Second Edition). London, U. K.: Sage Publications.
- Nemet, G. F. (2009). Demand-pull, technology-push, and government-led incentives for non-incremental technical change. *Research Policy*(38), 700-709. doi:10.1016/j.respol.2009.01.004
- North, D. C. (1994). Economic performance through time. *The American Economic Review*, 84(3), 359-368.
- Richardson, G. P., Andersen, D. F., Maxwell, T. A., & Stewart, T. R. (1994, 1994). Foundations of mental models research. Paper presented at the International System Dynamics Conference, Albany, NY. USA.
- RICYT. (2014). El estado de la ciencia 2014. Retrieved from Buenos Aires, Argentina: <http://www.ricyt.org/publicaciones>
- Schmookler, J. (1966). *Invention and economic growth*. Cambridge, MA: Harvard University Press.
- Unger, B. (2005). *Problems of measuring innovative performance* (pp. 19-50). Cheltenham, UK: Edward Elgar Publishing.
- Vhelo, L. (2004). *Science and Technology in Latin America and the Caribbean: an overview*. Retrieved from Maastricht, The Netherlands:
- Vonortas, N. (2002). Building competitive firms: technology policy initiatives in Latin America. *Technology in Society*, 24(4), 433-459. doi: [http://dx.doi.org/10.1016/s0160-791x\(02\)00034-9](http://dx.doi.org/10.1016/s0160-791x(02)00034-9)

Unrelated knowledge and related diversification - knowledge base combinations and path development in a DUI based, globalised region

Bjorn Asheim*(University of Stavanger), Markus Grillitsch(Lund University), Roman Martin(Lund University) and Michaela Trippel(Lund University)

* Bjorn.Asheim@circle.lu.se

KEYWORDS: Knowledge base combinations, Experience based mode of innovation, Path development

Regional clusters in high cost countries, dominated by engineering based industry and an experience based, DUI (Doing, Using, Interacting), mode of innovation, face increasing challenges to stay competitive in global markets. Only securing path extension will not be sufficient to achieve this in the long run. Such clusters will need to engage in new path development, especially path renewal based on regional branching by exploiting the generic part of the cluster's competence (i.e. related variety) as well as on knowledge base combinations, to remain innovative and competitive.

EEG maintains that related variety normally will be the key resource for regional renewal, but has recently started to ask the question whether relying on recombinations between related industries in the long run would be sufficient, or if diversification into more unrelated activities will be necessary to secure regional resilience.

The related variety and knowledge base concepts are distinct and complementary. Related variety emphasises the potential for learning and innovation in industries characterised by knowledge, which is neither too similar nor too different. The knowledge base concept differentiates between three knowledge bases, analytical, synthetic and symbolic, characterised by fundamental differences in how knowledge is created, used and transformed into innovations. According to the knowledge base approach, it is the combination of different knowledge bases, i.e. typically unrelated knowledge, that bears important innovation potentials. These ontological differences are also reflected in empirical approaches. Related variety is typically measured based on industry classifications.

Knowledge bases, in contrast, cut across industry classifications since i) different knowledge bases can occur in closely related sectors (e.g. a scientist and an engineer might work in the same industry, even though having different knowledge bases), and ii) the same knowledge base can occur in unrelated sectors (e.g. a graphical designer might work in highly unrelated industries). This then points to the complementarities between the concepts. Related variety is typically associated with the concept of branching by creating something new at the intersection between related industries. The knowledge base concept opens pathways for renewal regardless of the presence of related industries.

In this paper we shall focus on unrelated knowledge base combinations leading to new related industries, and analyse which cognitive, organisational and locational barriers and challenges exist for realising such knowledge combinations, how they can be overcome in regions with different types of RIS, and which organisational and institutional changes are needed to realise it. As part of this discussion we shall draw on the various proximity dimensions, and especially try to understand what is meant by an 'optimal cognitive distance' in this respect.

We shall maintain that unrelated knowledge combinations has been overlooked and represents unexplored potentials for new path development. Empirical examples of unrelated knowledge base combinations resulting in new path development would be traditional shoe or textile industries moving into technical shoe and textile by adding nanotechnology (analytical knowledge base) to the traditional (synthetic) knowledge base of the industry, food industry (synthetic knowledge) producing functional food using biotechnology (analytical knowledge), or the development of new media industry by combining unrelated symbolic knowledge with the analytical/synthetic knowledge bases of existing ICT industry.

Further examples of upgrading of traditional industries are to move into high value-added niches. This is a strategy that most efficiently can be realised by mobilising the symbolic knowledge base, often in combination with synthetic knowledge, and to apply a platform approach, i.e. transcending traditional sectors. This would normally imply that the firms continue to rely on the DUI mode of innovation, but are able to climb the value-added ladder by introducing new products that has a high element of symbolic knowledge to achieve product differentiation and, thus, represent unique products or services at the high-end of the global market. Industry examples would be tourism, food and beverages, furniture and fashion using advertisement, branding and design in market innovations.

We shall especially focus on analysing the potentials of unrelated knowledge combinations in regions dominated by an experience based, DUI mode of innovation in promoting path renewal. A regional maritime cluster in the North Western part of Norway, which is one of the regional clusters having the status of 'Global Centres of

Excellence' in Innovation Norway's cluster program, will be used as the specific empirical example. The case is highly interesting due to the region's outstanding economic and export performance while ranking low on common innovation indicators. On the one hand, it is therefore a perfect case advocating a broad perspective on innovation and knowledge bases as the foundation of firms' and regions' competitiveness. On the other hand, this case allows us to unveil the potentials for renewal in regions that are not blessed with a high degree of unrelated variety or strong universities.

The maritime industry can be described as a traditional manufacturing industry that relies largely on a synthetic knowledge base. This is to say that the workforce has a high level of experience-based, tacit knowledge in the field of engineering. Learning and innovation is supported by a high level of trust in the region, which allows for informal and quick communication between the various actors in the regional cluster. Furthermore, interaction and learning also occurs to a high degree between the management and employees thanks to flat hierarchies in learning work organisations. The maritime industry benefits from university colleges and applied research institutes, which have adapted their educational programs as well as research and development activities to the needs of the industry. As regards research and development, this means mainly applied research as well as support in testing and application development.

However, the maritime industry is currently facing tremendous challenges due to the dramatic fall in oil prices since the second half of 2014. The fall of the oil price has strained profits for the more demanding, technologically complex and costly exploration activities in the North Sea. This represents a big challenge for the Norwegian economy as a whole, and the maritime industry in particular, which delivers specialised equipment and provides services to offshore installations outside the coast of Western and Northern Norway. Besides the maritime and oil and gas industries, Møre and Romsdal exhibits a specialisation in the marine and furniture industries. The marine industry has substantial future potential. Møre and Romsdal has a long tradition in fishery, which contributes to the strong regional export performance equally as much as the sales of manufacturing goods. Due to the increasing cost pressures in traditional fishery, firms have begun to venture into biomarine. Biomarine describes the inflow of biotechnology into traditional marine activities that leads to new functional foods (e.g. healthy oils), pharmaceutical products, and flavors. Besides, traditional fishery is complemented by aquaculture, i.e. farming of salmon, cod and halibut. Due to these new developments, the marine industry has expanded steadily since 2000 and the market is expected to grow significantly in future. The renewal of the marine industry challenges the regional knowledge infrastructure dominated by experience-based engineering knowledge. The further development of the biomarine sector, in contrast, requires analytical, science-based knowledge. However, the region has until recently no university, only the university college in Molde has university status in logistics. Furthermore, the research and development expenditures per capita are far below national average. This weakness is problematic not only for biomarine but also for increasing the knowledge intensity of the maritime and other industries.

Strong efforts have been undertaken to enhance research capabilities in the region. This has resulted in a higher share of staff with PhD education, industry-sponsored professorships, and a successful application of the Aalesund University College to the "Centre for Research driven Innovation" programme. The latter promotes research collaboration with industry, in this case mainly the maritime industry, focusing on strategic basic research as well as advanced applied research. This application was done in partnership with the Norwegian University of Science and Technology, with which Aalesund University College was merged in 2016. This will potentially increase the access to basic (analytical knowledge) and applied (synthetic knowledge) research for firms in the region.

Besides seeking to upgrade the regional knowledge base, one priority also lies in creating synergies between existing regional clusters. In particular, cross-fertilisation is promoted between the maritime (GGE Maritime) and marine (Legasea Arena) clusters. A good potential is also seen in the promotion of generic competencies related to for instance material and production technology or logistics (promoted by the iKuben cluster). However, given the narrow knowledge base and peripheral location of Møre and Romsdal, new path development also relies heavily on searching and accessing extra-regional resources and knowledge, which is done extensively: The GCE Blue Maritime defines the scouting for knowledge globally as a core activity. The HEIs aim at establishing national and international linkages. Leading firms in the region collaborate with non-local partners to bring in complementary knowledge (mainly analytical and symbolic knowledge). Finally, the paper shows how this more differentiated regional innovation policy approach extends the related variety argument and proposes alternative avenues for promoting economic diversification.

5B. THEORETICAL PERSPECTIVES ON INNOVATION POLICY

Separate innovation policy and research policy - to abandon linearity!

Charles Edquist
(CIRCLE, Lund University)
charles.edquist@circle.lu.se

KEYWORDS: Innovation Policy, Holistic innovation policy, Research policy, Linear view, Systems of innovation.

1. Relevance for the conference theme

The paper deals with the relations between innovation theory and innovation policy and builds upon an account of relevant theories of innovation and innovation policy as well as on empirical data on innovation policies created specifically for the purpose of this analysis.

2. Research aims and questions

The aims of this paper are to study the relations between innovation theory and innovation policy and why innovation policy is behind innovation theory concerning how to influence innovation processes, e.g. why innovation policy is still linear and not holistic. On this basis, I will also reflect about the future development of innovation policy, and its relation to innovation theory.

3. Definitions of central concepts

The concept of a holistic innovation policy is, in this paper, defined as a policy that integrates all public actions that influence of may influence innovation processes. It is based upon a particular specification of the systems of innovation approach where ten activities (or determinants of innovation processes) define an innovation system (Edquist 2005, Edquist 2011, Borrás and Edquist 2013). All the Key-words mentioned below will, similarly, be explicitly defined in the paper.

4. Theoretical framework

The development of the innovation systems approach is summarized and so is the theoretical underpinnings of different perspectives on innovation policy. Both are specified and the relations between them are discussed in detail.

The innovation systems approach has diffused rapidly during the latest decades and has completely replaced the linear view in the field of innovation research. However, innovation policies is still largely based upon the linear view.

5. Empirical material

The empirical results are based on a questionnaire (designed by me) sent to twenty-three EU Member States (by the EC), out of which nineteen (83%) responded. Part of the work for this paper was carried out for the European Research and Innovation Area Committee (ERAC) of the European Commission (DG RTD). The paper and its results will also be based upon my personal experience as a member of the Swedish Research Policy Council and the Swedish National Innovation Policy Council (see below).

6. Methodology

On the basis of the conceptual specifications and on the basis of relations between the concepts specified, these theoretical propositions are contrasted with the empirical material collected, and conclusions are drawn on that basis.

7. Expected outcomes

The majority of European countries are striving in the direction of developing a more holistic innovation policy. However, it is concluded that the innovation policies in European countries are still dominantly linear despite the fact that a holistic policy seems to be the driving vision. Innovation policy is behindhand.

One reason why innovation policy is still dominantly based on the linear model, is that the research policy community is much better organized than the innovation policy community.

However, policy-makers attending conferences on innovation are practically always in favor of holistic (systemic, broad-based, comprehensive, etc.) innovation policies. They have abandoned the linear view by learning from innovation research. The division between “linear” and “holistic” seems to be located within the community where innovation policies are designed and implemented, a community composed of policy-makers (administrators/bureaucrats) and elected politicians. It will be argued that the dividing line is between these two groups in that politicians, who actually make the decisions, may still reflexively believe in the linear view.

There seems to be a failure in communication and interaction between researchers and politicians in the field of innovation and there is therefore a strong need to directly involve innovation researchers in policy design and implementation to a much higher degree. Another way to increase the degree of holism could be to separate innovation policy from research policy, since their continued integration tends to cement the linear character of innovation policy.

In quite a few countries (20-30), Science, Technology and Innovation Councils (or Research and Innovation Policy Councils – or variants of these names) have been created. They are often (at least formally) chaired by a leading politician, sometimes the President or Prime Minister. As indicated by their names, most of them cover both research policy and innovation policy. It is argued, in the paper, that this leads to research policy becoming dominant over innovation policy. In this way, innovation policy does not get the ‘space’ for developing itself into an independent policy area, but is pursued as a footnote to research policy – and the linear view remains.

In Sweden, the political organization of these two policy areas is different. A Research Policy Council has existed for decades, normally chaired by the Minister of Education or Research. This Council has advised the government when developing a research bill to Parliament every fourth year. The latest two bills have carried the name “Research and Innovation Bill”. However this has meant only a very marginal emphasis on innovation, and in a linear manner – as an appendix to research.

In February 2015, the Prime Minister created the Swedish National Innovation Council. It is chaired by the Prime Minister. He is personally chairing the 5-7 hour meetings four times per year – something that is extremely uncommon for corresponding councils in other countries. The council consists of 10 external advisors from industry, unions and academia. Except for the PM, the following ministers participate in the meetings: Finance, Industry/Innovation, Research and the Environment. (Most of these ministers have never heard the expression “linear view”, although they are certainly practicing innovation policies based upon it.) The secretariat of the Swedish Innovation Council is placed in the Office of the PM, i.e. above all Ministries.

For the benefit of developing an innovation policy independent of (but coordinated with) research policy, it is a great advantage that there are two different councils for research policy and innovation policy, respectively. This means that Sweden has the potential for becoming the first country that breaks with the linear model in its innovation policy and starts developing a holistic innovation policy.

I was a member to the Research Policy Council during 2012-2013. I am a member of the Innovation Policy Council from 2015. In this paper I will partly build upon these experiences (which very few innovation researchers have).

At the European Commission, there is currently a discussion about creating a European Innovation Council (Research Commissioner Moeda). This initiative will also be addressed in this paper.

References

Borrás, S., and Edquist, E. (2013). The choice of innovation policy instruments. *Technological forecasting and social change* 80(8), 1513-1522. doi:10.1016/j.techfore.2013.03.002.

Edquist, C. (2005). Systems of innovation: Perspectives and challenges. In Fagerberg, J., Mowery, D., and Nelson, R. (Eds.), *Oxford handbook of innovation* (pp. 181-208). Oxford, UK: Oxford University Press.

Edquist, C. (2011). Design of innovation policy through diagnostic analysis: Identification of systemic problems (or failures). *Industrial and Corporate Change* 20(6), 1- 29. doi: 10.1093/icc/dtr060.

An innovation system framework for system innovation policy: the case of Strategic Innovation Programs (SIPs) in Sweden

Lars Coenen*, Markus Grillitsch, Teis Hansen and Jerker Moodysson
(CIRCLE, Lund University)
*lars.coenen@circle.lu.se

KEYWORDS: Challenge-driven innovation policy, System innovation, Policy-mix, Socio-technical transitions

Relevance

Grand societal challenges such as climate change, ageing societies and food security feature increasingly on the agenda of policymakers at all scales. Innovation policies that directly target these challenges are in particular advocated by supranational organisations such as the OECD and the European Union (EU), but are gradually also taken on board by local, regional and national authorities (Cagnin et al. 2012). This orientation towards grand societal challenges can be seen as a new wave or paradigm for innovation policy that extends and complements its previous concern with innovation policy as an engine of economic growth (Gassler et al. 2008). This challenge-based rationale has raised attention for what is often referred to as system innovation policy which aims for system transformation rather than system optimization (Borrás and Edler 2014; Schot 2015).

While this kind of innovation policy has been heavily influenced by the burgeoning literature on socio-technical transitions (Geels, 2005), policy-makers are still challenged to translate the concepts, mechanisms and insights that follow from transition literature into policy practice, design and evaluation. The OECD (2015) observes that “by and large, most innovation policies aim to foster incremental change; fostering wider system change is a new challenge for innovation policy makers, especially as many of the actions will fall in areas outside the direct remit of research ministries or innovation agencies but where their input, coordination and implementation actions will remain critical” (p. 9). This makes a clear call for policy learning.

Definitions

According to the OECDs recent synthesis report system innovation policy refers to “a horizontal policy approach that mobilises technology, market mechanisms, regulations and social innovations to solve complex societal problems in a set of interacting or interdependent components that form a whole socio-technical system” (OECD 2015, p. 7). In similar vein, Kuhlmann and Rip (2014) argue that system innovation policy requires a mix of technological and social innovation, reconsideration with respect to policy aims and means, and involvement of new actor constellations that include a larger variety of actors, and consider new roles for traditional actors. Such broadening of scope raises important questions how to analyse and assess the role, potentials and challenges for innovation policies in targeting grand challenges.

Research aims

The aim of our paper is to develop an analytical framework to assess system innovation policy, bridging concepts and insights from innovation systems theory and transitions theory.

Expected outcomes

The expected outcome of this paper is to develop a framework which specifies the conditions that enable and constrain system innovation and to identify the overall policy-mix that influences these conditions.

Theoretical framework

The literature on socio-technological transitions is primarily concerned with specifying the conditions for transformative shifts in systems of production and consumption that unfold as disruptive technological change co-evolves with changes in markets, user practices, policy, discourses and governing institutions (Geels 2002; Kemp et al. 1998; Markard et al. 2012; Smith et al. 2010). This literature calls attention for the co-evolution of a broad range of innovations which highlights technological, social, organisational, institutional, and business model novelty. It shares many theoretical roots with innovation studies, most notably a system perspective on innovation and a neo-Schumpeterian evolutionary understanding of change and industrial dynamics (Coenen and López 2010). However, compared to innovation system approaches, it claims to comprise a wider set of

institutions and networks of heterogeneous actors including firms, user groups, scientific communities, policy makers, social movements and special interest groups. As a result, it stresses the importance of directionality, resistance and contestation in (radical) innovation processes. The most well-known examples of such socio-technological transitions concern low-carbon transition in fields of energy and transport. However the conceptual model can be applied to any field subject to broad system transformation.

Drawing on the Schumpeterian notion of creative destruction, research on socio-technological transitions has emphasized the role that technological niches play in radical change in the face of relatively stable regimes (Schot and Geels 2008). A regime refers to an entrenched socio-technical system whose institutional logic structures perception and behavior of actors, thus favoring incremental change and innovation. A central and recurrent proposition in socio-technical transition research is that system transition requires the destabilisation of an existing regime. A niche is defined as an ‘incubation space’ for radically new technologies characterized by high technological, institutional and market uncertainty. Niches protect radical innovations against market selection and institutional pressures from a regime and allow actors to learn about novel technologies and their uses through experimentation (Coenen et al. 2010; Geels 2002). System transition can occur when niches gather sufficient momentum so that these relatively loose configurations become institutionalized and create capacity for emergent technologies and radical innovations to challenge and substitute a regime. The distinction between niches and regimes has been proven to be a useful heuristic to capture processes of new path creation in the emergence of radically new sustainable technologies while at the same time accounting for processes of path-dependence and resistance when such technologies start to substitute and dislodge existing socio-technical systems (Smith et al. 2010).

However, a number of shortcomings can be identified. First of all, various scholars have pointed out that there is a need for greater rigor in the operationalization of niches and regimes (Berkhout et al. 2004; Fuenfschilling and Truffer 2014; Markard and Truffer 2008). Numerous empirical studies have for example conflated niches with new entrants and regimes with incumbent actors. As a result, there has been a relative neglect of the role of incumbents in driving radical transformation processes in transitions (Smith et al. 2005; Hockerts and Wüstenhagen 2010). Secondly, it has proven difficult to translate the socio-technical transition literature to the domain of innovation policy (Turnheim et al., 2015). Despite various contributions (Weber and Rohracher, Kivimaa and Kern, 2015) innovation policy-makers are still challenged to translate the concepts, mechanisms and insights that follow from transition literature into policy practice, design and evaluation.

Even though insights from transition studies have provided novel rationales for policy action in science, technology and innovation policy to address system innovation (Weber and Rohracher, 2012), these studies provide little guidance as to which policy instruments are effective in addressing system innovation. To translate and concretize the challenges of system innovation towards scope for policy action, we relate these challenges to three generic dimensions of innovation systems, i.e. (1) interests and capabilities of actors, (2) networks and network dynamics and (3) institutions and institutional change. These dimensions will allow us to analyze whether and how innovation policy instruments can be used to foster and expedite system innovation.

Empirics

Our analytical framework for system innovation policy will be empirically illustrated with reference to two initiatives in the Strategic Innovation Program (SIP) of VINNOVA (the Swedish governmental innovation agency), namely BioInnovation, targeting the transition to a bio-based economy and Re:Source, targeting the transition to a circular economy. Over the past years, VINNOVA has increasingly endorsed a more societal challenge driven logic for innovation policy, not only in discourse but notably also in terms of resource allocation. In various ways SIP has subscribed to the notion of system innovation policy. It aims for transformative change through system-innovation rather than optimising existing systems. It is explicitly geared to fostering radical and disruptive innovation. It targets technological innovation as well as social innovation. Moreover it acknowledges the need for interdependent institutional and technological change to foster system innovation.

Methodology

Literature review and stakeholder interviews

Innovation policy at stake: Should we throw the baby with the bath waters or change the composition of the bath waters

Philippe Laredo
(Université Paris Est, IFRIS)
philippe.laredo@enpc.fr

KEYWORDS: Innovation policy, Policy mix, Transition, Governance

There is an on-going debate about the need for deep revisions in the rationale, content and organisation of research and innovation policies

Summing up the debates that took place at the last EUSPRI conference, positions can be assembled along three lines, based upon a starting point proposed by Maria Mazzucato on the need for the state to become more active.

- One position considers that public intervention in innovation (Edler & Novotny in particular) is now unbalanced towards the supply side, and that it should be rebalanced towards the 'demand side', and in particular towards 'societal challenges' (this translating the more pro-active role of the state in orienting activities)

- Pushing further Johan Schott proposes a more radical shift considering that state intervention should be focused on the long-term transition we have to face, linked to climate change, sustainability & energy transition. His image is the need for an 'innovation policy 3.0'

- Finally I see in C. Edquist discourse a further position, pushing for separating de novo the science policy from innovation policy. Pushing his reasoning further, he sees the former as a new 'framework condition' for innovation to take place (capacity building) while he sees innovation policy as a new type of 'industrial policy' revised (looking back at the 1970s we find interesting similarities in particular with debates on supply vs demand based policies, and on the oil crisis and the need for an energy transition).

In this presentation I would like to bring four points to the discussion

a) Whatever position we adopt, I think we have to consider the long-term implications of the type of 'knowledge based society' we are de facto in (with far more than half of an age class in higher education). We have not embedded the implication of this fact in the institutional setting of 'higher education' at large and remain paralysed by old concepts (see the debates on excellence or on research intensive universities). Institutional frameworks dealing with capability building & reinforcing all along the working life remain to conceptualise, and operationalize. This is why I tend to share the position by Edquist and consider that this builds a policy per se.

b) I think that we have not taken the measure of the massive redefinition needed of policies supporting the innovation capacities of firms.

Most policies have focused on 'technology-based' innovation of manufacturing firms in what I characterise around 3 main types that often have also been phases in policy design (technical centres, collaborative programmes, focus on small firms innovation capacity and within it on the ecology for start-up firms).

I argue that we should heavily discuss this focus to take into account radical changes. The key words that characterise the new challenges R&I policies face, can be characterised by three 'umbrella' terms: (a) service economy (b) globalisation, (c) new 'lifestyles' and political consumption. There may be more but these three issues combined drive us to ask ourselves if there is not a completely new paradigm to consider for relevant public intervention.

Under these umbrella terms there are important transformations that question our assumptions on the rationales for policy intervention. Let me here just say a few words on each. In services we know about manufacturing-like services and on KIBS. But the core of employment (and even more the core of employment growth) is linked to services focused on 'individuals' – from health to tourism, leisure and culture. Some colleagues in SPRU have even coined the term "hidden innovation" to speak about transformations in the health sector. Can the now fashionable answer about business models help better characterise innovation processes, so that we can identify ways in which public authorities can accompany firm efforts and build an environment that is more conducive to innovation efforts?

Globalisation goes with concentration on a limited number of large firms, and drives to discuss all models of comparative advantages in international trade. But it also goes with a greater and greater decoupling between production & consumption. When both were coupled in one country, citizens' vote could 'frame markets'; when three quarters of what they buy come from outside, new forms of involvement are required. Political consumption and the rise of 'value-based' NGOs with their certification mechanisms are the other facet that question intergovernmental inability to frame markets.

There has been work on the shifting role of users in driving innovation (cf. Von Hippel plea for democratising innovation). They represent an entry point to a new phenomenon whereby in a knowledge-based society, the vast majority of users/consumers are themselves part of innovations processes in their work (or at least change processes). And this is fast developing in multiple directions that question us. Again here I select only a few developments that can be captured by simplifying keywords: (a) crowd sourcing, (b) political consumption and/or responsible innovation; (c) social innovation, (d) DIY and/or sharing economy. Once again the focus is on implications on the rationale, direction and content of innovation policies.

c) Science policies were born with 'mission oriented' policies and in a way this remains very visible in the composition of the US budget. One even has to remember that the first policy report by OECD (the Piganiol report) advocated for them. He proposed however an interesting design feature that has been by and large forgotten: a separation between overall resource allocation (that should be centralised at Prime Minister level) and implementation (that should remain in the hands of ministries and bodies in charge of the different missions). He even advocated the creation of special bodies when issues were strategic and required coordination beyond usual (he implemented that in France as De Gaulle 'délégué interministeriel de la recherche' creating a model of 'grand programme' far from stereotypes later discussed under the term of large programmes and from which we could learn when we discuss societal challenges). There is thus a long tradition about handling societal 'strategic issues' and I think we should reflect on it for discussing policy developments needed to anticipate the 'Transition'.

d) Finally a point that I do not see discussed very often but is everyday more visible in Europe at large (from Brexit to immigration policies) lies in a simple question: 'who is the policymaker', and if there is no single policymaker, what are 'operational forms' of collaborative governance (rather than multi-level). We could also well think, as many cities in the US, that global problems are better handled 'locally' than waiting on the emergence of a problematic 'global' governance. This gives de facto a different role to global organisations (in a recent conference on development, Y. Nugruho from Indonesia, one of the rapporteurs of the new Millennium SDGs, argued that their primary role was to influence national/local agendas).

My feeling is that we are at a turning point, and that we should be proactive in discussing what should be the next generation of innovation policies seen as policies anticipating coming structural changes.

New and Old Avenues for European Research, Technology and Innovation Policies: changing rationales for European RTDI

Peter Biegelbauer* and Matthias Weber
(Austrian Institute of Technology)

* peter.biegelbauer@ait.ac.at

KEYWORDS: Challenges in RTDI policy governance, History of innovation policy, EU RTDI policy, Policy rationales, Policy frames

For several decades EU research, technological development and innovation (RTDI) policy has been growing in importance. It is in a steady process of expansion when measured in terms of expenditures, share in EU budget and also in terms of the political clout of the field. The European Commission since the 1950s wanted to Europeanise the policy area, yet with the exception of the Euratom Treaty and the Joint Research Centre succeeded only in the 1980s with the realisation of the first major policy initiative, the First European Framework Programme on RTDI. With the following framework programmes the policy field became the second largest Europeanised policy area in budgetary terms in the late 1990s. The launch of the Lisbon Agenda and the European Research Area (ERA) policy in 2000, introduced a new phase of deepening and broadening cooperation in matters of RTDI policy in Europe.

Supranational European RTDI policy has reinvented itself continuously during this time-span. An important part of this process were the changing policy rationales, providing a framework for devising, legitimising, implementing and renewing policies. These observations warrant a number of questions: How did the rise of the EU RTDI policy happen? Which rationales can be identified for the last 50 years of European RTI policy? What was the role of these rationales in determining the orientation and shape of European RTDI policy, and in particular the framework programmes? And what can we learn from this analysis regarding the role of current and possible future policy rationales?

In this paper we will discuss the establishment and development of the policy area by analysing key policy documents. There will be an emphasis on the time since the development of framework programmes, looking at the different policy initiatives and programmes and the changes from one to the next. We will analyse the policy rationales underpinning the different framework programmes, which took the form of narratives. We will use these narratives to show how the rationales became more powerful and pre-structured the options of the different actors. Examples of these narratives are the fear of being left behind by economic competitors like the US (Servan-Schreiber 1968) and Japan, or the so-called European Paradox (i.e. the EU produces a lot of research results, but little innovation from firms, EC 1995).

In order to do so, we shall utilise the concept of policy frames, which is an effort to grasp the importance of discourses and narratives in policy-making. When policies are communicated - and since policy-making consists mostly of communicative acts, they are frequently told and retold - they are usually depicted as stories with a storyline, a beginning, a main part and an end. In other words: these stories provide a background with important policy problems as well as potential solutions, amongst which a specific solution is preferred in order to cause an optimal outcome, thus eradicating the problem. Policy frames therefore provide a framework of reference for a policy theory in the sense of understanding how a certain policy problem comes into being, through which instruments it may be resolved and how these instruments may impact upon the policy problem.

Whilst the narrative of the international technological and industrial competition has served as key underlying rationale for European RTDI policy since its inception in the early 1980s, it is supplemented by other narratives, which over time have begun to serve as frames in this Europeanising policy field. The most important ones are the European Paradox, the European Research Area and the Grand Challenges narratives.

The policy frame of "Europe as Laggard in S&T" features the policy problem of the EEC/EU being technologically and thus also industrially and technologically lagging behind in the international competition. The proposed solution of the concomitant narrative is to create common European industrial and technological programmes with the goal of catching up with other countries and regions and the outcome of industrial and technological excellence.

The “European Paradox: Europe as a laggard in Innovation” frame identifies as main problem that the EU excels in science, yet lags behind in industrial innovation. The proposed solution for the problem is to put more emphasis on EU innovation programmes with the goal, again, to catch up with other countries and regions and the outcome of industrial and technological excellence.

“European Research Area” is a policy frame focusing on the EU’s international competitiveness, which is hindered mainly by a missing common market/area for RTDI. The envisaged solution is to put more emphasis on cooperation and networking in EU RTDI programmes with the goal of solving societal problems and have to EU excelling in the international competition and the outcome is industrial, scientific and technological excellence.

The policy frame “Grand Challenges” deals with the problem of the EU facing societal challenges asking for trans/interdisciplinary RTDI solutions, which also provide opportunities for the international competition. This problem should be solved with trans/interdisciplinary problem-centred and application-near RTDI aiming at diminishing societal problems and achieving the outcome of societal resilience, but also industrial, scientific and technological excellence.

When the four policy frames are juxtaposed after the identified problem, proposed solution, intended goal and key values they feature, it becomes transparent that they share certain characteristics. For example the identified problems of the four narratives are quite similar, with the EEC/EU being deficient of a certain element/elements necessary in order to make it more successful. More importantly, the proposed solutions are mostly the same: common EU programmes in need of more competences on the EU level. With the partial exception of the “Grand Challenges” narrative, the goals are similar, too: the EEC/EU has to catch up with other countries and regions, as are the outcomes, which is mostly industrial and technological excellence.

Moreover there is a tendency for the four policy frames to become more complex over time. Whereas the frame “Europe as Laggard” may be described by a short sentence with a single element in its problem description, the “Grand Challenges” are more complicated and also need more elements in order to make up the argument. Similarly goals and key outcomes become more various over time.

The four narratives are not mutually exclusive. In fact, they build upon and complement each other and can be understood as creating a key discourse extending over several decades of European policy debates. Until the present day they frame European RTDI policy and frequently can be found in key documents of e.g. the European Commission.

The question remains why a policymakers should use a policy frame to begin with, when it prestructures their field of action and hinders them from acting more freely - in addition to actor and interest constellations as well as institutional structures, which policymakers have to deal with anyway. The reason why politicians and civil servants ever so often will hark back to specific narratives is that they are helpful in explaining highly complex relationships between policy problems, solutions, impacts and outcomes by telling a simple story or even utilising a single term, a sentence or a simple figure of speech. Well-known narratives may be seen as a sort of public library available to all actors part of a specific policy community that can be accessed by policymakers. Frames can invoke pictures and storylines in the minds of an audience and so can make the life of policymakers easier, thus reducing the complexity of policies and policy-making alike.

Policy frames, however, are context and time specific. Over time they may lose their power with audiences that change with regards to properties such as professional norms, broader societal values, historical experiences et cetera. In the case of the frame “Europe as Laggard”, the mobilising power of this narrative seems to have begun to diminish with the failure of the Lisbon Agenda in the 2000s. We will finish the paper by looking into the question if more recent policy frames will be able to take the place of the hitherto powerful rationale of being endangered by international economic competition and what propensities they may have to feature in order to become authoritative.

References:

Colebatch, H. (2006). "What work makes policy?" *Policy Sciences* 39(4): 309-321.
European Commission (1995). *Greenbook on Innovation*, EU.
Fischer, F. and J. Forester, Eds. (1993). *The Argumentative Turn in Policy Analysis and Planning*. Durham, London, Duke University Press.
Servan-Schreiber, J.-J. (1968). *Le Défi américain*. Paris, Éditions Denoël.

5C. TRACK THEME 9: FOSTERING INNOVATION AND INDUSTRIAL DEVELOPMENT IN GLOBALIZED INNOVATION SYSTEMS: POLICY CHALLENGES IN A MULTIPOLAR WORLD ECONOMY (II)

Niche development and upgrading in the PV value chain: The case of local assembly of PV panels in Senegal

Ivan Nygaard* and Ulrich Hansen

(UNEP DTU Partnership, Department of Management Engineering, Technical University of Denmark)

*ivny@dtu.dk

KEYWORDS: Upgrading, Global Value Chain, Photovoltaic, Innovation system, Assembly factory

1. Relevance

The paper presents a case study of the enabling and constraining factors for establishing an assembly factory for PV panels in Senegal. Within the last 5-6 years the market for both small and large scale PV has rapidly increased in Sub Saharan Africa (SSA)(Hansen et. al., 2014, 2015) and to stimulate and to service these markets assembly factories for PV panels has been established in South Africa, Ethiopia, Kenya, Burkina Faso and Senegal. So far, no research analysing the enabling and constraining factors for this upgrading or innovation has been published, and the paper is therefore both original and relevant with respect to the object of research. Establishment of assembly factories in a developing country context can be conceptualised not only in terms of development of a niche in a local innovation system, but also as upgrading in the global PV value chain influenced by national and international innovation policies. By combining the multilevel perspective on technological transitions and the value chain approach in studying establishment of local PV assembly factories the paper is adopting recent approaches to studying innovation systems in developing countries, and it conforms with the wish from the organisers to integrate these approaches as expressed under Track theme 9.

2. Research aim(s) and question(s)

The aim of the research is to understand the conditions for technological transition through upgrading in global value chains in developing countries and hence to contribute to insight on the effects of national innovation policies and on the opportunities for development of viable niches for green tech companies in SSA

The main research question is: What are the main enabling and constraining factors for upgrading in the PV value chain in terms of establishing and maintaining a local production of PV panels in Senegal

3. Definitions

The global value chain (GVC) provides a framework with which to describe the full range of activities required to bring a product or service from conception, through the different phases of production, to delivery to the final consumers and end-users in the market (Kaplinsky and Morris, 2003)

The GVC literature defines upgrading in terms of process upgrading, product upgrading, functional upgrading and inter-chain upgrading (Humphrey and Schmitz, 2002), or as matching market standards (Bolwig et al., 2010)

A defining characteristic of niches is that they provide temporary 'protective space' or incubation rooms for development of innovations (Geels, 2002).

4. Theoretical frameworks

In order to grasp the strong influence of international linkages in the development of a national innovation system in Senegal, the analysis will combine insights from the multilevel perspective on technological transitions (MLP) (Geels, 2002), and the global value chain framework (Gereffi, 1999; Humphrey and Schmitz, 2002; Gereffi et al., 2005).

5. Empirical materials

This paper is based on 8 key interviews with main stakeholders related to the assembly factory. These interviews

include actors directly involved in the factory such as: (1-3) the main shareholder and owner of the factory, the former CEO and the former product head. Actors involved at the policy level such as: (4-6) the minister of Renewable Energy from 2010 to 2012, the head of the climate committee (COMNAC) from 2010 to 2013 and the head of the climate committee from 2013-2016. Finally, two interviews (7-8) were conducted with a civil society actor and an importer and distributor of PV panels

6. Description of the methodologies

The interview persons were by actors in the energy sector identified as key actors in establishing a local niche for development of solar PV in Senegal. Five of the interviews were recorded and transcribed, while for the last 3 interviews, minutes were written immediately after the interview based on notes taken during the interview. Information from the interviews has been triangulated by information from the grey literature, such as reports to donors, consultancy reports, statistics, etc. and by information from newspapers and articles available on the internet. Last and not least, important information and conclusions have been discussed with individuals in the energy sector, with whom the author have had a longer term working relationship through projects in the energy and climate sector in Senegal and in the West African Region in the period from 2010-2016.

7. Expected outcomes

The scientific outcomes are improved understanding of technological transitions and upgrading in LDCs.

The preliminary conclusions are that upgrading in the PV value chain is challenging because the comparative advantages of national assembly of solar PV are questionable compared to the importance of being well connected in the value chain. The case shows that: i) it is important to include strategic investors, who are already well established at different levels of the value-chain in order to get inputs at a competitive price and to get access to markets; ii) national capital investment in PV assembly had an impact on national policy development due to direct political connections and influence at high level and due to enthusiasm among local PV value chain actors, iii) that the timing for establishing the factory in this case was bad because of a number of factors such as: a) regional unrest that destroyed or delayed the regional markets, b) a significant reduction in sales prices due to changes in FIT in Europe, and c) that the policy environment was dramatically changed due to the fall of president Wade in 2012.

References:

- Bolwig, S., Ponte, S., du Toit, A., Riisgaard, L. and Halberg, N.: "Integrating poverty and environmental concerns into value-chain analysis: a conceptual framework," *Dev. Policy Rev.*, vol. 28, no. 2, 173–194, 2010.
- Hansen, U.E., Nygaard, I., Pedersen, M.B. (2014) Prospects for investment in large-scale, grid-connected solar power in Africa. UNEP Risø Centre, Technical University of Denmark (<http://www.unepdtu.org/Newsbase/2014/06/New-Publication-Released-Large-scale-grid-connected-solar-power-in-Africa>)
- Hansen, U.E.; Pedersen, M.B.; Nygaard, I. (2015). Review of the Solar PV Market Development in East Africa. *Renewable & Sustainable Energy Reviews*, Vol. 46, 2015, p. 236–248
- Humphrey, J., Schmitz, H. 2002. How does insertion in global value chains affect upgrading in industrial clusters? *Regional Studies* 36, 1017-1027.
- Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Res. Policy* 31, 1257–1274. doi:10.1016/S0048-7333(02)00062-8
- Gereffi, G. 1999. International trade and industrial upgrading in the apparel commodity chain. *Journal of International Economics* 48, 37-70.
- Gereffi, G., Humphrey, J. and Sturgeon, T.: 'The governance of global value chains'. *Review of International Political Economy*, Volume 12, pp. 78–104, 2005.
- Kaplinsky, R. and Morris, M.: 'A Handbook for Value Chain Research'. Institute of Development Studies, University of Sussex, 2003.

A Policy Review on Instruments Fostering the Diffusion of Electric Vehicles in China

Michael Nauruschat*(Technical University of Berlin, Chair of Innovation Economics) and Tong-Yaa Su(University of Bremen, Faculty of Business Studies and Economics)
michael.nauruschat@tu-berlin.de

KEYWORDS: Policy mix, Electric vehicles, Technological innovation systems, China

Our paper gives a state-of-the-art policy review on the development of electric vehicles in China. We offer a comprehensive analysis as to the different policy instruments affecting the Chinese market for electric vehicles. Moreover, by looking at each individual policy instrument, we expound which groups and organizations (e.g., customers, manufacturers, research facilities, retailers, etc.) are involved besides policy-makers. Assessing and discussing the case on electric vehicles in China reveal illuminating insights concerning China's leapfrogging strategy and top-down approach to accelerate technological innovation and its catch-up process in the automotive industry.

1. Relevance

In December 2015, 195 countries adopted the first legal binding global climate agreement in Paris. One key element of the deal is the reduction of greenhouse gas emissions in order to keep the global average temperature below two degrees. As the global road transport is responsible for about 17-18 percent of CO₂ emissions (UNEP, 2015), alternative power strains and new ways of mobility highly matter for the purpose of reducing emissions. Electric vehicles are thereby considered to lower air pollution and the dependence on fossil fuels (Liu and Kokko, 2013). In this context, China is not only the fastest growing car market in the world (Tagscherer and Frietsch, 2014), but also holds 12% of the global electric vehicle stock which is the third highest as compared to other states (IEA, 2015).

Quitow (2015) states, that "there is widespread consensus that no individual policy instrument but rather a "policy mix" is needed to effectively drive the development and diffusion of environmental technologies." Our paper overviews the policy mix fostering the development and diffusion of electric vehicles in China as an environmental technology. This policy mix embraces instruments stemming from innovation, research, and industrial policy (Liu and Kokko, 2013; Yuan et al., 2015). Thereby, China is aiming to develop a lead market for electric vehicles and follows a different approach than other global key players due to its industry characteristics and political priorities (Bär, 2013).

Furthermore, besides the rapid growth of individual mobility, China seeks to become a technological leader in the automotive industry. A great innovative drive in the field of electric vehicles and a fast growing market could enhance the catch-up process in view of global automotive industry leaders (Altenburg, 2015). As a consequence, China might be able to enhance its role in global value chains in the automotive industry (Doraczynska and Bierau, 2014). Thus our scientific contribution goes in line with track theme 9 "Fostering innovation and industrial development in globalized innovation systems: Policy challenges in a multipolar world economy."

For the above-mentioned reasons, innovation, research, and industrial policy are important. Aside from that, other instruments like those that can be assigned to energy policy, decisions on the transportation infrastructure, government/tax incentives for private and commercial users, and national CO₂ limits are also playing a crucial role at driving the Chinese electric vehicle market (Tagscherer, 2012). For instance, the tenth "Five-year plan for national economic and social development" consists of promoting low-emission vehicle motors, in order to reduce Chinese and global carbon footprint (Yuan and Zuo, 2011). As a result, reviewing the comprehensive policy mix affecting innovations related to electric vehicles in China is of high relevance, because insights and implications from this research can be applied to analyses as to other countries.

2. Research aims and questions

Aiming at presenting conspicuous insights regarding the electric vehicle market in China, the contribution of our paper is twofold: (i) We propose a policy-related analysis tool: reviewing and assessing the policy instruments. First, a review of the policy mix influencing the development and diffusion of innovations shows which groups and organizations are affected. Second, our analysis tool assesses the policy mix concerning how the implementation of policy instruments works out and whether the objectives pursued by the policy-makers are reached. (ii) This paper also discusses the results and implications of China's electric vehicles policy on the global market and the international competition in this sector.

Relating to the present research aim, our research questions are as follows:

1. "What are the insights originating from the policy mix for the electric vehicle market in China?"
2. "What are the effects of China's electric vehicle initiatives on the global electric vehicle market?"

3. Definitions

Technological innovation systems (TIS) as we use them in our analysis can be described as socio-technical systems comprising actors, institutions, and networks. The system describes the relations and functions of the mentioned components in the development and diffusion of electric vehicles as a particular technological innovation (Bergek et al., 2008). By investigating policy instruments fostering the diffusion of electric vehicles in China, we precisely look at six categories: (i) governmental, (ii) industrial, (iii) transport and infrastructure, (iv) energy, (v) research, as well as (vi) environmental policy including the effect of their particular innovation approaches for electric vehicles.

According to the International Energy Agency, electric vehicles are defined in this paper as any car which is fully or partly driven on an electric engine for propulsion. Thus, the term electric vehicles encompasses plug-in hybrid electric vehicles (PHEV), battery electric vehicles (BEV), and fuel cell electric vehicles (FCEV) (IEA, 2013).

4. Theoretical frameworks

The paper's framework draws on theoretical findings from the literature (Otlander and Perez Vico, 2005; Bergek et al., 2008). Starting with defining the technological innovation system (TIS), we focus on the key policy instruments, structural components, and functions of the TIS. In the next step, Bergek et al. (2008) suggest to assess the functionality and analyze the process goals. This can be done by taking into account the summary of the assessment framework proposed by Quitzow (2015), tackling strategy content, strategy process, and strategic capacity. By doing so, policy goals can be examined as well (strategy content). What is more, there are countries in which the government plays a central role, being highly involved in decision-making regarding education, research, and driving the growth of the economy (Liu and Kokko, 2013; Yuan et al., 2015). This aspect is also addressed by our devised framework. Altogether, we offer a theoretical approach which captures the basic scheme of analysis (Bergek et al., 2008), the summary of the assessment framework (Quitzow, 2015), and considers emerging economies in which the government plays a prominent role at determining innovations (Liu and Kokko, 2013). Our paper rests on this theoretical framework and additionally employs the devised analytical tool on the case of electric vehicles in China.

5. Description of the methodologies

Firstly, we propose a theoretical framework as outlined in Section 4. Secondly, we employ our theoretical framework or analysis tool on the case of electric vehicles in China.

In the main part of the paper, we assign the various instruments to one out of six categories as mentioned in Section 3, analyzing both the impact on the market development of electric vehicles in China and the consequences for the actors being involved. Furthermore we highlight the effects of these instruments regarding the potential catch-up process of China's automotive industry, driven by the development of electric vehicles. To conclude, we give an overview of the collected results and summarize the impact of our paper on international research related to electric vehicles. Within this discussion, we illustrate whether our theoretical framework is suitable to analyze other emerging economies in the context of the development of sustainable innovations.

6. Expected outcomes

Our paper provides a state-of-the-art overview as to the policy mix pursued by the Chinese government. We examine policy instruments which may enhance the development of electric vehicles in China. Indicators for a successful market uptake of electric vehicles are identified and put into relation with the different actors being affected within the technological innovation system (TIS). By outlining the strategic instruments, we aim at manifesting the Chinese potential catch-up process.

We expect a comprehensive analysis covering the contribution and principles of each instrument in the diffusion of electric vehicles in China and in relation to the challenges in a multipolar world economy. Furthermore the designed framework may serve as a tool to analyze the development of electric vehicles in other emerging economies and their impact on globalized innovation systems.

References

- Altenburg, Tilman (2016): *Sustainability-Oriented Innovation Systems in China and India*, London: Routledge.
- Bär, Holgar (2013): http://kooperationen.zew.de/fileadmin/user_upload/Redaktion/Lead_Markets/Werkstattberichte/WB_12_Baer_2013_Electric_vehicles.pdf, accessed 14 March 2016.
- Bergek, Anna, Staffan Jacobsson, Bo Carlsson et al. (2008): "Analyzing the Functional Dynamics of Technological Innovation Systems: A Scheme of Analysis", *Research Policy*, Vol. 37, No. 3, pp. 407-429.
- Doraczynska, Katarzyna and Frauke Bierau (2014): <http://www.go4sem.eu/public/global-opportunities/china-1/electric-vehicle-supply-chain>, accessed 14 March 2016.

IEA (2013): https://www.iea.org/publications/globalevoutlook_2013.pdf, accessed 14 March 2016.

IEA (2015): http://www.iea.org/evi/Global-EV-Outlook-2015-Update_1page.pdf, accessed 04 March 2016.

ISO (2016): <http://www.iso.org/iso/home/standards.htm>, accessed 02 March 2016.

Liu, Yingqi and Ari Kokko (2013): "Who Does What in China's New Energy Vehicle Industry?", *Energy Policy*, Vol. 57, pp. 21-29.

Oltander, Gustav and Eugenia Perez Vico (2005): A Survey of the Swedish Security Industry and an Innovation System Analysis of the Swedish Security Sensor Industry, Master Thesis, Chalmers University of Technology Göteborg.

Quitow, Rainer (2015): "Assessing Policy Strategies for the Promotion of Environmental Technologies: A Review of India's National Solar Mission", *Research Policy*, Vol. 44, No. 1, pp. 233-243.

Tagscherer, Ulrike (2012): "Electric Mobility in China: A Policy Review", *Fraunhofer ISI Discussion Papers Innovation Systems and Policy Analysis*, No. 30, pp. 1-18.

Tagscherer, Ulrike and Rainer Frietsch (2014): "E-Mobility in China: Chance or Daydream?", *Fraunhofer ISI Discussion Papers Innovation Systems and Policy Analysis*, No. 40, pp. 1-28.

UNEP (2015): http://www.unep.org/transport/gfei/autotool/understanding_the_problem/Trends_and_scenarios.asp, accessed 05 March 2016.

Yuan, Xueliang, Xin Liu and Jian Zuo (2015): "The Development of New Energy Vehicles for a Sustainable Future: A Review", *Renewable and Sustainable Energy Reviews*, Vol. 42, pp. 298-305.

Yuan, Xueliang and Jian Zuo (2011): "Transition to Low Carbon Energy Policies in China — From the Five-Year Plan Perspective", *Energy Policy*, Vol. 39, No. 6, pp. 3855-3859.

Global Innovation Systems – a conceptual framework for technological innovation in transnational contexts

Bernhard Truffer*(Eawag), Christian Binz(Circle, Lund University) and Lars Coenen(Circle, Lund University)
*bernhard.truffer@eawag.ch

KEYWORDS: Innovation Systems, Sustainability Transitions, Global innovation networks

In a globalizing knowledge economy, the mobility and circulation of people, information, knowledge, and capital has led to a situation in which innovation processes in distant places are getting closely interconnected (Corpataux et al., 2009). As a result, clusters and territorial innovation systems are becoming nodes in the global innovation networks of varying sectors. This increased interdependency raises the question whether a territorial (local, regional, national) system perspective is still a valid one as system boundaries seem to become increasingly blurry and porous. More fundamentally, it may even imply that the innovation system (IS) perspective, on a more general level, is no longer a promising line of research and should be left on the shelves of the history of innovation studies, as concluded in the 2013 debate at the 35th DRUID celebration conference? The present paper argues against this view.

We maintain that a systemic perspective on innovation can still have strong explanatory potential, in particular when applied in transnational contexts. However, to realize this potential, a number of conceptual improvements are required: The strong reliance on institutional structures that condition innovation in territorially defined systems needs to be combined with greater emphasis on the role of multi-scalar networks and actors' influence on institutional conditions. Even though different variants of innovation systems approaches have so far largely lived parallel lives, this calls for a more integrated view in which national, regional, sectoral and technological innovation system perspectives start talking to each other in a more engaging and reciprocal way.

Innovation studies emphasize that new technologies emerge from complex interactions between actors with complementary (technological, managerial, investment or regulatory) competencies, which operate under specific institutional settings. By calling these constellations 'innovation systems', the distributed but more or less coordinated interaction between actors, networks and institutions in the innovation process is emphasized. The system metaphor is underpinned by the assumption that these interactions jointly create resources (positive externalities) that are of key importance in the innovation process, but very difficult to be produced or controlled by any actor on its own. The system is therefore more than the sum of its parts. Over the past 20 years several concepts have been developed to understand the complex interactions and to predict innovation success by these systemic interactions. In the early work on national and regional innovation systems, however, primacy was put on the institutional dimension. As a consequence, innovation system approaches were portrayed as mostly providing "lists of relevant institutions" and therefore being limited to mostly descriptive types of analysis (Uyarra, 2010). We maintain that this is a too restrictive interpretation of the explanatory potential of these frameworks.

To elaborate on this proposition, we take a closer look at the challenge of increasing globalization of innovation processes. Over the last decade authors argued that in various sectors, non-territorial forms of cognitive, organizational, social, and institutional proximity are increasingly substituting for geographic co-location (e.g. Boschma, 2005; Amin and Cohendet, 2005). The geographical configuration of innovation systems is accordingly getting more complex, spanning actor networks and institutional contexts at various places and across spatial scales (Bunnell and Coe, 2001; Carlsson and Stankiewicz, 1991; Coe and Bunnell, 2003). While various analytical approaches conceptualize the increasing importance of transnational linkages between regional and national innovation systems to some degree (Carlsson, 2006; for an overview see e.g. Grillitsch and Trippl, 2013), a more comprehensive and integrative analytical framework for global innovation systems is still missing. In particular, existing concepts were criticized for remaining rather vague in their conceptualization of interdependencies between various territorial subsystems of a global innovation system (Binz et al., 2014; Coenen et al., 2012; Grillitsch and Trippl, 2013; Wieczorek et al., 2015; Wieczorek et al., in print).

The present paper aims to reposition innovation system approaches to address these new realities. It draws on

various existing IS approaches, but emphasizes the role of systemic interaction in global networks - as acknowledged in the literatures on global value chains, global production networks or global innovation networks (see Coe et al., 2004; Gereffi et al., 2005; Liu et al., 2013). Innovation system scholars recently endorsed the need for a more constructive engagement with these literatures (Lundvall et al., 2014) and emphasized that the sectorial and technological innovation system concepts in principle resonate with this view as they address innovation processes without setting a-priori spatial boundaries (Breschi and Malerba, 1997; Carlsson and Stankiewicz, 1991). Yet, much work in this area still focused on innovation dynamics in specific regional or national contexts or rather incremental innovation trajectories in well-established sectors without highlighting the role of more multi-scalar system structures in a broad variety of sectors.

In this paper we aim to specify how various places or ‘subsystems’ get integrated (or not) in a global innovation system level through circulation of resources (for innovation) and co-evolution of actor networks and institutions. In this venture we build on existing multi-scalar perspectives on innovation systems (Bunnell and Coe, 2001; Oinas and Malecki, 2002), but elaborate two new conceptual dimensions.

First, drawing on insights from technological innovation system (TIS) literature we define subsystems of a GIS not based on pre-defined territorial boundaries, but on the actor networks and institutions that are involved in creating specific system resources (knowledge, markets, financial investment and legitimacy, see Binz et al. 2015) for new technologies or industries (Bergek et al., 2008; Binz et al., 2015; Hekkert et al., 2007). Whether or not the actor networks and institutions in each of these dimensions fall within territorial (national or regional) boundaries, is treated as an empirical question (Binz et al. 2014). The performance of a system in developing and diffusing innovation depends not only on the existence of these subsystems, but also on the availability of appropriate ‘structural couplings’ between them. Structural coupling is attained if specific actors, actor networks or institutions span across or overlap between various subsystems, be this in a specific region or country, in a global non-governmental organization or a multinational company.

Second, we draw on recent insights from SIS and RIS literature to explain sectoral differences in the spatial configuration of IS in various industries. Our framework differentiates between a technology’s dominant knowledge base - analytical vs. synthetic vs. symbolic (Asheim and Coenen, 2006; Asheim and Coenen, 2005) - and the economic system of valuation in which markets for the innovation are constructed -standardized products for global mass markets vs. products depending on symbolic valuation in local contexts (Huenteler et al., 2014; Jeannerat and Kebir, 2016). Based on empirical illustrations from recently emerging clean-tech sectors, we exemplify how the spatial configuration and structural coupling of subsystems differs between standardized commodities with an analytical knowledge base (i.e. solar PV) and products with a synthetic knowledge base that depend on institutional embedding for market diffusion (i.e. wind power, biogas). This enables the explanation of why in some industries national and regional innovation systems remain relevant and spatially sticky over longer periods of time, while in other sectors they become subject to increased international circulation of resources. Policy interventions that target specific national or regional subsystem will accordingly have very different spatial spillover effects depending on the overall configuration of the global innovation system.

These arguments will be developed as follows. We first discuss the gaps in existing innovation system literatures relative to the role of transnational linkages by drawing on different network-based approaches. Section 3 combines these insights to a multi-layered concept of global innovation systems, focusing on functional subsystems and their structural couplings at a transnational level. Section 4 develops a taxonomy of GIS configuration in different industries and illustrates them empirically. Section 5 discusses methodological challenges and outlines a broader research agenda that might be developed in the global innovation system field. We conclude by discussing policy implications and wider contributions to economic geography and innovation studies.

Global development trajectories in the wind and solar photovoltaics sector: how technology-related differences shape the dynamics of international knowledge transfer

Rainer Quitzow*(Institute for Advanced Sustainability Studies), Joern Huenteler(World Bank) and Hanna Asmussen(Technische Universität Berlin)

*rainer.quitzow@iass-potsdam.de

KEYWORDS: Emerging economies, Catching-up, Cleantech, Renewable energy, Innovation systems

In the past, market support schemes for renewable energies have been justified with the promise of domestic job creation and industrial development. Early promotion of a national market - the reasoning went – would spur technological innovation and provide local firms with a competitive advantage once global markets took off (Beise and Rennings, 2005; Jänicke and Jacob, 2004). Emerging evidence from the wind and solar energy sectors, however, is beginning to call this policy rationale into question. To the disdain of German policy makers in particular, ambitious demand-side policies are only one determinant of competitive success in these two emerging industries (Choi and Diaz Anadon, 2014; Quitzow et al., 2013).

In the 1990s and 2000s, Germany's feed-in tariff drove an unprecedented market expansion first in wind and then solar energy, establishing the country as the leading source of global demand for these renewable energy technologies. On the supply-side, however, developments in these two sectors have diverged considerably. Germany's competitive position in the area of solar photovoltaics (PV) has eroded rapidly, while German wind turbine manufacturers continue to be successful at home and abroad. Conversely, Chinese solar PV firms rose to global prominence without significant market support at home (Quitzow, 2014). Export performance of China's wind industry, on the other hand, has been relatively modest compared to its rapidly growing domestic market. An increasing number of studies have addressed the global dynamics of innovation and industrial development in these sectors with a particular focus on the role of China (Gallagher, 2014; Lewis, 2013). However, no systematic comparison of the wind and PV sector has been conducted to date. This paper takes a first step in closing this gap. Focusing on developments in Germany and China, the paper begins with an overview of key demand- and supply-side developments as well as the corresponding policies in support of the wind and PV industries in the two countries. The paper concludes that differences in policy across the two sectors do not offer a sufficient basis for explaining the divergence in development trajectories.

Rather, a comparison of technology-specific variables is needed to better understand the observed patterns of industry development. To do so, the paper draws on the distinction between so-called "complex assembled products and systems" and "mass-produced goods" proposed by Davies (1997). In mass produced goods, the growth and maturation of technology is accompanied by the emergence of dominant designs (Abernathy & Utterback 1988; Anderson & Tushman 1990). Since the product design is more or less standardized throughout the industry, competitiveness is mostly determined by capabilities related to efficient production, scaling up, and the coordination complex value chains (Utterback & Abernathy 1975). In contrast, complex products and systems never reach a dominant design, and firms continue to improve and modify the product (Miller et al. 1995; Davies 1997; Davies & Hobday 2005; Huenteler et al. 2015). Products are often designed and manufactured on demand for specific orders or even produced in one-off projects—such as nuclear power plants—in which no two projects are exactly the same (Hobday 2000). Even in later stages of the life-cycle, competitiveness is determined by capabilities related to system integration and product design, rather than capabilities related to high-volume manufacturing and supply chain optimization (Magnusson et al. 2005). The paper relates these technology-specific differences to the observed process of Chinese industrial development and capability building in the wind and PV sectors. The paper argues that the distinction between "complex assembled products" (wind energy sector) and "mass-produced goods" (solar photovoltaics) offers a number of important entry-points for explaining the different international development trajectories in the two sectors, most notably variations in the importance of user-producer interactions and the role of tacit knowledge. The latter can be linked to corresponding differences in the role that different modes of international technology transfer have played in the two technology fields. The paper argues that the different modes of learning that characterize innovation and technological development in complex products and systems, on the one hand, and, mass produced goods, on the other, translate into distinct opportunity structures for international technology transfer and catching-up. In complex products and systems user-producer interaction remains important even in later stages of the life-cycle as product- or project design requirements and component technology continue to change over time. Therefore, firms are much less likely to move manufacturing away from large product markets

(Miller et al. 1995; Davies 1997), and a strong presence in a home market is often a prerequisite for export success. Firms in late-comer countries are only able to catch up if they are able to exploit their home market advantages to gain manufacturing and design experience and have access to foreign design knowledge. This in turn can only be accessed via direct transfer of knowledge by foreign producers over a prolonged period of time. In the field of mass produced goods, on the other hand, learning by doing in the production process is key. Catching-up, thus, primarily requires access to up-to-date technological know-how and related production equipment. Hence, technology transfer does not require the direct involvement of manufacturing firms. The transfer of tacit knowledge related to the production process may be required in early stages of the transfer process but will rapidly decline in importance once production and hence learning by doing has been initiated in the recipient firm. This allows manufacturers of mass-produced goods to geographically disconnect production from product markets and to shift manufacturing facilities to the locations that offer the best conditions for large-scale manufacturing, often including low-wage countries (Vernon 1966). These shifts in manufacturing locations can be entirely independent of geographical trends in demand. Moreover, it offers opportunities for firms in follower countries to catch-up more rapidly with lead firms.

To support this claim, the paper offers detailed case studies of the transfer mechanisms employed by Chinese firms in the wind and solar energy sector. It finds that technology transfer in the solar PV sector has been less dependent on intra-firm mechanisms than in the wind sector. This aligns with the relatively higher importance attributed to tacit knowledge for developing and producing complex assembled products than for mass-produced goods. The case studies on technology transfer in the two sectors draw on mixed data sources, including interviews conducted in China, company reports and other publically available sources on the PV industry.

5D. TRACK THEME 5: INCLUSIVE INNOVATION POLICIES: RESEARCH AND POLICY INSIGHTS FROM THE GLOBAL NORTH AND SOUTH (II)

Distinguishing patterns of learning and inclusion through patterns of network formation in developing agricultural clusters

Matias Ramirez
(University of Sussex)
matias.ramirez@sussex.ac.uk

KEYWORDS: Inclusive innovation, Agriculture, Social networks, Clusters

A significant development in the economies of a number of less developed Latin American countries over the past decade has been the mushrooming of export-based agricultural clusters in hitherto economically underdeveloped regions, many of which are dominated by small-scale agricultural production. A consequent challenge for policy makers is to develop strategies that offer small-scale local producers opportunities to upgrade into more specialised higher value-added activities (Schmitz & Nadvi 1999, Gibbons 2001). In this paper, we draw on some of the insights from the literature on socially inclusive modes of participation to understand the dynamics of learning and diffusion of knowledge of local networks of producers. We discuss three types of networks based on different degrees of network cohesion and roles of strategic actors.

Debates on how to create more efficient production for small-scale agricultural producers often emphasize social rather technological features of small-scale production. The first of these has been commonly linked to notions of social capital and civic engagement, which are seen as a precursor to achieving some degree of coordinated action by local actors to produce positive outcomes (Mansuri and Rao 2013). This discussion extends beyond simple connectivity, to the recognition of the need to “embed” groups that instil social norms on their members and can hold people accountable (Tsai 2007).

Secondly, there is a focus on the role strategic actors play in learning processes at local cluster level. Within the innovation literature, lead firms are considered as the central unit of analysis for the implementation of new technologies and practices. It is then more or less assumed that through a variety of mechanisms, these can be disseminated to other local actors. By contrast, the role of strategic and large firms has had a more critical treatment within debates on development and local participation, often framing the influence of lead actors in terms of the benevolent and malevolent effects of the capture of resources by local elites (Abraham and Platteau 2004, Rao and Ibanez 2005).

Thirdly, Isolated from the influence of other contextual factors, information on network structure say little about how inclusive practices are introduced or distinguishes between authoritative, paternal or pluralistic methods of inclusion that can have fundamentally different implications on small producers. Here as well there has been a long and intense debate in post-war discussions of development. Preferences for top-down practices are inherent in Hardin’s (1968) “tragedy of commons” argument that pointed to the tendency towards over-consumption of common resources and Olson’s (1965) concerns over free-riding of public goods. Centralized implementation of new practices is argued to work best if there are benefits from economies of scale, require high levels of central coordination and where preferences and needs are likely to be more homogenous (Mansouri and Rao, 2013).

The motivation for this paper arises therefore as to how the dynamics within and between these two features of emerging clusters – participation of small firms in learning and the role of lead actors as the cluster moves from local towards niche or commodity production. We conceptualize this dynamic using social network analysis (SNA), the analytical approach of which is grounded in social capital theory and is built around the twin concepts of network cohesion (the degree of mutual socialization) and the position that focal actors hold within a network (Burt, 1992; Gargiulo & Benassi, 2000). Hence, the structural features of the networks provide insights into the connectedness of actors, while the position of individual actors in the network provides measures of the diverse resources some strategic organisations have at their disposal through the connections they have access to (Carpenter et al. 2012). This allows us to make some predictions regarding how different patterns of

connectivity, cohesion and centrality of key actors in the cluster can influence learning, diffusion of knowledge and the degree of dependence some organisations have over others in these emerging clusters.

The empirical data was gathered firstly through two surveys of producers in two “emerging” agricultural clusters, the Palm oil cluster in Colombia and the mango cluster in Northern Peru, both of which contain large numbers of small-sized producers and have experienced rapid growth in the recent period but demonstrate quite different network structures. From these two case studies we extrapolate three types of network structures that have quite different patterns of inclusion, lead organisations and knowledge diffusion. Taking these three as separate case studies, we then undertook a series of interviews with local producers, service organisations and policy makers to provide further depth to our analysis of networks. The figure above conceptualizes the three important variables we are analysing to compare and contrast between networks. The dominance of focal actors is measured by the centralities of key actors and their standard deviation. For cohesion we look at the K-core measure of sub-clusters. For the degree of learning we look at the indegree for knowledge from outside the cluster.

We firstly identify a network with one dominant producer organisation surrounded by small-scale producers. In this case, network theory predicts that networks will be highly highly asymmetric i.e. most vertices have a limited activity and a few vertices have a very strong ability to acquire external knowledge and develop network ties (Coward and Jonard 2009). In these circumstances, inequality will be high and can be locked-in, as firm(s) with high capabilities will benefit directly from new opportunities and there exist vast differences in capabilities and weak resources of small producers. Secondly, we identify a network with few lead producer organisations, and learning as well as diffusion of knowledge rely upon an ecosystem of service organisations coordinated by producer associations. In this case, high cohesion and the establishment of a cooperative infrastructure of endogenous institutions through which common pool resources and technology can be managed is critical. Finally, we distinguish a network that resembles Schumpeterian characteristics, where there exist a number of firms that both compete and cooperate and have access to external networks. In this case, the network is defined by the need for access to markets and commercial rather than cooperative prerogatives.

The above distinctions emphasize that inclusive processes of learning requires an understanding of the nature of the local networks, that incorporate the role of local leaders, the nature of connectivity and the existence of cooperative institutions. For example, in networks dominated by one large organisation, inclusion in learning is likely to occur primarily through a process of “meme transmission” i.e. imitation. Networks based on cooperative infrastructures are more likely to use the network as a space to learn and provide new lines of practice, rather than a simple transmission mechanism. More competitive networks on the other hand will be places to make contact with key information providers and external markets. These differences will have important implications for guiding the intervention of policy makers.

Inclusive innovation in sociotechnical systems: The cases of Russia and India.

Olga Ustyuzhantseva

(Research Center for Policy Analysis and Studies of Technologies, Tomsk State University)

olgavust@gmail.com

KEYWORDS: Inclusive innovation, India, Russia, Sociotechnical system

The issues of inclusive development and sustainable growth are of increasing importance in the world. To a large extent, these issues have been raised in relation to developing countries. Problems of growing inequality, poverty and the exclusion of a large share of a mainly agrarian population from the benefits of economic and innovative development are the most obvious in these countries (OECD, 2013).

There is no unified definition of inclusive innovation. Beneficiaries of inclusive innovation (and sometimes its producers) are defined as marginalised groups (OECD, 2012; Cozzens & Sutz, 2012), the bottom of the pyramid (BoP) (Prahalad, 2006; Prahalad & Mashelkar, 2010), low-income groups (OECD, 2013), grassroots people, and local communities (Smith et al. 2014; Gupta, 2011). Inclusive innovation is often equated with or replaced by such types of innovations as pro-poor innovation (aiming at the poor: World Bank, 2010; Berdegue, 2005); frugal innovation (affordable in terms of cost and in limited resources: NESTA, 2012); grassroots innovation (developed by/from/for grassroots for solving their unmet needs: Gupta, 2007); and user innovation (developed or refined by users, mainly at the site of implementation and use: von Hippel, 1986).

Several means of inclusion have been defined: inclusion as a process (when excluded groups are involved in the innovation process) and as an outcome (when excluded groups get access to the results of economic and innovation development) (Fressoli et al., 2014).

Heeks et al. (2013) consider inclusive innovation through levels of inclusion. The 'ladder of inclusive innovation' consists of six levels: intention to solve the problems of excluded groups; consumption by excluded groups; impact on the livelihood of excluded groups; the process of involving excluded groups in innovation; structure level when innovation occurs within an inclusive structure; and post-structure level when innovation activity occurs within inclusive frames and discourse. This approach is quite versatile, albeit with a high degree of generalisation.

Current literature on inclusive innovation is mainly of two types: case studies of inclusive innovation in various sectors and states (World Bank, 2013; Fressoli et al., 2014; Bhaduri & Sheikh, 2012; Swaans et al., 2014; Foster & Heeks, 2013a); or conceptualisation of inclusive innovation in various frameworks from economic, innovation and policy studies (Heeks et al., 2013; George et al., 2012; Foster & Heeks, 2013b; Aubert, 2005).

Despite most of the cases being drawn from various countries, there are no in-depth investigations of inclusive innovation in the context of a country, with its cultural, historical and social environment of innovation, specific norms, traditions and mentality of the nation and the society that benefits from inclusive innovation or produces it.

Inclusive innovations are mostly studied in the context of the state as a set of systems (economic, innovation) and institutions (policies, regulations, standards, etc). Case studies from Africa emphasize inclusive innovations by and for small farmers and local communities; Indian cases are focused on grassroots innovation; inclusive innovations in Latin America are represented as a continuation of the appropriate technology movement (Kaplinsky, 2011; Smith et al., 2013). The specific of inclusive innovation that is emphasized here is social inclusion through cooperation of local communities with business, government and research and development institutions. Inclusive innovation in China is considered innovation providing access of the BoP to goods and services and improving quality of life (World Bank, 2013). In the case of developed countries, such aspects of inclusive innovation as sustainability and the role of communities prevail (Seyfang & Smith, 2007; Seyfang & Haxeltine, 2011). Seemingly quite different cases have a common denominator: all stakeholders (government, business, academia, society) and institutions (policies, regulations, etc.) are influenced by their sociocultural and historical context.

Research frameworks

The framework of innovation systems, widely used in innovation studies, can be applied to characterise the main actors of inclusive innovation development and the relationships between them. However, inclusive innovations, originating from the grassroots, occur mostly in informal settings of society (Cozzens & Sutz, 2012), which is influenced by many social, cultural and historical forces. To analyse this dimension of inclusive innovation, the framework of sociotechnical systems is more appropriate. Considering the development of inclusive innovation from a multi-level perspective (Geels, 2004) allows analysing it in its cultural and social context. The heuristic nature of this approach removes certain limitations of ontological frameworks, which nevertheless underlie this research work. Using the method of historicism gives this study additional depth through understanding socioeconomic conditions and cultural impact on inclusive innovation development.

This research aims at adding one more dimension of analysis through exploring the dynamics of inclusive innovation within sociotechnical systems (Geels 2004) to address the questions: How do the spaces/niches for inclusive innovation appear in sociotechnical systems? In what way do inclusive innovation niches and regimes, both in policy and in the society, interact and what are the results of this interaction? How do sociotechnical landscape such as social values, cultural particularities, historical background and socioeconomic structure influence and determine inclusive innovation within the context of a specific country?

This research considers the cases of India and Russia. Both countries had similar political regimes and began economic reforms simultaneously at the beginning of the 1990s that led to transformation of these regimes. Both countries are experiencing the problem of imbalanced development and increasing social and economic disparity in society. I examine the governmental and societal regimes that are inside sociotechnical systems in these countries to define the spaces for inclusive innovation. The main purpose is to identify the factors and settings enabling inclusive innovation development at the level of society and public policy.

Methodology

In the case of India, the study is based on PhD research by the author from 2011 to 2014. The theme of the PhD thesis was 'Evolution of science, technology and innovation policy of India (1991-2013)'. The research explores the specifics of the science, technology and innovation policy of India within the framework of the national innovation system, using an historicism approach as the basic research method. The study covers political, economic and social aspects of science and technology (S&T) development, applying research methods of political economy as well. It traces the genesis of the system of support for grassroots innovation in India through the institutionalisation of the innovative activity of the informal sector.

The Russian case is based on the study and generalisation of data obtained from open sources (Internet, media), as well as from official publications (data, statistics) of the organisations supporting inventions in Russia (All-Russian Society of Inventors and Innovators, Rospatent, and others). The author has conducted a series of expert interviews with innovators and representatives of organisations involved in the development of inclusive innovation. Literature review and analysis of secondary sources of data (government official documents, S&T and science, technology and innovation policies; policy briefs, academic materials, internal government innovation and policy documents) are also used.

References

Global open innovation platforms facilitating inclusive innovation policy

Nadja Nordling*(University of Tampere), Mika Raunio(University of Tampere) and Jukka P. Saarinen(Nokia Research Center)

* nadja.nordling@uta.fi

KEYWORDS: Innovation policy, Inclusive innovation, Open innovation platform, Open innovation

This paper discusses the open innovation platforms as a recent mode of policy measures that foster the inclusive innovation policy in both, global North and South. The logic of activity is based on the technological change and namely digitalization, which has changed some practices in industrial organization of companies and clusters, including their innovation activities. Further, extension of this logic to physical hubs and centres established globally is strongly linked to regional knowledge-based economic development, and even some of its recent policy measures. In short, techno-social change fostered by digitalization is thus transferred to the practices of the regional innovation policy. The need to create incentives for external contributors in “industry platforms”, open innovation ethos and extension of activities to new markets, frequently to emerging economies or to developing countries, brings up the question of inclusiveness in this context.

We aim to make sense of the concept of an open innovation platform (OIP). The term has emerged in knowledge-based regional development discussion, yet without a detailed definition of the term, and mostly at fairly abstract level of related variety or knowledge-bases (Cooke & De Laurentis, 2010a, Cooke & De Laurentis, 2010b; Asheim, Boschma and Cooke, 2011; Uotila, Harmaakorpi & Hermans 2012; Lazzeretti, Capone & Cinti, 2010). This paper addresses the gap in the knowledge-based regional development literature and sets to study innovation platforms conceptually in order to systematize its use as a model in research and policy-making. We aim to go further with the conceptualization of the term and define the notion of open innovation platform more in detail and at an organizational level, in order to foster the both further academic discussion and construction of related policy designs.

The research question is, how OIPs facilitate inclusive innovation, and develop a framework of the different roles and functions of innovation platforms in inclusive innovation context. Therefore, we discuss how the key open innovation processes, community, space and innovation activity are organized in globally working OIPs in order to provide a conceptual understanding of basic elements that are needed to facilitate the inclusive innovation processes globally through OIPs.

The relevance of the paper relates to that inclusive innovation approach (Cozzens, 2010; Cozzens & Kaplinsky, 2010) has widely expanded in policies and in theories of innovation. Inclusion may be seen as a key challenge for the developing countries and their socio-economic development, and even for the most advanced economies in globalized world. It seems that open innovation platform innovation platform is renewing and widening inclusive innovation policy discussions, and could provide a relevant policy tool, as well as an analytical device, to implement and explore the inclusive innovation approach further. This would be especially in terms of a second, less frequently used definition, of inclusive innovation, according to which inclusion refers to people and groups who are engaged to learning and innovative processes, but also advanced products for developing markets.

The theoretical framework is build on open innovation literature (e.g. Chesborough 2003; von Hippel 2005) that describes in a wider sense how outside groups have been increasingly linked to firm’s innovation activities. Also, in management literature organizational approach and business models that organize open innovation processes have frequently tackled with the term platform. (e.g Gawer & Cusmano 2002; Bresnahan & Greenstein 1999; Thomas et al 2014). In management literature, the term has appeared as a useful approach in business models to organize open innovation processes. In this context, the platform business model has been used more clearly, and it refers to the facilitation process in which the platform owner offers the platform for users who may add the content for the platform. We believe that knowledge-based regional development literature (Asheim, Boschma, & Cooke, 2011; Cooke & De Laurentis, 2010a; 2010b) may benefit from this approach as it concerns platforms in, not only in an abstract level, but offers more practical view and more abundant empirical evidence. In platform economy – a community building or network effect – capability to build a community that attracts others to join, may be seen as a crucial success factor.

The empirical material of this research focuses on platforms on which private and public sector collaborate. Characteristic is also that concepts are globally spread and OIPs combine digital and physical elements, but emphasis the latter. This selection should ensure, that cases exemplify the viable and recent form of an OIP that creates value for both private and public sector. Further, although there is a much wider range of OIPs to be found, these are widely applied and fairly generic platforms combining virtual and functional aspects, and thus provide appropriate cases to be used for the conceptualization of the OIP at a generic level, including the interface of public and private economy. This applies both global north and south, since we assume that the rise of the platforms is based precisely on the socio-technical change of globalizing market place and technological change to digitalization.

The paper dwells into the cases of Microsoft innovation centers, mLabs & mHubs and Demola that all provide examples of models that mix regional development and business model approaches. All three cases provide examples of platforms that have spread out from the north to south, and in the case of Demola and MICs are using the same mechanisms of creating communities and organizing innovation activities in both.

The material analysed in this paper has been gathered, firstly, from three Brazilian Microsoft Innovation Centers in 2013. Altogether eleven interviews were conducted with MIC managers and students. The data also includes participation in one related workshop organized in one of the locations. Visiting the premises and following students in work was also a big part of the research. In addition, annual reports of the activities were studied in order to deepen the picture of the platform activities. Secondly, data from Nokia's mLabs and mHubs was gathered by following their set up from inside the company since their implementation is 2010. Strategy reports of the performance of mLabs and mHubs were also studied. Thirdly, data from Demola was gathered between years 2008 and 2016. Also the Demola case has been followed since its foundation. Several interviews with the key stakeholders have been conducted along the years, and all authors have also been involved as a project partner in Demola. Data also includes two student surveys (respondents N107) conducted in 2012. Also relevant reports and other additional material has been considered.

Research was carried out by implementing action research methods (e.g. Bergold & Thomas, 2012; Christens et al., 2015; Fisher, 2003; as well as early contributors e.g. Kurt Lewin and Paulo Freire). Authors have played strong and partly overlapping roles in the three cases presented in the paper. Characteristic to action research is that it has usually been a more practical way of doing research: the research has been carried out rather in the field than in laboratory settings. In fact, action research has often been practiced more due to practical rather than theoretical reasons (Willis & Edwards, 2014, 3), and our research is no exception to this.

Expected outcomes are built on case analysis that focus on three elements: how the community is build, how the innovation space or environment is organized and how innovation activity is facilitated by the platform. This will provide us understanding how global OIPs operate. Material analysed in this paper offers different perspectives to open innovation platforms, and to their operation and development to create understanding how they facilitate inclusive innovation. The manifold data has been taken into advantage to increase understanding of the elements of innovation platforms.

We recognize three different elements of OIPs that are crucial to facilitate inclusive innovation. These are the community, space and the innovation process. Organized accordingly, these enable inclusive innovation. The cases show that there are three success factors that enable an OIP to be scalable to a global network. These are stabilized process and standardized facilitation combined with the right local resources. Cases represent the organizations that provide a concept of co-creation for global use, and local hosts organize the space and funding to deploy co-creation process in regional development context.

This paper hopes to contribute to the discussion on inclusive innovation policy by discussing OIPs as the tools of facilitating inclusive innovation in the global north and south. More research upon the practises of OIPs still needs to be conducted. However, the work offers a fruitful soil to carry this work further.

References:

- Asheim, B., Boschma, R., & Cooke P. (2011) Constructing Regional Advantage: Platform Policies Based on Related Variety and Differentiated Knowledge Bases. *Regional Studies*, Vol. 45:6, pages 1–22.
- Bathelt, H. & Cohendet, P. (2014) The Creation of Knowledge: local building, global accessing and economic development – toward an agenda. *Journal of Economic Geography* 14 (5): 869-882.
- Bathelt H., Malmberg A. & Maskell P. (2004) Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography*, Vol. 28: 1, pages 31–56.
- Bergold, J. & Thomas, S. (2012) Participatory Research Methods: A Methodological Approach in Motion. *Qualitative social research*, Vol. 13;1; art. 30
- Chesbrough, H.W. (2003) *Open innovation: the new imperative for creating and profiting from technology*. Boston (Mass.), Harvard Business School Press.
- Christens, B., D.; Faust, V.; Gaddis, J.; Tran Inzeo, P.; Sarmiento, C., S. and Sparks S., M. (2015)
- In book: *Handbook of Methodological Approaches to Community-Based Research: Qualitative, Quantitative, and Mixed-Methods*, Publisher: Oxford University Press, Editors: Leonard A Jason, David Glenwick, pp.243-251
- Cooke & De Laurentis (2010a) The matrix: evolving policies for platform knowledge flows. In *Platforms of innovation: Dynamics of new industrial knowledge flows*, ed. Cook, P., De Laurentis, C., MacNeill, S. and Collinge, C. Edward Elgar Publishing.
- Cooke & De Laurentis (2010b) Platforms of innovation: some examples. In *Platforms of innovation: Dynamics of new industrial knowledge flows*, ed. Cook, P., De Laurentis, C., MacNeill, S. and Collinge, C. Edward Elgar Publishing.
- Cozzens, S. E. (2010). *Innovation and Inequality. The Co-Evolution of Innovation Policy: Innovation Policy Dynamics, Systems, and Governance*. S. Kuhlmann, P. Shapira and R. Smits.
- Cozzens, S. E. and R. Kaplinsky (2010). *Innovation, Poverty, and Inequality: Cause, Consequence, or Co-evolution?* *Handbook on Innovation Systems and Developing Countries – Building Domestic Capabilities in a Global Setting*. B.-Å. Lundvall, K. Joseph, C. Chaminade and J. Vang. Cheltenham, Edward Elgar.
- Fisher, K. (2003). *Activism in the face of globalisation: lessons from emancipatory action research*. *Action Learning and Action Research Journal*, 8(2), 3-25.
- Gawer, A. and Cusumano, M.A. (2002). *Platform leadership: How Intel, Microsoft and Cisco drive industry innovation*. Boston, MA; Harvard Business School Press.
- Gawer, A. and Cusumano, M.A. (2014). Industry platforms and ecosystem innovation. *Journal of Product Innovation Management*, Vol. 31(3), 417-433.
- (von) Hippel, E. (1988) *The Sources of Innovation*. Oxford University Press.
- (von) Hippel, E. (2004) *Democratizing Innovation*. Cambridge, MIT Press.
- Lam, A. (2000). Tacit Knowledge, Organizational Learning and Societal Institutions: An Integrated Framework. *Organization Studies* 21(3), 487–513.
- Lazzeretti, L., Capone, F. & Cinti, T. (2010) The regional development platform and “related variety”: Some evidence from art and food in Tuscany. *European Planning Studies*, 18:1, p. 27-45.
- Nonaka, Ikujiro; Takeuchi, Hirotaka (1995), *The knowledge creating company: how Japanese companies create the dynamics of innovation*, New York: Oxford University Press, pp. 284, ISBN 978-0-19-509269-1.
- Thomas, L.D.W., Autio, E. and Gann, D.M. (2014). Architectural leverage putting platforms in context. *The Academy of Management Perspectives*, Vol. 28(2). pp. 198-219.
- Uotila, T., Harmaakorpi, V., & Hermans, R. (2012) Finnish Mosaic of Regional Innovation System – Assessment of Thematic Regional Innovation Platforms Based on Related Variety. *European Planning Studies*, Vol. 20:10, pages 1583–1602.
- Willis, J., W. and Edwards, C. (2014) *Action research: models, methods, and examples*. Information Age Publishing, Incorporated.

5E. TRACK THEME 7: DESIGNING TRANSFORMATIVE CHANGE: ATTEMPTS TO BRIDGE MISSION-ORIENTED R&I AND THE DYNAMICS OF SOCIO-TECHNICAL CHANGE (I)

Institutionalisation of markets for innovative health technologies: The case of personalised cancer medicine in the Netherlands.

Ellen H.M. Moors*(Utrecht University), Piret Kukk(Fraunhofer Institute for Systems and Innovation Research),
Wouter P.C. Boon(Utrecht University) and Simona O. Negro(Utrecht University)

*e.h.m.moors@uu.nl

KEYWORDS: Transition, Technological innovation system, Institutionalization, Market formation, Personalised cancer medicine

Introduction and relevance

Socio-technical transitions are necessary to sustain economic welfare and societal well-being, as well as to tackle grand societal challenges like demographic changes and increasing pressures on public welfare services (EC, 2013; OECD, 2010). Healthcare is one of the areas of society facing challenges associated with high levels of complexity, stakes and heterogeneity in involved stakeholders. In this context, there is an accelerating demand for healthcare products and technologies, due to ageing populations and increase in chronic diseases in the Western world. Pharmaceutical companies, together with scientific institutes and care suppliers, have for decades been successful in developing new drugs, promoting patients' health as well as shareholder value. However, the current system of treatment development has reached its limits: it is more costly and difficult to develop products that are at least as good, in terms of safety and efficacy, as what is already there (Scannell et al., 2011). This leads to the introduction of less-needed products and higher drug prices (e.g. Drummond & Towse, 2014; Pammolli et al., 2011; Kaitin, 2010). To ensure high quality healthcare in the future, there is a need for socio-technical change, encompassing a wide range of innovative solutions and new innovation avenues (e.g. business models). Stakeholders in healthcare need to rethink how healthcare is organised, regulated and delivered. This makes studying the transition towards a more sustainable healthcare system, in which healthcare is affordable and accessible for everyone in need, highly relevant (Moors et al., 2014).

Research aim, theoretical framework and research questions

One technological driver of the transition in the healthcare, and in particular pharmaceutical sector is personalised medicine, i.e. tailoring diagnosis and therapy to the specific characteristics of patient groups (Collins & Varmus, 2015). The efficacy and safety of personalised medicine is expected to be higher than for conventional drugs. However, despite these high expectations, until now, developments in personalised medicine and the contributions to a more sustainable healthcare system has been slower than expected (Kukk et al., 2016; Joyner & Paneth, 2015).

Part of the explanation for this slow transition lies in the unforeseen scientific and technological challenges related to personalised medicine. Next to that, scientific and technological developments co-evolve with activities of companies, regulators, hospitals, patient organisations (Morlacchi & Nelson, 2011; Nelson et al., 2011). The multi-stakeholder and co-evolutionary perspective on innovation and transition is well covered by the innovation system framework, which we take as a point of departure for studying the uptake of personalised medicine. An innovation system consists of actors that contribute to the innovation process in various ways, e.g. through knowledge development, supply of financial resources, standardisation, and the application of innovation. These actors are constrained and enabled in their actions by the structure of the innovation system, that consists of network characteristics, technological artefacts and institutions (Hekkert & Negro, 2009). More specifically, we conceptualise the emerging personalised medicine field as a technological innovation system (TIS) (Carlsson & Stankiewicz, 1991), including actors, networks and institutions that contribute to the generation, development, diffusion and use of new technologies (Edquist, 1997).

Until now, the focus in TIS studies has been more on the knowledge generation of technologies than on the diffusion, development and implementation of new user practices (Dewald & Truffer 2012; 2011; Grabher et al., 2008; Geels, 2004), such as regulation and markets for the use of personalised medicines. The institutionalisation of markets for these personalised health technologies has not been studied in depth until now. Earlier work (Kukk et al., 2016; 2015) has already focused on healthcare transitions, in which the importance of institutions in market formation of radical innovations in healthcare systems was emphasised. These studies showed that the science and technology behind personalised medicine is a transnational endeavour, as science and big pharmaceutical companies operate on a global scale. Markets for personalised medicines, on the contrary, are

organised on a national or local level. Taking this into account, our aim is to further unpack the market formation part of technological innovation systems. In order to better understand institutionalisation of market formation over time, we follow two personalised medicines entering the Dutch healthcare market between 2000 and 2012. Both products are subsequently produced by Roche and used in cancer treatment. We approach the institutionalisation then by following a first-mover product in personalised cancer medicine and how it prepared the ground for the subsequent product.

This paper theoretically contributes to the present literature on TIS in three ways. First, it builds on recent work of market formation by Dewald & Truffer (2012; 2011), in which they perceive the high level of diversity in market dynamics as under-conceptualised, especially regarding spatial characteristics. They emphasise taking a micro-perspective on the market formation activities and differentiate market formation into three sub-processes: formation of market segments, market transactions and end-user profiles (Dewald & Truffer 2012). This paper adds to their conceptualisation and empirical studies of market formation by unpacking market formation processes following new health technologies over time. One way to bring in the temporal dimension is by looking at subsequent generations of innovations, i.e. novel first-mover and second-mover personalised medicine products. Second, this paper applies the concept of market formation (and its sub-processes) to the field of healthcare innovation and personalised medicine development that is subjected to specific market access conditions, such as regulated approval, reimbursement procedures and stratified user practices. This enables us to expand on Dewald & Truffer's (2012) emphasis on spatial characteristics of market formation through differentiating between global developments and national market formation activities involving, for example, the organisation of local reimbursement practices that is associated with local knowledge production. Third, understanding institutionalisation of markets of first-movers might be helpful for second-movers to develop in desirable directions.

A further conceptualisation of market formation processes, and first- to second-movers' dynamics may serve as a way to forecast technological futures and transitions of healthcare systems. Such increased understanding can also be beneficial for innovation policy. By uncovering market formation dynamics, innovation policymakers are able to proactively prepare for future institutionalisation and mobilise demand-side innovation instruments that work in the context of transitions (Boon & Edler, 2015).

In line with this, the following research question is answered: Which factors influence the market formation of personalised medicine innovation systems over time, by following first-mover and second-mover personalised medicines?

Empirical focus

In order to better understand market formation of personalised medicine, we follow two personalised cancer medicines entering the Dutch healthcare market between 2000 and 2012. Our goal is to understand if and how institutionalisation of markets for Herceptin®, a personalised medicinal product produced by Roche and used in breast cancer treatment, has paved the way for the follow-up product Tarceva®—also produced by Roche and used in lung cancer treatment—to enter the Dutch market.

Methodology

By operationalising the Technological Innovation System (TIS) approach (Hekkert et al., 2007), it is possible to systematically analyse different key processes essential for personalised medicine innovations over time, and to identify mechanisms that hamper or stimulate these innovation processes. First, we perform a qualitative event history analysis to develop a narrative and to gain insight in the dynamics of personalised medicine innovation processes in Dutch healthcare context. Second, we verify and further develop the narrative including the information from various semi-structured interviews with experts from different stakeholder groups, such as industry, academia and research, the non-profit sector and intermediary organisations, drug regulation and policy.

Expected outcomes (scientific and policy advances)

We apply the TIS approach to understand the diffusion, development and implementation of new user practices, e.g. in the form of regulation and markets for the use of innovative health technologies. We show that as part of the technological innovation system of the first-mover personalised medicine, market access became institutionalised, i.e. the market was formed. This paved the way for the later personalised medicine products. This study shows that the TIS framework can be improved by a better understanding of the market formation function (i.e. forming market segments, transactions, and user profiles).

Based on the findings, various recommendations for policy could be made, to facilitate dealing with high market institutionalisation in the personalised medicine innovation system. Innovation policy should take into account both geographical divergence and convergence in institutional practices. Initial differences could then be explained by the variety in market formation sub-processes, while convergence could be spurred by exchange of practices and rules, and interlinkages between the sub-processes. Explicating first versus second generation of

innovation that is associated with system building and builds to transformative change can benefit from TIS analyses like those presented. Such an approach makes the building of visions of the future more explicit and nuanced. Moreover, forecasting future pathways ensures policymakers with more guidance based on which they can conceptualise the instruments for supporting the transition of the healthcare system and more specifically personalised medicine development.

References

- Boon, W.P.C., Edler, J., 2015. The missing links – Demand based policy making and instruments in the context of mission orientation: concepts, impacts, governance challenges. In: proceedings of Eu-SPRI Conference 2015, Helsinki.
- Carlsson, B., Stankiewicz, R., 1991. On the nature, function and composition of technological systems. *Evolutionary Economics* 1(2), 93–118.
- Collins, F. S., Varmus, H., 2015. A new initiative on precision medicine. *New England Journal of Medicine* 372(9), 793–5.
- Dewald, U., Truffer, B., 2011. Market Formation in Technological Innovation Systems—Diffusion of Photovoltaic Applications in Germany. *Industry and Innovation* 18(3), 285–300.
- Dewald, U., Truffer, B., 2012. The Local Sources of Market Formation: Explaining Regional Growth Differentials in German Photovoltaic Markets. *European Planning Studies* 20(3), 397–419.
- Drummond, M., Towse, A., 2014. Orphan drugs policies: a suitable case for treatment. *The European Journal of Health Economics* 15(4), 335–40.
- EC, 2013. Horizon 2020 – The Framework Programme for Research and Innovation. Publications Office of the European Union, Luxembourg.
- Edquist, C. (1997). Systems of Innovation Approaches – Their Emergence and Characteristics. In: Edquist, C. (Ed.), *Systems of Innovation - Technologies, Institutions and Organizations*. Pinter Publishers/Cassell Academic, London., pp. 35.
- Geels, F. W., 2004. From sectoral systems of innovation to socio-technical systems. Insights about dynamics and change from sociology and institutional theory. *Research Policy* 33(6/7), 897–920.
- Grabher, G., Ibert, O., Flohr, S., 2008. The neglected king: The customer in the new knowledge ecology of innovation. *Economic Geography* 84(3), 253–80.
- Hekkert, M. P., Negro, S. O., 2009. Functions of innovation systems as a framework to understand sustainable technological change: Empirical evidence for earlier claims. *Technological Forecasting and Social Change* 76(4), 584–94.
- Hekkert, M. P., Suurs, R. A. A., Negro, S. O., et al., 2007. Functions of innovation systems: a new approach for analysing technological change. *Technological Forecasting and Social Change* 74(4), 413–32.
- Joyner, M.J. & N. Paneth, 2015. Seven questions for personalized medicine. *JAMA* 314(10), 999–1000.
- Kaitin, K. I., 2010. Deconstructing the drug development process : the new face of innovation. *Clinical Pharmacology and Therapeutics* 87(3), 356–61.
- Kukk, P., Moors, E. H. M., Hekkert, M. P., 2016. Institutional power play – the case of Herceptin. *Research Policy* (<http://dx.doi.org/10.1016/j.respol.2016.01.016>)
- Moors, E. H. M., Cohen, A., Schellekens, H., 2014. Towards a system of sustainable drug development. *Drug Discovery Today* 19(11), 1711–20.
- Morlacchi, P., Nelson, R. P., 2011. How medical practice evolves: Learning to treat failing hearts with an implantable device. *Research Policy* 40(4), 511–25.
- Nelson, R. R., Buterbaugh, K., Perl, M., et al., 2011. How medical know-how progresses. *Research Policy* 40(10), 1339–44.
- OECD, 2010. The OECD innovation strategy: Getting a head start on tomorrow. Organisation for Economic Co-operation and Development, Paris.
- Pammolli, F., Magazzini, L., Riccaboni, M., 2011. The productivity crisis in pharmaceutical R&D. *Nature Reviews Drug Discovery* 10, 428–38.
- Scannell, J. W., Blanckley, A., Boldon, H., et al., 2012. Diagnosing the decline in pharmaceutical R&D efficiency. *Nature Reviews Drug Discovery* 11(3), 191–200.

An analysis of the manufacture of futures for sustainable agro-food systems: competing visions of the agroecological transition

Sarah Lumbroso*(UMR SADAPT, AScA), Jessica Thomas(INRA LISIS), Marc Barbier(INRA LISIS) and Sébastien Treyer(IDDRI)
*sarah.lumbroso@asca-net.com

KEYWORDS: Sustainable agro-food systems, Agroecological transition, Futures, Sociotechnical regime, Techno-scientific promises

1. The relevance of considering futures to reveal competing visions of the “grand challenge” of sustainable food production

The transition towards more sustainable agro-food systems is currently a crucial issue addressed by research and innovation policies at different scales (H2020 EU Framework Programme for Research and Innovation, national research strategies such as Agriculture and Innovation 2025 in France, the UK Strategy for Agricultural Technologies...). Sustainable food production is perceived as a “grand challenge” because of its complexity and multidimensional aspects. Behind this apparent consensus around a promotion of change, there are actually competing representations of objectives and pathways for change for agro-food systems, reflecting different paradigms on the way their future is considered. Therefore there are different conceptions of what is behind the “grand challenge”, revealing different worldviews and actors’ interests. This coexistence between different visions for the future is not peaceful, as some narratives dominate others. Indeed, asymmetric power relations between actors of the agro-food systems also structure the interactions between futures. The actors of the dominant agro-industrial regime (Levidow, 2015) shape the “grand challenge” for agro-food systems by framing the debates around production imperatives. The future visions they produce participate in reinforcing their power position, therefore narrowing the options for change. Even though the literature on reflexive governance emphasises the need for a common future vision to foster change, it also insists on the necessity to continuously implement iterative and reflexive adjustments of this vision. Thus a tension in governing change is to conciliate a common horizon for action and a plurality of futures to keep a diversity of options open in an uncertain context. We consider one “grand challenge” for R&I policies is to make sure a variety of options for the future of agro-food systems remain open.

2. Research question: analysing the “manufacture of futures” of agro-food systems in France

We consider that R&I policies are influenced by a variety of future visions of the agro-food system, interacting with each other and co-evolving. In addition to political and scientific narratives on future, various actors’ actions rely on explicit or implicit references to future. As previously described, the “manufactures of futures” is inserted in a strategic context structured by existing power relations. Therefore, the question we address is how an analysis of these “manufactures of futures” reveals tensions between a dominant future vision and alternative proposals?

To understand how future visions impact actors’ insertion in sustainable transitions of food systems, we consider in this paper the “manufacture of future” of actors engaged in a version of the agroecological transition in France.

3. Definitions of two central concepts: the manufacture of futures and the agroecological transition

By the concept of “manufacture of futures” we refer to processes of explicit or implicit formulations of visions for the future of agro-food systems. A diverse panel of social actors manufacture futures depending on different resources, methods and objectives (e.g. a foresight study led by a research team, a policy plan for agriculture designed by the Ministry of agriculture, the project of a farmers’ collective around the redesign of their production systems...). To study how they are manufactured, we analyse the content of future visions and associated transition pathways, the material tools used to produce them, the spaces where they are built and where they circulate, the actors involved and their power relations.

We focus on futures manufactured around a specific concept: agroecology, which can be defined as the application of ecological concepts and principles to the design and management of sustainable food systems (Gliessman, 2007). We acknowledge that a large variety of actors is appropriating and transforming this concept, according to their objectives. We take into account the multiplicity of these definitions, as they influence actors’ choices and actions. However, we analyse visions of the future around agroecology in reference to a particular

definition of an agroecological transition, which is a transition towards agroecology in its “strong” acception (Duru et al., 2014), encompassing the whole food system to improve the resilience of agro-ecosystems through systemic changes. This vision differs from a “sustainable intensification” perspective, as the latter actually conforms with a productivist agenda (Levidow et al., 2014). Adopting this definition as a reference point allows us to study the dialectic between this vision and other narratives on the future of agro-food systems.

4. Theoretical frameworks to study the interactions between dominant regimes and alternatives

As we consider the interactions between a dominant framing of futures and alternative visions, we use:

- the multi-level perspective on socio-technical transitions (Geels, 2004). We consider that the manufacture of futures is one driver of the articulation between regime and niches.
- the regime of techno-scientific promises (Joly, 2015). This perspective supports our argument that there is a dominant regime in the production of futures and helps characterise this regime.

5&6. Empirical material and methodology

The particularity of our approach of future visions built around the agroecological transition is that we consider futures designed in various “spaces”. Futures are not built only in scientific or technical spaces, and limiting our analysis to “traditional” spaces of R&I policies is not relevant as they are prompted to open up. Co-construction is closely associated to agroecology. Therefore we aim to open the consideration of different spaces implementing significant changes. We will consider these spaces as significant for an agroecological transition when they explicitly refer to a version of agroecology but also in spaces implicitly engaged in an agroecological transition. We rely on a comparative analysis of case studies of spaces where futures of agro-food systems are built (e.g. foresight studies on food systems, the French Government agroecological project, farmers initiatives...). The aim is to compare the manufacture of futures that are more or less formalized, in more or less institutionalized spaces.

The material on these case studies has been gathered in different research programs or experiences of the authors. We re-read them in the light on our framework on the manufacture of futures.

7. Expected outcomes

Through case studies of scientific, political and professional spaces, we identify future visions and we question potential power asymmetries between them. We seek to identify how future building processes open up or close down opportunities for transformative change. Indeed, agroecological futures building has to deal with the rules imposed by the dominant regime, in particular concerning commonly accepted performance criteria. As the regime is dominant so are its judgement criteria, therefore the burden of proof falls on those advocating an alternative vision.

Finally, there are processes of articulation between agroecological principles and the dominant regime requirements in the manufacture of futures. Some actors intending to support a strong agroecological transition need sometimes to integrate some elements of the dominant regime in their future vision to access to decision-making debates (e.g. Afterres 2050, a scenario representing a radical technical change of production systems in France also demonstrates that it would still be compatible with the objective of maintaining an important level of cereal exportations). On the contrary, as societal concerns on some negative impacts of the dominant regime increase, dominant actors also seek to integrate some elements of the agroecological narratives (e.g. the French Ministry of Agriculture designed an “Agroecological Project” for France).

The analysis and comparison of our case studies show dynamics of hybridization, integration and conflict between different futures building. Those interactions between different future building processes shape choices for research and innovation policies.

References

- Duru, M., Fares, M., & Therond, O. (2014). Un cadre conceptuel pour penser maintenant et organiser demain la transition agroécologique de l'agriculture dans les territoires. *Cahiers Agricultures*, 23(2).
- Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research Policy*, 33(6–7), 897–920.
- Gliessman S.R., 2007. *Agroecology: the ecology of sustainable food systems*. CRC Press, Taylor & Francis, New York, 384 p.
- Joly, P.-B., 2015. Le régime des promesses technoscientifiques, in Audetat M. et al. (eds), *Sciences et technologies émergentes : pourquoi tant de promesses ?*; Hermann, Paris, 316 p.
- Levidow, L. (2015). European transitions towards a corporate-environmental food regime: Agroecological incorporation or contestation? *Journal of Rural Studies*, 40, 76–89.
- Levidow, L., Pimbert, M., & Vanloqueren, G. (2014). Agroecological Research: Conforming—or Transforming the Dominant Agro-Food Regime? *Agroecology and Sustainable Food Systems*, 38(10), 1127–1155.

How governments should deal with incumbents when governing societal transition processes

Marko Hekkert*(Utrecht University) and Joeri Wesseling(Circle)

*m.p.hekkert@uu.nl

KEYWORDS: Incumbents, Power, Lobby, Innovation policy, Transition policy

Current economic systems are characterized by a lock in of technologies, technological systems and related institutions that will most likely lead to rapid and severe climate change. This lock in situation is labeled as carbon lock in (Unruh, 2000). Societal transition processes are required to break out of the current lock in situation (Hekkert, Suurs, Negro, Kuhlmann, & Smits, 2007).

A societal transition process requires a new direction of innovation. Innovation along the same trajectories will only strengthen the current lock in situation. Therefore, discontinuous and radical innovations are required. The literature states that often large incumbent firms have difficulties producing these radical innovations (Shaz & Krop, 2012). Due to path dependent development of capabilities, deep investments in current technology and high levels of bureaucracy they often fail to introduce radical innovations and develop vested interests to maintain the status quo. Chandy and Tellis (2000) label this phenomenon the “incumbent’s curse” (Chandy & Tellis, 2000).

New entrants to the sector or challenger firms are often the ones that introduce radical innovations (Shaz & Krop, 2012). The successful introduction of radical innovation is a very risky process and many challengers fail. An important reason for this is that the current institutional structure is not aligned to these radical innovations and that new entrants need to make major investments in to build up new and change existing institutional structures (Aldrich, Fiol, & Aldrich, 2008). This type of work is called institutional work when it only concerns institutional change (Lawrence, Suddaby, & Leca, 2010), or system building when also other supportive structures are aimed for (Kukk, Moors, & Hekkert, 2015). According to van de Ven (1993) the development of a supportive structure for radical innovations is a very time consuming, risky and costly process (van de Ven, 1993).

The slow and uncertain developments of a societal transition process is therefore often explained by the battle between challengers and incumbent firms. Incumbent firms are well positioned to protect their vested interests and often perform institutional work to reproduce current technological systems and institutions while challenger firms struggle to legitimize their radical alternatives for the technologies of today (M. Smink, Negro, Niesten, & Hekkert, 2014)

However, this traditional view can also be challenged as incumbents sometimes do lead radical innovation races. Chandy and Tellis (2000) state that the incumbent curse may be exaggerated since in the two product markets that they studied, incumbents produced more than half of the radical innovations during the recent decades. Wesseling et al., (2005) also has shown that over time the innovation strategy of incumbents may change.

Governments who aim to develop policies for societal transition processes need to deal with a challenger – incumbent policy dilemma. It is a dilemma since incumbent firms may not be the best firms to place bets upon to change current technological systems but they are well embedded in political networks and often have a strong influence on national policies (M. Smink et al., 2014). Also they employ many employees and are therefore supported by unions in their socio-political lobby (Unruh, 2000). Challengers on the other hand are hard to identify since they are poorly organized, large in number and much less visible than incumbent firms (M. Smink et al., 2014). To complicate things further, the role of incumbents in relation to racial innovation is not always the same and may change over time from opposing transition processes to supporting them (Wesseling et al., 2015). When this happens, incumbents may significantly speed up societal transition processes due the sheer size of their investments and market power (Geels, 2014).

In this paper we will identify the strategies for policy makers to tackle this dilemma. How should national governments deal with incumbent firms when developing societal transition policies?

To answer this question, we will first analyze how incumbent firms effectively lobby to maintain the status quo. This analysis is based on the PhD thesis of Magda Smink who analysed the lobbying strategies of incumbent firms in the Netherlands related to biogas and the defensive strategies of a broad range of incumbents related to broad sustainability issues (M. M. Smink, Hekkert, & Negro, 2015) as well as on Wesseling and van der Vooren (forthcoming).

Second we will analyze how incumbent firms respond to policy instruments that strive to induce technological change. This analysis is based on the recent work of Wesseling, reported in (J H Wesseling, Farla, Sperling, & Hekkert, 2014; J.H. Wesseling, Faber, & Hekkert, 2013) and recent work by Penna and Geels (Caetano C R Penna & Geels, 2014)(Caetano C.R. Penna & Geels, 2012)

We will use the insights from these studies to derive fruitful policy strategies for dealing with incumbent firms when a societal transition is strived for.

The policy strategies can be summarized by means of five pillars.

1. Policy makers need to create their own vision on the direction of the societal change process. This requires a deep knowledge regarding the technological systems where a transition process is required. This deep knowledge calls for a different species of policy makers: the government is in need of more sector specialists instead of general process managers. A strong self-created vision makes the government less susceptible for lobbying practices. It also means that policy makers are not guided by long term technology roadmaps developed by industry associations, as these are typically restricted to incremental innovation.
2. When it comes to assessing technological options for change, incumbent firms and especially industry associations should not be consulted. Universities, technology institutes and new entrants provide more reliable vision of what is technologically possible.
3. Policy makers need to set long term goals for industrial change and be persistent in maintaining these goals. Long term goals provide the necessary guidance of the search for industries to alter their innovation direction.
4. Policy makers may join forces with the most innovative incumbent firms to over time adapt transition policy . Our evidence suggests that the most innovative firms are willing to support transition policies to gain competitive advantage over laggard firms.
5. Reduce the self-regulatory power of industries dominated by incumbent firms. This means that norm and certification committees, which in these industries are typically dominated by incumbent firms, are instead governed by either public agencies or by neutral NGOs. Such committees can pose formidable market barriers for radical innovation.

References:

- Aldrich, H. E., Fiol, C. M., & Aldrich, H. E. (2008). FOOLS RUSH IN ? THE INSTITUTIONAL CONTEXT OF INDUSTRY CREATION, 19(4), 645–670.
- Chandy, R. K., & Tellis, G. J. (2000). The Incumbent's Curse? Incumbency, Size, and Radical Product Innovation. *Journal of Marketing*, 64(3), 1–17.
- Geels, F. W. (2014). Regime resistance against low-carbon transitions: Introducing politics and power into the multi-level perspective. *Theory, Culture & Society* 31(5), 21–40.
- Hekkert, M. P., Suurs, R. a. a., Negro, S. O., Kuhlmann, S., & Smits, R. E. H. M. (2007). Functions of innovation systems: A new approach for analysing technological change. *Technological Forecasting and Social Change*, 74(4), 413–432. doi:10.1016/j.techfore.2006.03.002
- Kukkk, P., Moors, E. H. M., & Hekkert, M. P. (2015). The complexities in system building strategies — The case of personalized cancer medicines in England. *Technological Forecasting and Social Change*, 98, 47–59. doi:10.1016/j.techfore.2015.05.019
- Lawrence, T., Suddaby, R., & Leca, B. (2010). Institutional Work: Refocusing Institutional Studies of Organization. *Journal of Management Inquiry*, 20(1), 52–58. doi:10.1177/1056492610387222
- Penna, C. C. R., & Geels, F. W. (2012). Multi-dimensional struggles in the greening of industry: A dialectic issue lifecycle model and case study. *Technological Forecasting and Social Change*, 79(6), 999–1020. doi:10.1016/j.techfore.2011.09.006
- Penna, C. C. R., & Geels, F. W. (2014). Climate change and the slow reorientation of the American car industry (1979–2012): An application and extension of the Dialectic Issue LifeCycle (DILC) model. *Research Policy*. doi:10.1016/j.respol.2014.11.010
- Shaz, S., & Krop, P. (2012). Incumbent performance in the face of a radical innovation : Towards a framework for incumbent challenger dynamics □, 41, 1357–1374.
- Smink, M. M., Hekkert, M. P., & Negro, S. O. (2015). Keeping sustainable innovation on a leash? Exploring incumbents' institutional strategies. *Business Strategy and the Environment*, 24(2), 86–101. doi:10.1002/bse.1808
- Smink, M., Negro, S. O., Niesten, E., & Hekkert, M. P. (2014). How mismatching institutional logics hinder niche-regime interaction and how boundary spanners intervene Keywords. *Technological Forecasting & Social Change*, 1–31. doi:10.1016/j.techfore.2015.07.004
- Unruh, G. C. (2000). Understanding carbon lock-in. *Energy Policy*, 28(March), 817–830.
- van de Ven, A. H. (1993). The development of an infrastructure for entrepreneurship. *Journal of Business Venturing*, 8, 211–230.
- Wesseling, J. H., Faber, J., & Hekkert, M. P. (2013). How competitive forces sustain electric vehicle development. *Technological Forecasting and Social Change*. doi:10.1016/j.techfore.2013.02.005
- Wesseling, J. H., Farla, J. C. M., Sperling, D., & Hekkert, M. P. (2014). Car manufacturers' changing political strategies on the ZEV mandate. *Transportation Research Part D-Transport and Environment*, 33, 196–209. doi:10.1016/j.trd.2014.06.006
- Wesseling J.H., van der Vooren A. forthcoming. Analyzing interdependent systemic problems for the diffusion of clean innovations in the Dutch concrete industry.

Researching urban sustainability transitions in the city of Genk (Belgium): Investigating the nuclei for transformative change and the potential for acceleration

Leen Gorissen*, Erika Meynaerts and Pieter Valkering
(VITO)

*leen.gorissen@vito.be

KEYWORDS: Acceleration, Sustainability transition, Transition initiatives, Governing urban sustainability

1. Relevance of the research

The overall objective of the research presented in this paper is to understand the conditions under which urban sustainability transition initiatives that aim to change the provisioning of key human needs (e.g. energy, food, ecosystem services) can contribute to accelerating sustainability transitions. In recent years, multiple initiatives (e.g. urban agriculture, energy cooperatives, sharing platforms) have been set up in cities across the world to kick-start transitions of urban systems towards sustainability. Since initiatives are clearly multiplying in city regions, we hypothesize that some European cities exhibit dynamics of moving from the pre-development to the acceleration phase of sustainability transitions in certain domains and geographic areas. The focal unit of analysis are the local transition initiatives; innovative activities and related actor-networks from the city region. In addition, we investigated how the local governance context is supporting or hindering the mainstreaming of such alternative ways of doing, thinking and organising (DTO). Our findings are relevant to deepen the understanding of transition scholars on the acceleration dynamics of urban sustainability transitions since this has thus far been under-conceptualised in the literature.

2. Research aims and questions

We apply an analytical framework of five acceleration mechanisms to our case study, the city-region of Genk. To advance our understanding of acceleration dynamics, we ask two research questions: First, to what extent can we observe the five conceptualised mechanisms of acceleration in Genk when studying local transition initiatives? Second, is the local governance context supporting or hindering these acceleration dynamics? Our empirical research is part of the research project Accelerating and Rescaling Transitions to Sustainability (ARTS), funded by the 7th Framework Programme by the European Commission between 2013 and 2016.

3. Theoretical and analytical framework & definitions

Drawing from the conceptual framework of ARTS, we defined and studied five acceleration mechanisms which have been defined as:

Replicating: copying or emulating new ways of DTO of one transition initiative by another initiative or different actors within the city-region and/or from outside the city-region;

Coupling: linking up of transition initiatives or between transition initiatives and other organisations in order to exploit synergies between new ways of DTO;

Upscaling: the growth of members, supporters or users of an initiative within the city region in order to spread new ways of DTO;

Instrumentalising: tapping into, utilizing, exploiting or building on developments at any level in order to strengthen new ways of DTO locally;

Embedding: anchoring new ways of DTO into city regional governance patterns.

Fig. 1: Conceptual presentation of five mechanisms for acceleration urban transitions to sustainability

These mechanisms thus describe how transition initiatives can increase their outreach, spread transformative ways of DTO, develop and strengthen connections with each other to exploit synergies, change formal and informal governance institutions, and mobilize resources, legitimacy and support. On an aggregate level, we suggest that these mechanisms represent ways through which transition initiatives increase the speed of change within their city-region, i.e. accelerate sustainability transitions. Of course, acceleration dynamics also heavily depend on the local governance context: in a conducive environment the spreading and upscaling of transformative ways of DTO is promoted while in a hostile environment this is slowed down. To investigate this, we analysed the local governance context in terms of policy priorities and programs.

4. Methods

First, an inventory of 90 locally-based, civil society, business and government-led initiatives focusing on socio-economic and environmental sustainability was compiled. The list was put together based on the team members' prior knowledge of local activities, additional desk research, consultation of key informants from the City (defined as helicopter viewers) and a workshop with employees of the City Administration. From this list 10 initiatives were then selected that had a strong focus on environmental sustainability. We adopted a qualitative research design approach as we were studying a poorly understood phenomenon and aimed to test and improve our theoretical propositions about acceleration mechanisms [1]. Information about the 10 selected initiatives was gathered and confirmed through 19 semi-structured interviews with 31 individuals and 3 workshops. Interviewees included members of the selected transition initiatives in Genk, employees of umbrella organisations that these initiatives belong to and helicopter viewers who could provide an external perspective on these initiatives (see appendix 1). Interviews also included questions about the local governance context which was investigated via the study of the local policy programs and participation in several city-led participatory workshops.

5. Empirical findings

Our findings show that all five mechanisms of acceleration are occurring in Genk. These are described in detail in [2]. Of the mechanisms studied, coupling and embedding appear to be the most significant for mainstreaming alternative ways of DTO in Genk. This is closely related to the local governance context which in general, appears to be supportive of the acceleration mechanisms. More specifically, the local government actively supports and promotes embedding of transformative ways of DTO. For example: approximately 8.5% of the total budget of the City in 2015 was allocated to two policy programs specifically focusing on institutional innovation: becoming a 'laboratory city' and 'increasing citizen involvement and participation' [3, 4]. Illustrative activities include the establishment of a cross-departmental transition team, the organisation of masterclasses on systems thinking and envisioning for civil servants, the organisation of participatory workshops on 'greening the city centre' (which inspired pop-up gardens made by volunteers as a first step), 'upcycling' and 'food in the city' and the introduction of a local currency for the specific promotion of environmental friendly behavior in the whole of Genk (Genk beloont). However, the link between economic development and environmental sustainability is still rather weak [5, 6]. A significant lever for acceleration is thus to align the 'entrepreneurial city program' with the 'ecological city program' e.g. by developing an overarching vision of economic development within planetary boundaries as a compass to guide economic decisions. Furthermore, since Genk has a tradition in pioneering social innovation, policy programs are effectively supporting replication, instrumentalising and coupling. To achieve this, a well organised network of district managers has been set up. These are active connectors that have been pivotal in the success of many transition initiatives (Bee plan, Organic allotment gardens, compost masters, Heempark, Pass-on shop). In addition, Genk has set up a district budget which promotes bottom up activities of shared and collective value creation in the local communities. Next to district managers, community development workers (e.g. Stebo) also played an supporting role in the success of transition initiatives (Zetjes, Pass-on shop, Organic allotment gardens). They especially support capacity building and build environmental consciousness in target groups. In a next phase, strategies for acceleration will be identified in several co-creative workshops with local actors. These will form the basis of an acceleration roadmap that aims to bring together bottom up transition initiatives and top down policy programs in a mutual reinforcing way to further fuel transformative change towards increased sustainability.

6. Implications for research & policy

While still early days, on an aggregate level, our findings do provide early indications of accumulated changes, increased reflexivity from governance actors and diffusion and embedding of new ways of DTO. In line with Rotmans and Loorbach [in 7] and Grin [in 7] we suggest that moving beyond the take-off phase into the acceleration phase, requires mutual reinforcing dynamics between so-called transition initiatives promoting transformative ways of DTO and the local government to contribute to the governance of system innovation. Of course, the nature of the work presented here is still exploratory. More research will be needed to further investigate the multitude of aspects relevant for acceleration and how these play out in accelerating the sustainability transition. We believe that this exploratory study furthers transition theory by adding new insights on the acceleration dynamics of urban sustainability transitions and may be of particular interest for practitioners

on the field. In the next step of the project, we will investigate governance strategies to promote a fertile breeding ground for transition initiatives to further germinate, grow and replicate.

References

1. Marshall C. & Rossman G. B. 1995. Designing qualitative research (2nd ed.). Thousand Oaks, CA: Sage.
2. Gorissen L, Spira F, Meynaerts E, Valkering P, Frantzeskaki N. 2016. Moving towards systemic change? Investigating acceleration dynamics of urban sustainability transitions in the Belgian City of Genk. In progress.
3. Policy document 'Making the city together'. Genk, 2015.
4. Policy document 'Meaningful city'. Genk, 2015.
5. Policy document 'Entrepreneurial city'. Genk, 2015.
6. . Policy document 'Ecological city'. Genk, 2015.
7. Grin, J., Rotmans, J. & Schot, J. (2010). Transitions to Sustainable Development – New Directions in the Study of Long Term Transformative Change, New York: Routledge

Appendix 1

Reference Related to which initiative, helicopter viewer or theme of workshop Date Interviewee/or participants in workshop

Interview 1 Compost masters 09.02.2015 One employee of Vlaco responsible for running the compost masters / kringloopkrachten model in Flanders

Interview 2 Helicopter viewer 04.03.2015 Director of Stebo, a local centre for community development who has been involved in the local communities for a long time

Interview 3 Zetjes, Organic allotment gardens, Pass-on shop 02.04.2015 Founder and main driver behind the Zetjes, employee of Stebo involved in the districts with the allotment gardens and Pass-on shop

Interview 4 Pass-on shop 23.02.2015 Founder

Interview 5 Helicopter viewer and specifically Bee-plan and Heempark 26.02.2015 Main coordinator of the Heempark and Bee-plan

Interview 6 Velt vzw 10.02.2015 Two employees of Velt vzw (Flemish umbrella organisation) responsible for staying in contact and supporting local Velt groups

Interview 7 Velt Genk 07.04.2015 5 members of the current board of Velt Genk, the local branch of Velt vzw

Interview 8 Re-use Center De Koop 23.02.2015 Director and another employee of Kringwinkel De Koop

Interview 9 Re-use Center De Koop 29.02.2015 Two employees of KOMOSIE, the umbrella organisation for all kringwinkels in Flanders.

Interview 10 Organic allotment gardens 04.03.2015 Two members who have been involved in the initiation of the garden in Genk Noord

Interview 11 Organic allotment gardens 12.03.2015 Former employee of Velt vzw who helped to set up the first organic allotment gardens and then spread the model throughout Flanders

Interview 12 Helicopter viewer 22.01.2015 One politician of left, progressive political party that is part of the local coalition government

Interview 13 Helicopter viewer and specifically Natuurpunt Genk 26.02.2015 Member of the Leefmilieuraad, the environmental committee of Genk that includes civil society and public officials

Interview 14 Helicopter viewer and specifically Heempark and Natuurpunt Genk 23.05.2015 Member of Natuurpunt Genk and of the Leefmilieuraad, the environmental committee of Genk that includes civil society and public officials

Interview 15 Bronsgroen 16.03.2015 Two board members of Bronsgroen, one of which is a citizen of Genk

Interview 16 Helicopter viewer 26.05.2015 Head of the district management team of the city

Interview 17 Velt Genk 26.08.2014 Member of Velt Genk who maintains the garden of Bokrijk and works in homes for the elderly

Interview 18 Helicopter viewer 02.03.2015 Staff member of Limburg.net

Interview 19 Compost masters 31.03.2015 Four compost masters active in Genk

Workshop 1 Mapping and structuring exercise 15.12.2014 A diverse group of civil servants discussed and enriched the inventory of transition initiatives and structured these according to their perception

Workshop 2 Mapping and structuring exercise 16.04.2015 All department heads of the city government and the Mayor contemplated about the building blocks of transformative change in the city, how these interrelate, what is needed in terms of transition strategies to improve transformative capacity and where the selected transition initiatives under study fit in

Workshop 3 Validating exercise 03.06.2015 A group of civil servants and helicopter viewers discussed and enriched our conclusions

Parallel Sessions 6

6A. EVALUATIONS OF INNOVATION AND RESEARCH POLICY

Concentration on the Few? R&D and Innovation Participation in German Firms between 2001 and 2013

Torben Schubert* (CIRCLE, Lund University & Fraunhofer ISI) and Christian Rammer (Centre for European Economic Research (ZEW))

*torben.schubert@circle.lu.se

KEYWORDS: Innovation participation, R&D, Innovation Policy, Subsidies

Motivation: Innovation expenditures in Germany have increased at an impressive rate in the course of the last two decades. Between 1995 and 2013, businesses in Germany raised their spending for developing and introducing new products and new processes from €60.8bn to €144.6bn giving a compound annual growth rate of 4.9% (Rammer et al. 2015). While these numbers suggest that German firms have become ever more focused on innovation, they hide the fact that this rise was mainly driven by large firms belonging to a few sectors. When we look at the above numbers by firm size we find that firms with less than 500 employees experienced only a very modest increase in their innovation expenditures (€25.7bn in 1995 vs. €34.5bn in 2013, i.e. 1.6% per year) whereas large firms with more than 500 employees increased their spending from €35.1bn in 1995 to €110.1bn in 2013 (6.6% per year). In line with these observations we also find a concentration of the activities on fewer firms. In particular, the share of innovators – firms that have introduced at least one product or process innovation during the preceding three years – has similarly declined since the late 1990s. Having reached a peak in 1999 at 55.5%, it dropped to 43.7% in 2007 and further declined to 37.1% in 2013. These developments would not be problematic if they were due to highly-innovative firms organically growing at an above-average rate. We however argue that the phenomenon is more likely to be explained by smaller firms withdrawing from innovation activities at a large scale. Such a development would be of much greater concern because one of the pillars of the competitiveness of the German economy is seen in its highly innovative SMEs (Mittelstand). A withdrawal of these firms from innovation would make the German economy considerably more reliant on set of well-known large companies, while grassroot innovation in SMEs may be lost. Moreover, since choices about innovation activities display a high degree of path dependence, these developments may easily turn permanent.

Methodology and Results: While the aggregate figures from above indeed provide initial evidence of SMEs withdrawing from innovation, such aggregate indicators can be misleading when processes simultaneously taking place are left unaccounted. More convincing evidence must therefore rely on firm level evidence using methods that can appropriately account for confounding factors. Relying on a panel of all firms that took part in the annual German Innovation Surveys covering the period from 2001 to 2013 we employ Markov Chain methods that model when and why firms change their innovative state both in terms of actual innovation outcomes as well as in terms of R&D effort. The main results are threefold. By dividing our data into three periods from 2001-2007 (pre-crisis), 2008-2011 (crisis), and 2012-2013 (post-crisis), we show that the long-term share of firms engaging in innovation and R&D is considerably lower in the second period with an increase of the share of firms not innovative at all. This downward trend is not due to shock induced by the crisis, because it even intensifies after 2011. Second, analyses of the determinants suggest that, as expected, smaller firms are more likely to quit innovation activities. We show that they are less likely switch to higher levels of innovative activities (e.g. from non-innovative to product or process innovator or from product or process innovator to simultaneous product and process innovator). They are also more likely to fall back to lower levels of innovativeness. Most importantly this pattern is becoming more pronounced in the later period of 2008 (respectively 2012) and after. Thus, the already more unstable innovation behaviour of SMEs became even more fragile in the later periods of our sample. Based on this result we analyze the effectiveness of a set of mechanisms potentially offsetting or at least slowing down these developments. We show that public innovation support, better financial capabilities and engagement in innovation collaborations increase the chances to move to higher levels of innovativeness and reduce the probability to fall back.

Systemic Threats: Our results show that the shares of innovators and R&D performing firms are falling in Germany. This is particularly problematic because persistence in innovation strategies suggests that a firm's decision to move out of innovation and R&D cannot be easily undone. This is because of the cumulative nature of innovation processes. In particular, firms discontinuing innovation and R&D tend to lose the capabilities associated with these activities. In that respect, the decreasing shares of innovation and R&D-active firms are a major challenge for innovation policy in Germany.

We also provide evidence that this concentration trend is the result of the retraction of mainly smaller firms. While Germany is often hailed for its highly innovative SME sector, this suggests that the German innovation system is gradually losing one of its most important pillars. This can in the long-run bear considerable systemic risks not only for withdrawing smaller firms themselves but also for the larger ones. In particular, several authors have highlighted the existence of complementarities between small and large firms in innovation (Tether 1998; Nooteboom 2009) that often results from a greater organizational flexibility and flat hierarchies of smaller firms (Baier et al. 2015). In particular, in high-tech sectors large firms "outsource" parts of their innovation activities to innovation alliances with smaller firms experiencing a lower degree of organizational rigidity (Ciborra 1991). However, if such innovation active SMEs become increasingly scarce, the potentials using the organizational complementarities in innovation vanish.

A further problem of the concentration is related to the hazard of Germany developing an industrial monoculture dominated by a few large firms. More precisely, if only a limited number of firms mainly located in some key sectors (automobiles, chemistry, and machine construction) remain, there is a risk that the sectoral composition in Germany will shift even more towards these selected factors. This is because the effect of innovation is one of creating an asymmetry by making some firms more competitive than others (Dosi 1988). The more competitive firms will then grow at the expense of other firms. On the sectoral level this will imply a shift of resources to sectors with higher levels of innovativeness (Andries et al. 2015). While the reallocation of resources towards more productive uses is certainly desirable, the fact that only a limited number of firms are driving this trend implies an increasing dependence on few firms and sectors. As a consequence the German economy runs a risk of becoming much more vulnerable to aggregate technology or demand side shocks that affect firms in a certain sector in a similar way. In this respect, the ongoing concentration processes may in the longer term considerably reduce the resilience of the German economy against crises and business cycles.

Policy Implications: Because of the great systemic risks, there is a strong need to take measures against the concentration of innovation and R&D activities on larger firms. Our results showed that several firm characteristics considerably moderate the decisions to move in or out of innovation and R&D. We have found that public subsidies, innovation cooperation, and better financial positions tend to be associated with lower risks of falling back to lower levels of innovation and R&D engagement while they increase the chances that firms increase their innovation and R&D engagement. As concerns public subsidies this emphasizes the effectiveness of the existing project support in Germany to keep firms committed to innovation and R&D activities. Indeed using causal mediation analysis, there exists evidence that the main channels through which innovation subsidies increase innovativeness relate to increasing the level of interfirm innovation cooperation (typical for project-based funding) and through increasing the financing capabilities (Rammer et al. 2012). Thus, a way to counteract the declining trend in innovation and R&D participation in Germany is seen in increasing the overall public innovation support. In fact, there is considerable potential to do that, as Germany is among the countries with the lowest public support. More specifically, in 2012 the share of private R&D funded by the state was slightly above 4% in Germany, while it was almost 8% in France and the UK and more than 10% in the US. Even Italy, heavily hit by financial crisis, ranked much higher with about 7% (Deutsche Telekomstiftung 2014).

References:

- Andries, P., M. Hoskens, J. Janger, C. Rammer, T. Schubert (2015), The New EU 2020 Innovation Indicator: A Step Forward in Measuring Innovation Output? Concordi Conference, Sevilla.
- Baier, E., C. Rammer, T. Schubert (2015), The impact of captive innovation offshoring on the effectiveness of organizational adaptation, *Journal of International Management* 21, 150–165.
- Ciborra, C.U. (1991), From Thinking to Tinkering: The Grassroots of Strategic Information Systems, *Proceedings of the Twelfth International Conference on Information Systems*, New York, 283–291.
- Deutsche Telekomstiftung (ed.) (2014), *Innovationsindikator 2014*, Bonn.
- Dosi, G. (1988), Sources, procedures, and microeconomic effects of innovation, *Journal of Economic Literature* 26, 1120–1171.
- Nooteboom, B. (2009), *A Cognitive Theory of the Firm: Learning, Governance and Dynamic Capabilities*, Cheltenham: Edward Elgar.
- Rammer, C., O. Som, S. Kinkel, C. Köhler, T. Schubert, F. Schwiebacher, E. Kirner, A. Pesau, M. Murmann (2012), *Innovationen ohne Forschung*, ZEW Wirtschaftsanalysen, Bd. 101, Baden-Baden: Nomos.
- Tether, B.S. (1998), Small and large firms: sources of unequal innovations? *Research Policy* 27, 725–745.
- Bartelsman, E., Scarpetta, S., Schivardi, F., 2005. Comparative analysis from demographics and survival: evidence from micro-level sources in OECD countries. *Industrial and Corporate Change*, 14 (3), 365–391.

- Cincera, M., & Veugelers, R. (2013). Young leading innovators and the EU's R&D intensity gap. *Economics of Innovation and New Technology*, 22(2), 177-198.
- Ciriaci, D., Moncada-Paternò-Castello, P., Voigt, P., (2014). "Does size of innovative firms affect their growth persistence?". *Brussels Economic Review*, Volume 57, Issue 3, p. 317-348. ULB-Dulbea editor. Brussels, autumn 2014.
- Dosi, G., & Nelson, R. R. (2010). Technical change and industrial dynamics as evolutionary processes. *Handbook of the Economics of Innovation*, 1, 51-127.
- European Commission (2014): "The EU Industrial R&D Investment Scoreboard", – Joint Research Centre, Institute for Prospective Technological Studies and Directorate General Research - Scientific and Technical Research series – <http://iri.jrc.ec.europa.eu/scoreboard.html>
- Foray, D., & Lhuillery, S. (2010). Structural changes in industrial R&D in Europe and the US: towards a new model?. *Science and Public Policy*, 37(6), 401-412.
- Gambardella, A., Giuri, P., & Luzzi, A. (2007). The market for patents in Europe. *Research Policy*, 36(8), 1163-1183.
- García-Manjón, J. V., & Romero-Merino, M. E. (2012). Research, development, and firm growth. Empirical evidence from European top R&D spending firms. *Research Policy*, 41(6), 1084-1092.
- Hölzl, W., Kaniovski, S., Kutsam, J., Peneder, M., Reinstaller A., Sieber, S., Stadler, I., Unterlass, F. (2011). Structural change and the competitiveness of EU member states. Janger J, editor. Austrian Institute of Economic Research; 2011 Oct 14.
- Krüger, J. J. (2008). Productivity and structural change: a review of the literature. *Journal of Economic Surveys*, 22(2), 330-363.
- Jorgenson, D. W., & Timmer, M. P. (2011). Structural change in advanced nations: A new set of stylised facts*. *The Scandinavian Journal of Economics*, 113(1), 1-29.
- Malerba, F., & Orsenigo, L. (1997). Technological regimes and sectoral patterns of innovative activities. *Industrial and corporate change*, 6(1), 83-118.
- O'Sullivan M., (rapporteur), (2007) "The EU's R&D Deficit and Innovation Policy", report based on contributions of the members of the EU Commissioner J. Potočník's Expert Group on "Knowledge for Growth"
- Perez, C. (2009). Technological revolutions and techno-economic paradigms. *Cambridge Journal of Economics*, bep051
- Pianta, M. (2014). An industrial policy for Europe. *Seoul Journal of Economics*, 27, 277-305.

Assessing the impact of research in Social Science and Humanities: A Comparative Perspective on National Evaluation Systems in France and Germany

Lucio Morettini(IRCRES CNR), **Emanuela Reale***(IRCRES CNR), Charles Larkin(School of Business Trinity College Dublin) and Charles Travis(School of Business Trinity College Dublin)

*e.reale@ceris.cnr.it

KEYWORDS: Social impact, Research evaluation, Political system, Public administration, SSH

Relevance

Assessing the social impact of research is becoming more important in the debate on evaluation policies. The diffusion of the neo-liberal paradigm (NPM) and the changes in the concept of research and its results led toward the emergence of efficiency, effectiveness, and productivity driving the way in which the activities must be managed. Accountability and the principle of value for money further enforce the mentioned trend, as well as the establishments of standards as benchmarks of successful performance (Brunsson and Jacobsson, 2002).

This process of change goes with the cutting of public resources (first and foremost funding) devoted to R&D, and with the emergence of a quest from the policy makers on behalf of society about the utility of research and its capability to contribute to the progress and well-being of the whole community. The needs of ‘evidence-based justification’ to sustain R&D through public funding, and the push toward focusing on “relevant” themes of investigation affected also the reflexivity about the public investment on R&D, questioning the capability of the research to address grand challenges for the sustainable development, to generate breakthrough and innovation, and definitely the impact produced by the R&D activities on science, society, economy and policy (Penfield et al., 2014; de Jong et al., 2014).

Despite the interest, impact evaluation of R&D is strongly affected by the time lag and attribution problems, and solutions elaborated to solve them are still striving debates among scholars and policy makers about their capability to contribute to the evidence-based policy process (Hughes, A. and B. Martin, 2012; Spaapen et al., 2014; Reale et al. 2014).

Research aim

The paper investigates how the evaluation of impact is implemented in national R&D systems, trying to understand how the configuration of the systems in different countries can influence the perception of social impact of research in Social Science and Humanities (SSH) among researchers, policymakers and research managers. The analysis is devoted to control whether the research evaluation systems: i) use (or intend to use) mechanisms to evaluate the social impact from the research results, ii) gather (or try to gather) evidence about the social impact of the projects assessed and make it visible, iii) include indicators for the assessment of scientific, political and social impact. The paper is based on data collected for the project “IMPACT – EV: Evaluating the impact and outcomes of European SSH research” funded under the EUFP7 .

The paper takes a comparative perspective of two case studies about Germany and France. Both France and Germany are large countries of continental Europe that have suffered less than other instances of the reforming of New Public Management but they present also deep differences about the role and autonomy of Higher Education Institutions and the structure and the role in research policy of central and local administration. The focus on SSH allows to shed light on fields whose contribution to economy and society is questioned, and considered less relevant than natural sciences; SSH are sometimes perceived as a sort of non-productive investment, whose added value is difficult to identify (Nussbaum, 2012; Bod, 2013). Moreover, the possibility to measure the outputs of the research activities in these fields of science is constrained by the lack of adequate indicators and metrics. Problems of time lag and attribution are particularly high when the assessment of SSH results is concerned, as well as the identification of the relevant stakeholders.

Definitions and theoretical framework

The political system and the administrative culture and traditions play a central role structuring the research and HE systems of the countries: for instance Bleiklie and Michelsen (2013) found that the influence of political system can be more ambiguous and flexible but also deeper than expected, while Whitley (2007) shows how organized groups of politician, business elites and other policy advisers could strongly condition research activity if there is not separation with national academic system. The analysis of research systems’ configuration in European countries also shows a large heterogeneity among national R&D systems that are characterized mainly for peculiarities of intermediary organizations between policymakers and researchers. The characteristics of intermediaries are not neutral with respect to the structures of research system and to its history as reported by Ferlie et al. (2009).

Speaking about political systems, two basic dimensions of the state structure are considered: the first is the

vertical dispersion of authority, which is the case of decentralized federal countries where the power is delegated to sub-national entities, thus being less uniform than centralized countries where the power is owned at central level and the focus on delivery and results is more pronounced (Bliklie and Michelsen, 2013). The second dimension is the horizontal coordination at central government level. As to the national cases considered in this paper, Pollitt & Bouckaert (2003) consider France a country more coordinated than Germany because the administrative élites of officers balance the fragmentation of the system, while in Germany the fragmentation is higher because a mechanism of coordination is less efficient.

When the paper refers to administrative culture and traditions, it indicates two typologies used by Peters (2008) and Painters and Peters (2010). One is the Napoleonic tradition, where the focus is on law -as a mean of the state to intervene on society, and on administration -strictly related to the laws, with a small role that in principle the societal actors are supposed to play. However, since the presence of implementation gaps is a key characteristic of this tradition, distances between what is prescribed by law and the actual existence or utilization of management tools are always observed. The other typology is the German tradition, with a dominant role of the state to integrate the different parts of the system, and a strong role of the bureaucracies to assure the compliance to regulations and rules.

The paper assumes that since the political – administrative structure influences the configuration of HE system in each country (Bleiklie and Michelsen, 2013) it is likely to affect the evaluation system as well. More specifically, the configuration of the state structure (centralized-decentralized, coordinated-fragmented) and the administrative culture and traditions of the countries (Napoleonic vs German) shape the implementation of the evaluation of R&D impact as to: a) the importance given to the ex-ante R&D impact assessment vs the ex-post one, b) the actors involved in impact assessment and the autonomy they have with respect to the state and the performers; c) the indicators and metrics used, d) the association between the R&D impact assessment and the R&D funding.

Empirical framework and description of the methodology

Testing the perceptions and ideas of actors with different role in the R&D system is the base for the comparative analysis of France and Germany. To this aim we integrate the results coming from desk analysis and interviews to eight representatives per country, selecting them among following categories (IMPACT-EV, 2015):

- 1) Research Evaluator/Peer Reviewer for the purposes of funding and/or accountability in charge of SSH evaluation;
- 2) Research Manager/Scientific Officer within a research funding agency (within a government department or in an exclusive funding body quango);
- 3) Policymaker/politician/budget holding civil servant;
- 4) Academics.

The interviews are focused on the current work of representatives, policy makers and reviewers or researchers about the evaluation of research results, with a deep investigation on tools and technics. Furthermore, was asked to the subjects involved to define the social impact of research, providing examples of the effects observed on people's lives and on policy actions. The goal of these interviews is to collect qualitative that could show us the vision of different actors about the same topic, trying to identify common characteristics and strong differences between countries and among them.

Desk analysis deals with the following:

- Legal and policy documents approved by national parliaments on SSH research evaluation or national research policy

(a) Primary legislation –including bodies within D/Education, bodies within D/Enterprise or Business, and independent authorities–

(b) Statutory instruments

(c) Government departments/agencies circulars and advisories

- Documentation related to recent calls for research projects, and other relevant documents (i.e. evaluation guides) of the process of selection.

Interviews and desk analysis will be integrated in a matrix combining the items investigated and the effects expected according to the characteristics of the political-administrative systems of the countries under examination.

Expected outcomes

Given the differences between the two countries, we expect that in Germany decision makers and academics could be more inclined to differentiate between assessing the impact of research work inside the research system –either the scholar community or the organizations, and outside the research system. While the former can be assumed but not fully evaluated, the latter is not in the disposal of researchers and policy makers, thus political and social impact is not an issue at stake. On the other hand, decision makers and academics in France could be more likely to consider research as something that must be fully integrated in society, with a “natural”

transmission of the results to other members of the political and administrative system with which they share the determination of the path of research policies. Implementation nonetheless very often might show a very limited importance of research impact assessment either in ex ante and in ex post evaluations.

We expect that in both countries SSH does not present differences in comparison with other fields but the identification of metrics adapt to capture the effects produced on society, with productive interactions and dialogues with stakeholders having higher importance than input/output approaches based on metrics.

Finally, the difficult to find a common definition for social impact of evaluation between elements of the same research system could be amplified by the influence that different configurations of research and political – administrative systems have on several topics of research policy.

Innovation Assessment: Making Sense of Collingridge Dilemmas

Jacob Hasselbalch
(University of Warwick & L'Université Libre de Bruxelles)
j.a.hasselbalch@warwick.ac.uk

KEYWORDS: Sensemaking, Institutions, Framing, Technology assessment, Disruptive innovation, Regulation

1. Relevance

There is a growing sense of unease among the policymaking elite that they are increasingly placed on the back foot when it comes to addressing innovation and technological change, forced to react to such changes rather than shape them from the outset. Most policy work within the field of innovation studies is concerned with questions of how to produce more or better innovation, placing policymakers in the driver's seat and innovators in the passenger's seat. This article turns those questions on their head, asking: what happens when policymakers are forced to react to those new regulatory challenges that innovations raise? When innovators are driving and policymakers are the passengers, what options do they have available for steering the innovations and how do we assess those options?

If the theoretical core of innovation studies is “the conceptualization of innovation as an interactive process” (Lundvall 2013, p.33), then when it comes to the political system, it is fair to say that it has mostly been treated as a case of policies acting on innovations and not the reverse. Science and technology studies have long been indicating the co-constitutive effects and feedback loops between science and policy (Jasanoff 1987; Latour 1998), but this interaction seems less fully developed when we look at innovation and policy. Even when attention does get directed specifically to interaction in the innovation-policy “dance” or the effects of non-technological regulations, it is always with a view to enabling more innovative activities (Kuhlmann et al. 2010; Paraskevopoulou 2012). To attain the self-professed goal of IS of gaining systematic and reliable knowledge on how to best secure the societal benefits from innovations, we have to also look at how innovations sometimes act on policies and what that means. Taking that perspective implies that we become temporarily agnostic as to the sources and drivers of innovation, to grant that some innovations happen regardless of what policymakers prepare for or what scientists intend, and to focus on what happens within socio-political systems as a consequence of the innovation.

2. Research aims and questions

The aim of the article is to theorize the neglected direction of the innovation-policy relationship. I ask: how do innovations act on policies and with what consequences? I narrow the inquiry to look at the regulatory challenges raised by controversial, disruptive innovations such as hydraulic fracturing, e-cigarettes, Uber and AirBnB. All of these innovations fall between the cracks in our regulatory frameworks, raise public concerns, and demand attention from policy actors to bring the disruptions under control. We can consider this work as being a form of Innovation Assessment, which the article then goes on to define and conceptualize.

3. Definitions

I define Innovation Assessment as the formation of public and political opinion on the societal aspects of technologies via a structured, deliberative process. The article argues that Innovation Assessment, as defined here, fills out the space between Technology Assessment (TA) and the Regulation of Risk (RoR). TA comes too early and focuses on science and technology more than innovation (Ely et al. 2014) – it neglects the post-market stages of innovation diffusion. In contrast, RoR comes too late. At this stage, the nature of the innovation is taken as a given, and work is focused on how to mitigate risks rather than appraise and alter the direction of innovation development (van Asselt & Vos 2006). Innovation Assessment bridges the gap by devoting attention to those innovations that are already on the market and to the work of regulatory agencies (as opposed to technology assessment agencies) and their stakeholders in negotiating public, political and expert opinions on how to relate to these innovations.

4. Theoretical frameworks

To probe the contours of Innovation Assessment, I return to a foundational problem within TA, namely the

Collingridge Dilemma. First put forward in 1980, it was originally described as a “dilemma of control” (Collingridge 1980, p.11): there is a double-bind problem facing those who wish to control or steer the direction of technological developments – an information problem (we do not know enough to act in the early stages of a technology) and a power problem (but we need to act now to have any chance of influencing the technology). The dilemma has been subjected to a range of criticism, mostly attacking the accuracy of the assumptions on which it rests and whether it can even be solved (Johnston 1984; Schmidt & Liebert 2010; Nordmann 2010). In contrast to these criticisms, I want to ask not whether the dilemma is true or false, or how to solve it, but to ask how policy actors make sense of the dilemma. That is, what political practices arise as a consequence of policy actors approaching their regulatory tasks according to the logic of the dilemma?

To answer the aims and questions of the article, I therefore turn to theories on sensemaking, framing and disruption (Goffman 1974; Weick 1995; Vollmer 2013). Sensemaking is the process of giving meaning to experience – it begins and becomes necessary when the encountered reality defies expectations (Weick et al. 2005, p.409). Disruptive innovations that raise regulatory concerns defy expectations for how markets function and therefore require sensemaking. Disruptions need to be explained or made comprehensible in order for cooperation and organization to resume (Vollmer 2013, pp.47–8). In other words, actors need to produce the answers to two questions: “What’s the story here?” and “Now, what should I do?” (Weick et al. 2005, p.410). In order to produce these answers, the disruptive events are bracketed out for closer inspection, then labelled and categorized. Labels and categories make the disruption comprehensible and actionable in terms drawn from actors’ preconceptions or institutional/organizational environments. These labels and categories are organized into narratives that explain the disruption and tell actors what to do.

In the course of the article I identify two central implications of seeing Collingridge dilemmas as opportunities for sensemaking: (1) Collingridge dilemmas are not given – they are constructed; (2) Collingridge dilemmas are not solved – they are negotiated. The first implication thus concerns which institutions matter (defining the setting); the second implication concerns how those institutions are then transformed or defended (dictating the action). The two takeaways are, with respect to the first implication, that the discursive construction of the dilemma decides which groups and institutions are affected and how, and with respect to the second implication, that the action is dictated by patterns of framing and counter-framing driven by coalitions organized around contending normative and cognitive claims. When Collingridge dilemmas are viewed as opportunities for sensemaking, we should therefore analyse not the specific content of the reasons that actors give for their actions, but the way that those reasons link together or mobilize key groups of actors around common ideals.

5. Empirical materials

The research draws on document analysis and interviews conducted in Brussels with key policy actors working on regulatory or lobbying activities within the areas of electronic cigarettes and hydraulic fracturing – two case studies on disruptive innovation that were recently regulated at the EU level.

6. Methodologies

The empirical materials will serve as background information to propose illustrative examples and counterfactual reasoning that demonstrate the logic and thrust of the argument, which is mostly conceptual in nature.

7. Expected outcomes

The cyclicity and co-evolution of innovation and policy (or regulation) is an uncontroversial theorization (Kuhlmann et al. 2010; Irwin & Vergragt 1989; Martin 2012). Yet, some have pointed out that criticisms of the linear model have gone too far and risked creating an equally confusing caricature where innovation is vague, diffuse and everywhere (Balconi et al. 2010). Innovation has a “crucial, but neglected normative property of direction” making it “a vector, rather than just a scalar quantity” (Stirling 2008, p.263). This impetus is a motor that drives the co-constructive cycle of innovation and policy. We can put this engine in reverse and see what happens without abandoning some of the core assumptions of the field. The advantage of doing that is that it lets us probe the innovation-policy relationship in a way that has not been explored yet by “opening the black box of policy” (Smith et al. 2010, p.446) and investigating how the state plays an active role in actually creating the market for innovations through its regulatory powers and not just fixing market failures (Mazzucato 2013). The policy relevance of this approach also bears mentioning. If we are indeed on the cusp of a Fourth Industrial Revolution spurred by advances in robotics and artificial intelligence (Schwab 2016), we can expect a wealth of disruptions and unforeseen knock-on effects that will require regulatory responses that lock in certain

development patterns. Any general insights concerning how regulators respond to disruptive innovations and how better to secure societal benefits thereby will become increasingly valuable. Most of these insights today build on economic cost benefit analyses and narrowly technical conceptions of risk which run the risk of being overly reductive and glossing over differences in values and assumptions (Stirling 2010). Research on Innovation Assessment, as envisioned here, is better suited to investigate the question of how societies respond to disruptive technological change.

Bibliography

- van Asselt, M. & Vos, E., 2006. The Precautionary Principle and the Uncertainty Paradox. *Journal of Risk Research*, 9(4), pp.313–336.
- Balconi, M., Brusoni, S. & Orsenigo, L., 2010. In defence of the linear model: An essay. *Research Policy*, 39(1), pp.1–13.
- Collingridge, D., 1980. *The Social Control of Technology*, New York, NY: St Martin.
- Ely, A., Van Zwanenberg, P. & Stirling, A., 2014. Broadening out and opening up technology assessment: Approaches to enhance international development, co-ordination and democratisation. *Research Policy*, 43(3), pp.505–518.
- Goffman, E., 1974. *Frame Analysis: An Essay on the Organization of Experience*, Cambridge: Harvard University Press.
- Irwin, A. & Vergragt, P., 1989. Re-thinking the relationship between environmental regulation and industrial innovation: The social negotiation of technical change. *Technology Analysis & Strategic Management*, 1(1), pp.57–70.
- Jasanoff, S., 1987. Contested Boundaries in Policy-Relevant Science. *Social Studies of Science*, 17, pp.195–230.
- Johnston, R., 1984. Controlling Technology: An Issue for the Social Studies of Science. *Social Studies of Science*, 14(1), pp.97–113.
- Kuhlmann, S., Shapira, P. & Smits, R., 2010. A Systemic Perspective: The Innovation Policy Dance. *The Theory and Practice of Innovation Policy: An International Research Handbook*, pp.1–22.
- Latour, B., 1998. From the World of Science to the World of Research. *Science*, 280(5361), pp.208–209.
- Lundvall, B.-Å., 2013. Innovation Studies: A Personal Interpretation of the “State of the Art.” In J. Fagerberg, B. R. Martin, & E. S. Andersen, eds. *Innovation Studies. Evolution and Future Challenges*. Oxford: Oxford University Press, pp. 21–70.
- Martin, B.R., 2012. The evolution of science policy and innovation studies. *Research Policy*, 41(7), pp.1219–1239. Available at: <http://dx.doi.org/10.1016/j.respol.2012.03.012>.
- Mazzucato, M., 2013. *The Entrepreneurial State: Debunking Public Vs. Private Sector Myths*, Anthem Press.
- Nordmann, A., 2010. A forensics of wishing: technology assessment in the age of technoscience. *Poiesis & Praxis*, 7(1-2), pp.5–15.
- Paraskevopoulou, E., 2012. Non-technological regulatory effects: Implications for innovation and innovation policy. *Research Policy*, 41(6), pp.1058–1071.
- Schmidt, J.C. & Liebert, W., 2010. Collingridge’s dilemma and technoscience. *Poiesis & Praxis*, 7(1-2), pp.55–71.
- Schwab, K., 2016. *The Fourth Industrial Revolution: what it means, how to respond*. World Economic Forum. Available at: <http://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond> [Accessed February 11, 2016].
- 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(4), pp.435–448.
- Stirling, A., 2010. Keep it complex. *Nature*, 468(7327), pp.1029–1031.
- Stirling, A., 2008. “Opening Up” and “Closing Down”: Power, Participation, and Pluralism in the Social Appraisal of Technology. *Science, Technology & Human Values*, 33(2), pp.262–294.
- Vollmer, H., 2013. *The Sociology of Disruption, Disaster and Social Change: Punctuated Cooperation*, Cambridge: Cambridge University Press.
- Weick, K.E., 1988. Enacted Sensemaking in Crisis Situations. *Journal of Management Studies*, 25(4), pp.305–317.
- Weick, K.E., 1995. *Sensemaking in Organizations*, Thousand Oaks, CA: SAGE Publications.
- Weick, K.E., Sutcliffe, K.M. & Obstfeld, D., 2005. Organizing and the Process of Sensemaking. *Organization Science*, 16(4), pp.409–421.
- Bleiklie I. and S. Michelsen (2013) Comparing HE policies in Europe: structures and reform output in eight countries; *Higher Education* 65 (2013), pp. 113 – 133
 - Bod R. (2013) *A new history of the humanities: The search for principles and patterns from antiquity to the present*, Oxford University Press
 - Brunsson N. and B. Jacobsson (2002) *A world of standard*, Oxford University Press
 - de Jong et al. (2011). Evaluation of Research in Context: an approach and two cases. *Research Evaluation*, 20 (1), 61-72
 - Ferlie E., C. Musselin, G. Andresani (2009) The governance of higher education systems: a public management perspective; in C. Paradeise, E. Reale, I. Bleiklie, E. Ferlie, *University Governance – Western European comparative perspectives*, Springer, pp. 1 – 19
 - Hughes, A. and B. Martin, (2012) ‘Council for Industry and Higher Education, UK Innovation Research Centre. Enhancing Impact. The Value of Public Sector R&D’, Summary report, (Pubd online) accessed 26 Oct 2012.
 - IMPACT-EV (2015). WP2 Final Report. IMPACT-EV
 - Nussbaum M. (2012) *Philosophical Interventions*, Oxford University Press
 - Painter M. and B. Peters (2010) *Tradition and Public Administration*, Palgrave Macmillan UK
 - Penfield T., M. J. Baker, R. Scoble and M. C. Wykes (2014) Assessment, evaluations, and definitions of research impact: A review; *Research Evaluation* 23 (2014) pp. 21–32
 - Peters B., (2008) "The Napoleonic tradition", *International Journal of Public Sector Management*, Vol. 21 Iss: 2, pp.118 - 132
 - Reale E., M. Nedeva M., D. Thomas and E. Primeri (2014) Evaluation through impact: a different viewpoint; *Fteval JOURNAL for Research and Technology Policy Evaluation* 39 (2014) pp. 36 – 41
 - Spaapen, J. & van Drooge, L. (2011). Introducing “productive interactions” in social impact assessment. *Research Evaluation*, 20 (3), 211-218
 - Whitley R. (2007) Changing governance of the Public Sciences: the consequences of establishing research h evaluation system for knowledge production in different countries and scientific fields; in R. Whitley and J. Glaser *The changing governance of the sciences*, Springer, pp. 3 – 27

6B. INNOVATION AND MEDICAL APPLICATION (II)

Diversity creation and selection mechanisms in health innovation: the role of public policies

Carlos Bianchi
(IECON –UDELAR)
carlos.bianchi77@gmail.com

KEYWORDS: Health innovation, Evolutionary mechanisms, Innovation system, Public policy, Uruguay

1- Objectives and theoretical framework

The aim of this paper is twofold. On the one hand, it aims to contribute to the stream of evolutionary economics and innovation systems (IS) through the study of the role of public policies in health innovation processes. On the other hand, it contributes to public policy analysis by studying the articulation of public policies and offering new evidence about how that can determine the innovation process.

One of the main research questions of the evolutionary approach refers to how systems create diversity through innovation while – at the same time- they provide selection mechanisms. This dynamic is the result of an evolutionary interactive process, which includes systemic self-organized mechanisms and deliberate actions of the agents, i.e. policy actions (Sotarauta and Srinivas, 2006).

The analysis of the diversity creation processes and the selection mechanisms has been focused on the role of markets (Metcalf, 1994.), organizations (Aldrich and Reuf, 2006) or the scientific system (Grebel, 2011). Even though neoschumpeterian and evolutionary authors have stressed the relevance of public policies in innovation process, policies have received little attention as diversity-creation and selection mechanisms (Balzat and Hanusch, 2007. Bryant, 2001).

From an innovation system perspective, public policies play a fundamental role promoting the emergence of new actors -firms, research organizations and public agencies- and new knowledge (Soete et al., 2010. Cimoli et al., 2009). Also, within the IS stream, public policies select or reject innovations through public demand (Edler and Yeow, 2016. Edquist et al., 2015). The role of public policy in the diversity creation and the selection process involves not only innovation policy but the set of policies that -explicitly or implicitly- affects innovation process in a specific domain. This set of policies, called as policy mix, is an analytical tool to understand the articulation of policies in a solving problem rationale. However, since articulation does not always work, it should not be taken as a description of the real policy design in a specific country and an activity sector (Flanagan et al., 2011. Borrás and Edquist, 2013). In this regard, a health innovation policy mix should consider, at least, three policy arenas: science, technology and innovation policy, health policy and industrial policy. Diversity creation process and selection mechanisms are specific to a domain - i.e. a technological regime and activity sector. Evolutionary economics has largely studied the health sector (Gelijns and Rosenberg, 1994. Mokyr, 1998. Mina et al. 2007. Consoli and Mina, 2009.) stressing the uneven evolution of innovation across technologies, healthcare areas and regions.

Each domain presents different development paths and different diversity features according to its technical, economic and institutional characteristics. Stirling (2007) breaks down diversity according to three dimensions: variety –the presence of different types of elements. i.e. agents or knowledge areas-; balance –the relative weight or frequency of each element present in the population- and; disparity –the degree of difference or horizontal distance between the elements (Stirling, 2007). Since diversity is a requisite to interactive innovation process, decomposing it in these dimensions helps to understand the innovation pathway in a specific domain. Moreover, recognizing the specific features of each domain calls for a discussion of novelty (Witt, 2009) as well as the satisfactoriness of innovations (Lundvall, 1985). Novelty is not a dichotomist attribute, but a gradual concept related to time and domain (Witt, 2009). Selection requires an evaluative criterion of validation to determine what is new and useful. Hence, someone may be able to define the degree of novelty –according to the technical basis and the domain’s characteristics- and the utility that the innovation implies (Mokyr, 1998). Non-radically novel innovations –i.e. incremental or frugal innovations- rather than radical innovations could result selected if they are more satisfactory in a specific domain.

2 - Methodology and data

Following the conceptual framework of Consoli and Mina (2009), this paper traces five health innovation pathways in Uruguay between 2006 and 2015. It is based on the analysis of the context where innovation

emerges as well as on the analysis of three events: i) the identification of a problem that innovation tries to solve; ii) the solution design, involving technical features, novelty and satisfactoriness for the specific domain, and iii) the end of the innovation pathway in terms of selection or rejection.

Longitudinal case study research methodology was used. Data were collected through extensive literature review, public document analysis and face to face interviews. In addition, national STI and health statistics were used to contextualise each case. Field work was conducted between 2007 and 2015.

Using snowballing techniques five cases were selected. They include: two innovations in medical devices - one of them for complex neurosurgery and other for jaundice treatment in newborn babies; one biopharmaceutical innovation for cancer treatment, and; two organizational innovations mainly focused on preventive medicine.

Uruguay is a middle-income small country, which has traditionally been characterized by high level of social welfare. However, in the long run perspective, Uruguay shows a deterioration of the socioeconomic indicators and the future development presents big challenges, related to the growth and dissemination of innovative capabilities. Three stylised facts characterize the Uruguayan IS: i. STI activities and infrastructure have been concentrated in the public sector; ii. there is lack of articulation linkages within the NSI, strongly related to the chronic weakness in productive knowledge demand (Arocena and Sutz, 2010); and iii. innovation in Uruguay faces barriers of scale. Even though the national budget for STI has grown dramatically over the last decade, the STI national budget is still negligible compared to the investment in developed countries, and it is significantly smaller than the STI investment of other Latin American countries (Aboal et al., 2014).

Based on this background, this paper states three hypothesis:

H1 Small domains might present a diversity of actors and knowledge more unbalanced than large ones.

H2 Health innovations are selected according to a particular combination of their degree of novelty and their satisfactoriness to solve specific problems.

H3 In small health innovation systems, public policy mix acts as the main selection mechanism.

According to the methodological design, internal validity was the primary consideration. Hence, the hypothesis and conclusions were delimited to the cases studied. However, preliminary theoretical generalizations are presented as well, providing useful insights to understand market functioning and the relevance of public policies to boost satisfactory innovations in small middle-income countries.

3 - Results

The comparative analysis of the cases studied allows identifying two patterns of health innovation: policy-pull selected innovations and market-rejected innovations. Moreover, it is possible to recognise non-market mechanisms that operate between consumer demand and health services supply (Grebel, 2011). The main mechanisms operating in the cases considered are university-firm collaboration and public policy interventions. They allowed the emergence of innovations pushed by academic research or pulled by the public health policies and programs. Hence, H1 can be confirmed: the diversity of actors in the Uruguayan health innovation domain is unbalanced, showing a higher presence of non-business actors than business actors.

As far as H2 is concerned, the existence of a particular combination of novelty and satisfactoriness working as an evaluative criterion of innovations has also been confirmed. The analysis of the cases of bioengineering devices development show that they were innovations because they were frugal –new and satisfactory for the specific domains–, not because they were globally new. In the same vein, the organisational innovations analysed were innovative because they solved a relevant problem in a creative and satisfactory way, but they were not radically new.

Among the cases studied, selected innovations were supported by articulated health and innovation public programs. The five innovation pathways analysed began in a context of intensive interactions among agents, which was a pre-requisite for the identification of the problem and the emergence of the innovation process. But only the cases that also featured a basic balance among the actors derived in selected innovations. Balance and low disparity let to developing novel and satisfactory solutions, which were adopted through the articulation of national health policy and innovation policy programs. However, in the cases in which innovations were rejected, market forces acted as the main selective mechanism. Therefore, since public policy mix is just one of the main selection mechanisms, H3 is only partially confirmed.

These results show the relevance of the study of policies as selective mechanisms. Even though their functioning is more complex than market mechanisms, the study of policy mechanisms at micro level can contribute to the evolutionary stream beyond the usual critics to the market failures approaches.

Regarding the research on innovation policies, this paper contributes to the current agenda focused on the

articulation between innovation policies and other public policies. Finally, Uruguay has implemented a reform of both national health system and the national STI policy during the last decade. Therefore, the analysis of the innovation pathways followed by the five innovation experiences studied could contribute to the revision of these processes.

References

- Aboal, D. Angelelli, P. Crespi, G. Lopez, A. Vairo, M. (2013). "Innovación en Uruguay". Inter-American Development Bank.. Montevideo.
- Aldrich, H. Ruef, M. (2006) *Organizations Evolving*. Sage, London
- Arocena, R. Sutz, J. (2010) "Weak knowledge demand in the South: learning divides and innovation policies". *Science and Public Policy*, 37(8), pp 571–582.
- Balzat, M. Hanusch, H. (2007) "Fundamentals of the concept of national innovation systems". In: Hanusch, H. Pyka, A. *Elgar companion to neo schumpeterian economics*. Elgar Publisher
- Borrás, S. Edquist, C. (2013) "The choice of innovation policy instruments". *Technological Forecasting & Social Change* 80 (2013) 1513–1522.
- Bryant, K. (2001) "Promoting innovation: an overview of the application of evolutionary economics and systems approaches to policy issues". In: Foster, J. Metcalfe, S. *Frontiers of Evolutionary Economics. Competition, Self-Organization and Innovation Policy*. Edward Elgar. Cheltenham, UK.
- Cimoli, M. Dosi, G. Nelson, R. Stiglitz, J. (2009) "Institutions and Policies in Developing Economies" In: Lundvall, B-A. Joseph, K.J. Chaminade, C. Vang, J. (ed.). *Handbook of Innovation Systems and Developing Countries*, Edward Elgar.
- Consoli, D. Mina, A. (2009) "An evolutionary perspective on health innovation systems". *Journal of Evolutionary Economics* 19: 297–319.
- Edler, J. Yeow, J. (2016) "Connecting demand and supply: The role of intermediation in public procurement of innovation" *Research Policy* 45 (2016) 414–426
- Edquist, C., Vonortas, N., Zabala-Iturriagoitia, J.M., (2015) "Introduction". In: Edquist, C., Vonortas, N., Zabala-Iturriagoitia, J.M., Edler, J. (Eds.). *Public Procurement for Innovation*. Edward Elgar.
- Flanagan, K. Uyarra, E. Laranja, M. (2011) "Reconceptualising the 'policy mix' for innovation" *Research Policy* 40 (2011) 702–713
- Gelijns, A. C. Rosenberg, N. (1994) "The dynamics of technological change in medicine". *Health Affairs* 13 (3):28–46.
- Grebel, T. (2011) *Innovation and Health: Theory, Methodology and Applications*. Edward Elgar Publishing: Cheltenham.
- Lundvall, B-A. (1985) "Product innovation and User Producer interaction". *Industrial Development Research Series* N° 31. Aalborg University Press, Aalborg.
- Metcalfe, J. (1994) "Evolutionary Economics and Technology Policy". *The Economic Journal*, Vol. 104, No. 425 (Jul., 1994), pp. 931-944
- Mina, A. Ramlogan, R. Tampubolon, G. Metcalfe, J. (2007) "Mapping evolutionary trajectories: Applications to the growth and transformation of medical knowledge" *Research Policy* 36 789–806.
- Mokyr, J. (1998) "Induced technical innovation and medical history: an evolutionary approach" *Journal of Evolutionary Economics*. 8: 119-137
- Soete, L. Verspagen, B. Ter Weel, B. (2010) "Systems of Innovation". In: Hall, B. Rosenberg, N. (Eds.) *Handbook of the Economics of Innovation*, Volume 2. North Holland.
- Sotarauta, M. Srinivas, S. (2006) "Co-evolutionary policy processes: Understanding innovative economies and future resilience". *Futures* 38 (3). 312–336
- Witt, U. (2009) "Propositions about novelty". *Journal of Economic Behavior & Organization* 70 311–320.

Constructing regulatory niches for medicines that address unmet needs

Jarno Hoekman* and Wouter Boon

(Innovation Studies Group, Copernicus Institute for Sustainable Development, Utrecht University)

*j.hoekman@uu.nl

KEYWORDS: Pharmaceutical innovation, Regulatory innovation instruments, Technology assessment, Institutional theory, Niche-regime interaction

In recent years the conventional regulatory regime for approval of medicines has come under increased pressure. Patient advocacy groups have called for addressing unmet medical needs by demanding expedited access to therapies that show promising effects in early phase testing (Epstein 1996); the pharmaceutical industry has pushed for lower market entry barriers in order to facilitate innovation and overcome a productivity crisis (Scannell et al. 2012); scientific advancements have fragmented patient populations making it increasingly difficult to conform to uniform requirements for large-scale testing (Boon and Moors 2008).

As a response to these innovation challenges in the pharmaceutical sector, drug regulatory agencies around the world have implemented regulatory instruments to facilitate early authorization of medicines that address unmet medical needs of patients. In this paper we consider these early access instruments as regulatory innovation instruments that form protective spaces (Smith and Raven 2012): areas in which medicines that address unmet medical needs of patients can be developed and assessed based on alternative evidentiary standards, with the goal of shielding these socially desirable innovations from existing selection pressures imposed by generic, conventional regulation. The aim of the paper is to examine the institutional work of different actors (e.g. regulators, pharmaceutical companies) in constructing such a regulatory niche for early access with particular emphasis on how alternative ways of valuating technical objects affect how innovative medicines become available to patients.

Starting from the sociology of valuation and evaluation (Lamont 2012), we argue that regulatory niche construction happens through the emergence and differentiation of ways in which technical objects are valued. Differentiation processes affect conventional orderings of what is considered valuable in a technical object, who holds legitimacy to contribute to the valuation process, and when it is legitimate to perform certain valuation activities. Alternative orderings of valuation are enacted in two phases: (1) a political phase in which the niche space is carved out and set apart from the current regime by legally endorsing alternative evaluation criteria, and (2) a regulatory phase in which the niche space is populated with technical objects that go through a valuation process using these alternative evaluation criteria (Jacobsson and Bergek 2004; Smith & Raven, 2012). The regulatory phase consists of two types of valuation activities: (1) production of value, i.e. generation of evidence on the performance of objects which is traditionally done by drug developers, and (2) assessment of value, i.e. procedures to judge value of technical objects traditionally done in regulatory expert committees (Vatin 2013).

How production and assessment of value become exactly ordered in a regulatory niche is mainly determined in the regulatory phase, given that endorsed legal evaluation criteria as the outcome of the political phase will always contain inherent ambiguities. Regulators and companies can interpret and act upon these ambiguities in different ways depending on their strategic interests (Mahoney and Thelen 2010). We hypothesize that regulators aim to consistently implement rules to reduce ambiguities, while companies will exploit ambiguities to obtain early approval for their products based on lower evidentiary standards. How companies exactly deal with ambiguities depends on their alignment with the regulatory regime, and differs between incumbents and newcomers. Importantly, the contrasting strategic interests of regulators and different types of companies (incumbent versus newcomers) are expected to result in struggles in the valuation process over ordering of what is being valued, who is valuing and when valuation activities are performed.

We examine the regulatory valuation process based on a longitudinal case-study of the implementation of the conditional marketing authorisation pathway in the European Union, which was enacted in 2006 to facilitate early access to medicines that address unmet medical need. Our data consisted of interviews with regulators and companies involved in the development and evaluation of medicines that were approved via this pathway, different types of documents (e.g. legal, media, reports of stakeholders), various indicators of the regulatory lifespan of all innovative pharmaceuticals that were assessed for authorization by European regulators since

2006, and quantitative data from previous studies conducted by the authors on this topic (Boon et al. 2010; Hoekman et al. 2015). The different methods allow us to reconstruct the valuation process pertaining to all individual medicines that were authorised via this process in the period 2006-2015, paying specific attention to strategies to deal with ambiguities in the use of evaluation criteria such as ‘unmet medical needs’ and ‘sufficient levels of evidence’ which are supposed to legitimize early market access.

Our results indicate that the political process of creating a regulatory niche resulted in legal evaluation criteria that were ambiguous in prescribing how the valuation process could be differentiated from the regime. Companies and regulators subsequently used these ambiguities in the regulatory process to try to institutionalize different orders of valuation. This observation is clearly visible from limited agreement between both parties on whether they considered medicines as being part of the niche. More specifically, in merely one-third of the applications both regulators and companies agreed on the assessment of value, leaving two-third of all cases in which there was disagreement about whether the product would fit in the niche.

Concerning different orders of valuation, while regulators tried to accommodate changes in their core activity of the assessment of value, only limited efforts by companies were observed to change their core activity of producing value. More specifically, regulators tried to institutionalize early assessment of ‘unmet medical need’ after which ‘sufficient levels of evidence’ could be produced by and in close interaction with the companies. In contrast, companies and specifically incumbent firms presented pharmaceuticals with lower levels of evidence to regulators after which ‘unmet medical need’ was actively produced by regulators to legitimize market access. Active involvement of regulators in the production of ‘unmet medical need’ – which is for them a non-core activity – coincided with a general trend of regulators to facilitate the emergence of personalized medicines.

The particular ordering of the valuation process resulted in a situation where the niche became a protective space for approval of medicines when data were not strong enough for authorization in the conventional regime rather than a space for the approval of medicines that address unmet medical needs. Our preliminary conclusions suggest that policy-makers should be aware of different ways in which actors may try to impose orders on how technical objects are valued. Although struggles around ordering may naturally follow from the enactment of new rules, adversarial ordering due to influence of particular actors has the potential to undermine the legitimacy of new innovation policy instruments. Conceptualizing the valuation processes, taking into account different perspectives of companies and regulators is a valuable lesson for innovation policy, especially when valuation of innovative products is performed against the backdrop of prevalent ambiguities.

References

- Boon, Wouter P.C., and Ellen H.M. Moors. 2008. “Exploring Emerging Technologies Using Metaphors – A Study of Orphan Drugs and Pharmacogenomics.” *Social Science & Medicine* 66 (9): 1915–27.
- Boon, Wouter P.C., Ellen H.M. Moors, Albert Meijer, and Huub Schellekens. 2010. “Conditional Approval and Approval Under Exceptional Circumstances as Regulatory Instruments for Stimulating Responsible Drug Innovation in Europe.” *Clinical Pharmacology & Therapeutics* 88 (6): 848–53. doi:10.1038/clpt.2010.207.
- Epstein, Steven. 1996. *Impure Science: AIDS, Activism, and the Politics of Knowledge*. University of California Press.
- Hoekman, Jarmo, Wouter P.C. Boon, Jacqueline C. Bouvy, Hans C. Ebbens, Jean Philippe de Jong, and Marie L. De Bruin. 2015. “Use of the Conditional Marketing Authorisation Pathway for Oncology Medicines in Europe.” *Clinical Pharmacology & Therapeutics* 98(5):534-41.
- Jacobsson, Staffan, and Anna Bergek. 2004. “Transforming the Energy Sector: The Evolution of Technological Systems in Renewable Energy Technology.” *Industrial and Corporate Change* 13 (5): 815–49.
- Lamont, Michèle. 2012. “Toward a Comparative Sociology of Valuation and Evaluation.” *Annual Review of Sociology* 38 (1): 201–21.
- Mahoney, James, and Kathleen Thelen. 2010. *Explaining Institutional Change: Ambiguity, Agency, and Power*. Cambridge: Cambridge University Press.
- Scannell, Jack W., Alex Blanckley, Helen Boldon, and Brian Warrington. 2012. “Diagnosing the Decline in Pharmaceutical R&D Efficiency.” *Nature Reviews Drug Discovery* 11 (3): 191–200.
- Smith, Adrian, and Rob Raven. 2012. “What Is Protective Space? Reconsidering Niches in Transitions to Sustainability.” *Research Policy* 41 (6): 1025–36.
- Vatin, F. 2013. “Valuation as Evaluating and Valorizing.” *Valuation Studies* 1 (1): 31–50.

A lesson in Lost Innovation: Australia's quest for the bionic eye

Leigh Dayton
(Macquarie University)
leigh.dayton@students.mq.edu.au

Relevance – 1

My proposal fits neatly into the sub-theme “The practice of innovation and research policies across different countries and regions”. It is particularly apt as Australia's innovation system is a good bad example of how not to enhance national innovation. Australia's system is ad hoc and crippled by shortsightedness, political partisanship, and a lack of coherent structure and policy. The country fails to learn from international models adopted by comparable developed nations. The National Innovation Systems (NIS) model provided an intellectual tool for conducting a “diagnostic analysis” of the system.

Research aim(s) and questions(s) -- 2

Australia is a developed nation, a wealthy nation, a nation with a solid intellectual system. Its higher education system was ranked 10 out of 50 national systems, according to the U21 Ranking of National Higher Education Systems report, prepared in 2015 by the University of Melbourne. According to the most recent SJR citation rankings, 2014, Australia came 11th of 229 nations.

Yet of 141 countries on the Global Innovation Index Rankings for 2015, Australia came 17th, far less than the education and citation rankings would suggest. And according to the U21 report, the country scored merely 21 of 50 nations on knowledge transfer and 30 for joint publications with business. The OECD gave Australia an even lower mark on collaboration: only 3.3 per cent of large Australian businesses collaborate with research organisations, placing the country 27th of 34 OECD nations. Worse, in 2011, just 1.5 per cent of Australian firms developed new to the world innovations in 2011, compared to 10-40 per cent in other OECD countries. Why? Why is Australian fundamental research widely respected, while the country's ability to turn applied research into commercial products and processes lagging so far behind? Why is Australia's innovation policy comparatively so ineffective? What can be done to improve the situation?

These are questions that long-plagued me in my role as an Australian science writer and broadcaster. My decision to return to graduate school provided me with an opportunity to answer those questions, and to offer recommendations for enhancing innovation to politicians, policymakers and research organisations.

The case study I used to examine these questions followed a 2008 announcement by Australia's then newly elected Prime Minister Kevin Rudd that by 2020 Australia would design and build a bionic eye. A bionic eye is a visual prosthesis designed to improve the sight of people with visual impairments, from partial to complete blindness.

The project that eventuated from Rudd's announcement was the Australian Research Council Special Initiative in Bionic Vision Science and Technology, what I call the bionic eye initiative. Nearly A\$60 million was awarded to two multi-disciplinary consortia for five years, but to date no commercial-ready prototype has been developed. It is a classic case of lost innovation.

Definitions – 3

What is innovation? As noted in a discussion of the conference sub-themes, innovation policy is becoming established as an independent policy area. Unfortunately, as a recent literature review shows, use of the term ‘innovation’ is as fragmented as it is voluminous.

It “spans disciplines and levels of analysis”, write Greg Sears and Vishwanath Baba . The scatter-gun term is used primarily in studies of a range of industries, such as agriculture, aviation, communications technology, engineering and medical devices. Charles Edquist describes this breakdown of the term innovation into numerous sub-categories as “sectoral innovation”. Innovation is also frequently used as a synonym for an ‘invention’, a new device or procedure.

In contrast to both these uses, I define innovation as the act of creating something new. It is a dynamic, iterative process involving multiple people and organisations, one which exploits new ideas.

I will use this definition in my presentation's case study -- Australia's quest for the bionic eye.

Theoretical framework – 4

Innovation case studies mean little in isolation. They must be put into a broader context. To provide useful data, case studies must be analysed within an intellectual framework offering tools for assessing their structure, dynamics and linkages to the wider innovation system.

There are many models of innovation, for instance, the evolutionary economic model, the chain-linked model and the multistage-multilevel model. I have chosen the national innovation systems (NIS) model as my

theoretical framework. It enabled me to link data obtained from qualitative interviews with participants in the bionic eye initiative with data obtained from policy documents and other open-source literature.

The NIS model allowed me to view the effectiveness and operation of Australia's innovation system as just that, a system. Instead of studying the bionic eye initiative in isolation, the NIS model provided an analytical framework for teasing out the dynamics and assessing the effectiveness of the project within its political, economic and socio-cultural context. The NIS served as a diagnostic tool for both the bionic eye initiative and the national policy within which the project operated.

The NIS model has proven invaluable in analyzing Australia's innovation system and identifying ways to enhance innovation as Australia moves into the age of complex, multi-disciplinary, multi-national science.

Description of methodologies – 6

As noted above, a goal of the work I wish to present is to identify the strengths and weaknesses of the Australian innovation system, from the structural to the interpersonal. My objective is to provide recommendations for boosting the nation's lagging innovation output.

While quantitative techniques provide critical facts – the number of patents or papers produced by an organisation, Australia's ranking on the Global Innovation Index, and so forth – they do not provide data on the interpersonal drivers and dynamics of the country's innovation system. To do so, it is necessary to view innovation from the perspective of people engaged in innovation. Qualitative methods were ideal for investigating participants' experiences of the complicated, highly human endeavor of innovation.

After gaining ethical approval for my work, I used qualitative methods --- including purposive and snowball sampling, semi-structured interviewing and thematic analysis -- in my analysis of 29 participant interviews and follow-up communications. I combined the results with those gained by reviewing texts and archival documents, keeping the NIS framework in mind. This mixed methodology showed how the framework of Australia's innovation system impacted on the interpersonal dynamics of the bionic eye initiative, and vice-versa.

Expected outcomes – 7

Results of my research suggest that there are strong structural and interpersonal barriers to innovation in Australia. A few key points follow.

The most fundamental barrier stems from the ad hoc nature of the country's innovation system. In a nutshell, when federal governments change, so too do science and innovation policies. The result is a system in which political whim and short-term thinking set national priorities, funding decisions and the activities of universities and government funded research agencies. Programs for promoting research-industry collaborations chop-and-change. They are especially poorly suited to the requirements of large multidisciplinary national projects such as the bionic eye initiative.

Critically, while the federal government funds most of the nation's research, funding for science and innovation is low, compared to that of other OECD nations. Industry is notoriously risk averse. Potential products regularly fall into the 'valley of death' with little or no funding to get them ready for commercialization.

Interpersonal barriers to successful innovation derive from the cultures operating within the broader system. For instance, Australia's Academic Culture is driven by the need for funding. Universities and government agencies fight for funding to stay afloat. Researchers fight for project funding, between and even within disciplines and institutions. Collaboration is often geared to gaining funds, not achieving shared goals. Within the culture, publication and grant 'track records' are central to career progression. Researchers who work with or within industry risk falling off their academic career path.

Conversely, Australia's Industry Culture values patents and profits, not publications. There is a reluctance to collaborate with government funded agencies and universities on research and development. There is even less interest in funding pre-commercial research. Few firms, large or small, conduct in-house research & development.

As noted above, the Political Culture sets the tone for Australian science and innovation. The three-year political cycle mitigates against long-term planning, stable infrastructure and bipartisan support for innovation. There is limited understanding about science and innovation among politicians. Along with their advisers, politicians are time-poor, often making decisions based on who has their ear, rather than the evidence. Science is seen as of little interest to the general public, and is, therefore, subject to funding cuts and ideological interference. I'd like to present my findings and confer with conference delegates about recommendations for reducing barriers to Australian innovation.

1. Australian Government, Chief Scientist, Science, Technology, Engineering & Mathematics: Australia's Future, September 2014, pg 10.

2. Sears and Baba, Toward a Multistage Multilevel Theory of Innovation, 2001, pg 357.

3. Edquist, The Systems of Innovation Approach and Innovation Policy: An account of the state of the art, 2001, pg 2.

6C. TRACK THEME 9: FOSTERING INNOVATION AND INDUSTRIAL DEVELOPMENT IN GLOBALIZED INNOVATION SYSTEMS: POLICY CHALLENGES IN A MULTIPOLAR WORLD ECONOMY (III)

The role of the home market in international technological innovation systems

Håkon Endresen Normann* and Jens Hanson
(University of Oslo)

*h.e.normann@tik.uio.no

KEYWORDS: Technological innovation system, Internationalisation, Offshore wind, Home markets

1 Relevance

Many countries actively promote the development of new renewable energy technologies linked to the on-going energy transition. The development of these technologies can be seen to take place globally, with some countries taking the lead. Germany and China for instance play important roles in photovoltaic deployment and manufacturing. However, most countries do not have leadership positions but attempt to develop such industries. This paper asks how such countries can couple on to the globally developing technological field of renewable energy.

2 Research aim and questions

The objective of this paper is to contribute to the recent literature on the internationalization of technological innovation systems by asking the following question: How can industries in non-leader countries with lack of a home market link up with international technological innovation systems?

3 Definitions

This paper connects with recent contributions to the field of sustainable transitions and spatial dimensions of technological innovation systems (TIS). TISs are embedded and often interact with broader contexts both in technological and geographical dimensions (Bergek et al. 2015). Empirical applications have however been criticized for lacking spatial recognition, often resulting in the a priori system delineation on the national level (Truffer & Coenen 2012). There is therefore a seemingly contradiction between the international dimensions of TIS and importance of geographical, cultural, and political proximity between actors within TIS, as pointed out by (Carlsson & Stankiewicz 1991). As a solution to this dilemma, Binz et al. (2014) suggest studying separate sub-systems (that may be national or regional) with linkages through an international TIS, rather than focusing on one global TIS or a single national TIS. A key reason for this is that while differing countries and regions may harbour different conditions for innovation activities, these activities may still be interconnected across geographies. Based on recent investigations of the spatial dimensions of TISs (Binz et al. 2014; Quitzow 2015; Vasseur et al. 2013) Markard et al. (2015, p. 4) thus recommend analyses of how TIS structures and functions in different countries build upon and complement each other. We see market formation and the role of the home market as a particularly interesting area for such investigation.

4 Theoretical frameworks

To explore this we apply the technological innovation system (TIS) approach, which has become a popular framework for studying the development of renewable energy technologies (Markard et al. 2012). This popularity has also been accompanied by critique contending that the framework has had a too narrowly defined national focus (Wieczorek et al. 2015, p. 4) and an underdeveloped understanding of geography (Binz et al. 2012; Truffer & Coenen 2012).

As a response to this critique recent developments of the framework have moved towards integrating spatial dimension in TIS analysis. It has for instance been demonstrated that individual countries do not necessarily need to develop entire supply chains domestically given the international dimension of TISs (Binz et al. 2014; Binz et al. 2012). However, coupling onto emerging TISs is arguably not straightforward as access to resources within the system, such as access to markets, is likely to be affected by geographical location (Coenen et al. 2012).

Home markets are an important dimension to industry formation given the importance of local interaction and linkages among producers and suppliers (Fagerberg 1992; Freeman 1987). Even if markets may be global, the home market can be important to test products, to learn, and to obtain early revenues (Bergek et al. 2008, p. 416). This gives reason to believe that the potential for non-leader countries to link up to international technological innovation systems may be hampered by a lack of a home market.

We investigate two factors that might influence the level of access to international markets in the absence of a home market. First, firm size is considered to be particularly important as larger firms have the resources to overcome sunk export costs and trade barriers (Castellacci & Fevolden 2014). Larger firms benefit from greater R&D resources and ability to scale (Utterback & Suarez 1993). Moreover, size can allow access to resources denied to smaller firms that provide leeway to tolerate setbacks due to unsuccessful innovations (Dass 2000). Consequently, Hockerts and Wüstenhagen (2010) argue that large firms might play a crucial role in the development of a range of new renewable energy technologies. Second, the negative impact from a lack of a home market may be reduced through the presence of an internationally successful related industry (Porter 1998, pp. 101-105). The formation of new industries is embedded in related activities that have been present in a region (Hansen & Coenen 2015). By sharing activities in technology development, manufacturing, or marketing, firms gain access to opportunities normally provided by a home market.

5 Empirical materials

To answer our research question, we analyse the case of offshore wind in Norway. Bergek et al. (2014) point specifically to the internationalization of the offshore wind industry as particularly relevant to study as international TISs. In this industry important transnational linkages between nationally delineated TISs have been identified. The international market for offshore wind power has experienced significant growth in recent years and is expected to continue to grow in the coming years (Smith et al. 2015, p. 25). This growth has led a number of Norwegian firms (many of which with related activities in petro-maritime industries) to explore international markets given weak domestic market formation (Steen & Hansen 2014). We thus see the offshore wind industry in Norway as a suitable case to study opportunities and barriers for linking up with an international TIS.

6 Description of the methodologies

For this study, we have employed a mixed-method approach that follows multiple steps. First, we conducted initial scoping interviews with individuals knowledgeable about the Norwegian offshore wind industry. Interviews were semi-structured and individually tailored to the interviewee in order to exploit the specific knowledge of each of the interviewees. Second, based on initial assumptions about the role of the home market, firm size and related industries, we constructed a survey. In total, 102 Norwegian firms engaged in the offshore wind industry were surveyed and this forms the data for our quantitative analysis. Following the quantitative analysis, we conducted additional semi-structured interviews with a variety of firms, including firms of different sizes and both pure offshore wind firms and firms that have diversified from the petro-maritime industries. In total we draw upon 19 interviews in the qualitative part of the analysis.

7 Expected outcomes

First, we find that weak local market formation negatively affects the possibility for local industry to link up with international markets. Most notably, we see that testing and qualifying technology is an important process in a complex and capital-intensive industry such as offshore wind. Second, both survey and interview data confirm that larger firms are less affected by weak local market formation. We explain this mainly because larger firms have better access to important resources (financial, market access, research). Third, we find that the offshore wind and offshore oil & gas and maritime industries in Norway are closely intertwined. The presence of a successful related industry has been a critical enabler of the emergence of a Norwegian supply industry for offshore wind. Thus, we find that these related industries can offset the effects of lack of domestic market for offshore wind by providing opportunities to test and demonstrate technology and by providing access to customers.

Recent studies of international dimensions of TISs have been interested in how certain system functions may not be required in all sub-systems as weak functionality for a technology in one country or region may be offset by strengths in other subsystems. While the evidence in this paper suggests that it is indeed possible to circumvent

challenges of weak domestic market formation by exploiting neighbouring markets, it must be underlined that this is not straightforward and without obstacles.

In terms of policy, we suggest two ways in which our results may contribute. First, policy should consider needs of firms that do not benefit from close relations to the oil & gas and maritime industries. Second, policy should aim to stimulate larger firms to act as intermediaries, which can help suppliers with access to financial and research resources and international markets. Third, policies should nuance and differentiate between larger and smaller firms in order to secure both entrepreneurial experimentation and the active presence of larger firms.

References

- Bergek, A., Hekkert, M., Jacobsson, S., Markard, J., Sandén, B., & Truffer, B. (2015). Technological innovation systems in contexts: Conceptualizing contextual structures and interaction dynamics. *Environmental Innovation and Societal Transitions*, 16, 51-64
- Bergek, A., Hekkert, M., Jacobsson, S., Markard, J., & Truffer, B. (2014). TIS interactions with technological, sectorial, political and geographical contexts: some lessons for analysts. Radar Paper 2014
- Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. *Research Policy*, 37(3), 407-429
- Binz, C., Truffer, B., & Coenen, L. (2014). Why space matters in technological innovation systems - Mapping global knowledge dynamics of membrane bioreactor technology. *Research Policy*, 43(1), 138-155
- Binz, C., Truffer, B., Li, L., Shi, Y., & Lu, Y. (2012). Conceptualizing leapfrogging with spatially coupled innovation systems: The case of onsite wastewater treatment in China. *Technological Forecasting and Social Change*, 79(1), 155-171
- Carlsson, B., & Stankiewicz, R. (1991). On the nature, function and composition of technological systems. *Journal of Evolutionary Economics*, 1(2), 93-118
- Castellacci, F., & Fevolden, A. (2014). Capable Companies or Changing Markets? Explaining the Export Performance of Firms in the Defence Industry. *Defence and Peace Economics*, 25(6), 549-575
- Coenen, L., Benneworth, P., & Truffer, B. (2012). Toward a spatial perspective on sustainability transitions. *Research Policy*, 41(6), 968-979
- Dass, P. (2000). Relationship of Firm Size, Initial Diversification, and Internationalization with Strategic Change. *Journal of Business Research*, 48(2), 135-146
- Fagerberg, J. (1992). The Home Market Hypothesis Re-examined: The Impact of Domestic User-Producer Interaction on Export Specialisation. In B.-Å. Lundvall (Ed.), *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning* (pp. 226-241). London: Pinter.
- Freeman, C. (1987). *Technology, policy, and economic performance : lessons from Japan*. London ; New York: Pinter Publishers.
- Hansen, T., & Coenen, L. (2015). The geography of sustainability transitions: Review, synthesis and reflections on an emergent research field. *Environmental Innovation and Societal Transitions*, 17, 92-109
- Hockerts, K., & Wüstenhagen, R. (2010). Greening Goliaths versus emerging Davids — Theorizing about the role of incumbents and new entrants in sustainable entrepreneurship. *Journal of Business Venturing*, 25(5), 481-492
- Markard, J., Hekkert, M., & Jacobsson, S. (2015). The technological innovation systems framework: Response to six criticisms. *Environmental Innovation and Societal Transitions*, 16, 76-86
- Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy*, 41(6), 955-967
- Porter, M. E. (1998). *The competitive advantage of nations: with a new introduction*. Basingstoke: Macmillan Business.
- Quitow, R. (2015). Dynamics of a policy-driven market: The co-evolution of technological innovation systems for solar photovoltaics in China and Germany. *Environmental Innovation and Societal Transitions*, 17, 126-148
- Smith, A., Stehly, T., & Musial, W. (2015). 2014-2015 Offshore Wind Technologies Market Report. U. S. D. o. E. National Renewable Energy Laboratory.
- Steen, M., & Hansen, G. H. (2014). Same Sea, Different Ponds: Cross-Sectorial Knowledge Spillovers in the North Sea. *European Planning Studies*, 22(10), 2030-2049
- Truffer, B., & Coenen, L. (2012). Environmental Innovation and Sustainability Transitions in Regional Studies. *Regional Studies*, 46(1), 1-21
- Utterback, J. M., & Suarez, F. F. (1993). Innovation, competition, and industry structure. *Research Policy*, 22(1), 1-21
- Vasseur, V., Kamp, L. M., & Negro, S. O. (2013). A comparative analysis of Photovoltaic Technological Innovation Systems including international dimensions: the cases of Japan and The Netherlands. *Journal of Cleaner Production*, 48(0), 200-210
- Wieczorek, A. J., Hekkert, M. P., Coenen, L., & Harmsen, R. (2015). Broadening the national focus in technological innovation system analysis: The case of offshore wind. *Environmental Innovation and Societal Transitions*, 14(0), 128-148

Policy proposal for clean energy technology transfer: Classification of technologies and identification of transfer channels

Masachika Suzuki
(Graduate School of Global Environmental Studies Sophia University)
suzuki@genv.sophia.ac.jp

KEYWORDS: Climate change, Clean energy, Technology transfer, Innovation, Foreign direct investment

Transfer of clean energy technologies has been a central agenda in climate change negotiation. The Paris Agreement signed in December 2015 promotes the use of market mechanisms to encourage the transfer of clean energy technologies on the cross-boundary scale. In the academic community, there have been intensive and extensive research initiatives that attempt to identify various barriers (institutional, technological, and financial) in transferring clean energy technologies to developing countries. Some research suggests the design of policies and/or institutions to overcome such barriers. It is not clearly understood, however, which policies and institutions are effective in removing the barriers depending upon the types of technologies.

The objectives of this study are threefold. The first objective is to classify renewable and energy efficiency improvement technologies that have been transferred (or not transferred) on the cross-boundary scale. The technologies investigated for this study are extracted from several existing database on clean energy technologies including 1) Clean Development Mechanism (CDM)'s registry, 2) the project list on Climate Technology Center & Network (CTCN), 3) United Nations Industrial Development Organization (UNIDO)'s environmental technology database, and 4) lists of technology under specific country's initiatives such as Joint Crediting Mechanism (JCM) as well as L2-Tech in Japan.

As for CDM, the results of several research projects indicate that there is limited number of the projects leading to technology transfer. Over the last 10 years, there have been several empirical studies that attempt to analyze the trends of technology transfer among CDM projects based on the CDM's registry database (De Coninck, 2007; Haites et al., 2008; Holzer and Hoffmann, 2008; Seres, 2008; Seres et al., 2009). Some of the research identifies the projects that may or (may not) lead to transfer of a technology and/or transfer of knowledge. This study intends to update the analysis of the trends of technology transfer under CDM, together with the above-mentioned schemes that are newly established in the last 5 years.

While the number of transfer may be limited, a preliminary investigation suggests that there are a great variety of technologies among the database that have been or planned to be implemented or transferred to developing countries. The types of technologies

include 1) medium-scaled renewable energy technologies such as wind, photovoltaic, and biomass/biogas, 2) energy efficiency improvement technologies being introduced at large scale industrial facilities such as electricity generation, oil refinery, steel, cement and pulp and paper mills, 3) small-scale clean technologies such as micro-grid, mini-hydro, and energy efficient cook stove that may bring about social or "co-benefits" to the community through the implementation of the project. Under the CDM, for example, there are many renewable energy and energy efficiency improvement technologies implemented in developing countries. On the other hand, the technologies that are assisted for transfer under UNIDO tend to be small-scale technologies in remote areas. In addition to these technologies, large-scale technologies such as clean coal and solar thermal technologies are equally important to look into since they may reduce greenhouse gases on the large scale, even though some of the technologies are still at the innovation stage and being implemented on the demonstration scale only.

The second objective of this study is to identify the transfer channels of those technologies. Research in the area of business and technology management indicate that the transfer of technologies can take place through several different channels including 1) bilateral and multilateral grant-based assistance, 2) trade, 3) foreign direct investment, 4) licensing agreement, and 5) reverse engineering. As indicated above, the transfer of clean energy technologies through the trade channel (import and export) may be observed on CDM registry database or global trade database such as UN Comtrade Database or CDM registry database. It is not clear, however, at this stage how/whether it is possible to find data on technology transfer through foreign direct investment and licensing agreement. While the case study approach or expert interviews may be a way forward for the analysis, more literature review is necessary to explore different possibilities of research methods.

If this research is successful in classifying clean energy technologies and identifying transfer channels for key technologies, the next stage of this research is to address barriers in technology transfer on the technology-specific and/or transfer mode-specific basis. This is the third objective of this research. There is an ample volume

of prior research that has identified barriers in technology transfer (Painuly, 2001; Reddy and Painuly 2004; Ockwell et al., 2007; Ockwell et al., 2009). Further research is much needed, however, to understand the barriers for the diffusion of clean energy technologies in developing countries.

References:

- De Coninck H.C., Hake, F., van der Linden N. 2007. Technology transfer in the Clean Development Mechanism. ECN-E--07-009.
- Haites, E., Maosheng, A., Seres, S. 2006. Technology transfer by CDM projects. *Climate Policy*, Volume 6, Issue 3, 2006, 327–344.
- Holzer, M. and Hoffmann, V. 2008. Understanding the CDM's contribution to technology transfer. *Energy Policy*, Volume 36, Issue 8, 2930–2938.
- Ockwell, D., Watson J., MacKerron G., Pal P., and Yamin, F. 2007. UK–India Collaboration to Identify Barriers to the Transfer of Low Carbon Energy Technology: Final Report.
- Ockwell, D., Watson J., MacKerron G., Pal P., and Yamin, F. 2009. UK-India Collaborative Study on the Transfer of Low Carbon Technology: Phase II Final Report.
- Painuly, J., 2001. Barriers to renewable energy penetration; a framework for analysis. *Renewable Energy*. 24(1): 73–89. doi:10.1016/S0960-1481(00)00186-5
- Reddy, S., Painuly, J. 2004. Diffusion of renewable energy technologies-barriers and stakeholders' perspectives. *Renewable Energy*, 29: 1431-1447. doi:10.1016/j.renene.2003.12.003
- Seres, S. 2008. Analysis of Technology Transfer in CDM Projects. Prepared for the UNFCCC Registration & Issuance Unit CDM/SDM, Bonn.
- Seres, S., Haites, E., and Murphy, K. 2009. Analysis of technology transfer in CDM projects: An update. *Energy Policy*, 37: 4919–4926.

Tailoring innovation policies to technology-specific learning patterns: An analysis of the locus of learning and knowledge feedbacks in three clean energy technology innovation systems

Abhishek Malhotra*(ETH Zurich), Tobias Schmidt(ETH Zurich) and Joern Huenteler(World Bank)
*abmalhot@ethz.ch

KEYWORDS: Industry value chains, Locus of learning, Knowledge feedbacks, Wind, Solar PV, Lithium ion batteries

1. Relevance

Policies aiming to address societal challenges for which technology is a relevant factor, often intend to influence the speed and direction of technological change (Freeman, 1996; Mowery et al., 2010). In neoclassical economics, the key principle for policy intervention is to internalize the externality that underlies the societal challenge. Hence, the key distinction between technologies in a neoclassical sense is based on whether and to what extent technologies contribute to the problem or help address it. For example, in the debates around climate change, many economists distinguish technologies on the basis of their carbon emissions and their costs. This often results in a distinction between “clean” and “dirty” technologies and the argument that clean technologies (which are often more expensive than existent dirty technologies) should be supported by putting a price on the carbon emissions and providing incentives for R&D (to address positive externalities involved in R&D) (Jaffe et al., 2005).

However, from an evolutionary innovation perspective, when designing policies to address societal challenges (e.g., climate change) through technological change, distinguishing between technologies solely on the basis on their environmental impact is too simplistic (Mowery et al., 2010; Azar and Sandén, 2011). Evolutionary approaches to innovation policy provide a more nuanced view by opening the “black box” of innovation (Rosenberg, 1982). On one hand, many studies have analyzed the role of socio-institutional and political factors in making the innovation process context-specific (e.g., Lundvall, 1992; Bergek et al., 2008). On the other hand, technological learning can differ strongly between technologies (Malerba and Orsenigo, 1996), depending on the stage of the technology’s life cycle and the inherent characteristics of the technology (Clark, 1985). As a result, in globalized technological innovation systems covering industrialized and emerging economies, technology-specific interventions for fostering technological innovation, technology transfer and industry localization may be required (Schmidt and Huenteler, 2016), depending on the locus of learning and knowledge feedbacks in the industry value chain. However, there is a relative lack of attention to how the locus of learning and knowledge feedbacks in globalized innovation systems for different technologies might differ, and in turn, might influence (and be influenced by) the geographic extent of industry value chains.

2. Research aim

This study intends to address the question of how the locus of learning and knowledge feedbacks within global industry value chains differ across technologies.

3. Definitions

For the purpose of this study, we take the technological system as defined by Murmann and Frenken (2006) as the unit of analysis. Specifically, we compare the industry value chains of solar photovoltaic systems, wind turbines, and lithium-ion batteries. We adapt Porter's (1985) definition in defining an industry value chain as a collection of activities spanning across different firms that are performed to develop, produce, market, deliver and support a technology. The activities in the industry value chain which exhibit a relatively high occurrence of innovations constitute the locus of learning. Finally, knowledge feedbacks are conceptualized as interactive knowledge flows between actors in the “chain-linked model” technology innovation system, as described by Gallagher et al. (2012).

4. Theoretical framework

In the literature on technology life cycles, Abernathy and Utterback (1978) show that for certain technologies, the locus of innovative activity shifts from product to process innovation over the technology life cycle, driven by learning by doing. Davies (1997), on the other hand, shows that the life cycle of complex technologies is predominantly characterized by product innovation, and emphasizes the importance of learning by using.

Huenteler et al. (2015) combine both perspectives in a framework that differentiates technologies on the basis of their design complexity and scale of production and whether their life cycle is primarily characterized by product innovation or process innovation. Based on this framework and an underlying patent citation analysis they draw implications on how to design technology policies that consider the differences in the learning patterns. However, one drawback of using patents as an indicator for the locus of innovation is that it excludes tacit knowledge and does not give an indication of the “stickiness” of knowledge (which cannot be codified in the form of patents or manuals) (Polanyi, 1967; von Hippel, 1994; Howells, 1995), and hence the extent of interaction and feedbacks involved in the learning and innovation processes within the industry value chain. This study uses these concepts from the literature on technology life cycles, and complements the use of patent data with qualitative methods, as described in sections 5 and 6.

5. and 6. Empirical materials and methodologies

To address the research question, we focus on three different technologies (solar photovoltaics, wind turbines, and lithium-ion batteries) because of three reasons. First, understanding the innovation process for these technologies is highly relevant for policy makers aiming at accelerating innovation to mitigate climate change. Second, all three technologies’ industry value chain are relatively complex, covering several sectors, allowing for the possibility of an iterative process of problem solving at the different loci of problem solving. Third, the technologies have varying levels of complexity in their architecture (Huenteler et al., 2015; Battke et al., 2016).

We proceed to address the research question in two steps. First, we carry out semi-structured interviews (~60) with actors at different steps in the industry value chain in order to identify which activities in the value chain exhibit a relatively high level of innovation, where learning through interactions and feedback takes place, and what kind of knowledge (process or product) is involved. Second, we analyze the content of the most important patents over the life cycle of the technologies in order to triangulate with the results of the interview data analysis, and to verify the suitability of using patent data in identifying the locus of learning. The patent data is obtained from the Derwent Innovation Index. The most important patents for the three technologies are obtained by identifying the patents with the highest number of forward citations, plus a fractional weight multiplied by the number of citations received by those citing patents (or, in other words, the patents with the highest number of subsequent knowledge flows, as demonstrated by Trajtenberg et al., 1997). The patent data is used to identify (i) the inventor’s position in the industry value chain, (ii) the type of innovation (process or product), and (iii) the year.

7. Expected outcomes

We find that the pattern of innovation and learning feedbacks in technological innovation systems varies substantially across the three analyzed technologies. Learning in the wind industry is driven by a higher degree of interaction and knowledge feedbacks between the original equipment manufacturers and power producers during the use phase. The solar PV industry shows a higher degree of interaction between the original equipment manufacturers, production equipment suppliers and material suppliers during manufacturing. The lithium-ion battery industry shows a high degree of interaction between the mentioned actors during both the manufacturing and use of the technology. We observe some differences between the locus of innovation as indicated by the patent data, and that observed from the interview data, with a more detailed account of learning and feedbacks involving tacit knowledge during manufacturing and use phases obtained from the interviews. These results have implications for policy makers, since they highlight the need for technology-specific policy measures in order to foster innovation in different technologies.

References

- Abernathy, W.; Utterback, J. Patterns of Industrial Innovation. *Technol. Rev.* 1978.
- Azar, C.; Sandén, B. A. The Elusive Quest for Technology-Neutral Policies. *Environ. Innov. Soc. Transitions* 2011, 1 (1), 135–139.
- Battke, B.; Schmidt, T. S.; Stollenwerk, S.; Hoffmann, V. H. Internal or External spillovers—Which Kind of Knowledge Is More Likely to Flow within or across Technologies. *Res. Policy* 2016, 45 (1), 27–41.
- Bergek, A.; Jacobsson, S.; Carlsson, B.; Lindmark, S.; Rickne, A. Analyzing the Functional Dynamics of Technological Innovation Systems: A Scheme of Analysis. *Res. Policy* 2008, 37 (3), 407–429.
- Clark, K. B. The Interaction of Design Hierarchies and Market Concepts in Technological Evolution. *Res. Policy* 1985, 14 (5), 235–251.
- Davies, A. The Life Cycle of a Complex Product System. *Int. J. Innov. Manag.* 1997, 01 (03), 229–256.
- Freeman, C. The Greening of Technology and Models of Innovation. *Technol. Forecast. Soc. Change* 1996, 53 (1), 27–39.
- Gallagher, K. S.; Grübler, A.; Kuhl, L.; Nemet, G.; Wilson, C. The Energy Technology Innovation System. *Annu. Rev. Environ. Resour.* 2012, 37 (1), 137–162.
- von Hippel, E. “Sticky Information” and the Locus of Problem Solving: Implications for Innovation. *Manage. Sci.* 1994, 40 (4), 429–439.
- Howells, J. Tacit Knowledge, Innovation and Technology Transfer. *Technol. Anal. Strateg. Manag.* 1995, 8 (2), 91–106.
- Huenteler, J.; Schmidt, T. S.; Ossenbrink, J.; Hoffmann, V. H. Technology Life-Cycles in the Energy Sector — Technological Characteristics and the Role of Deployment for Innovation. *Technol. Forecast. Soc. Change* 2015.

Jaffe, A. B.; Newell, R. G.; Stavins, R. N. A Tale of Two Market Failures: Technology and Environmental Policy. *Ecol. Econ.* 2005, 54 (2-3), 164–174.

Lundvall, B. *National Systems of Innovation: An Analytical Framework*. London: Pinter 1992.

Malerba, F.; Orsenigo, L. Schumpeterian Patterns of Innovation Are Technology-Specific. *Res. Policy* 1996, 25 (3), 451–478.

Mowery, D. C.; Nelson, R. R.; Martin, B. R. Technology Policy and Global Warming: Why New Policy Models Are Needed (or Why Putting New Wine in Old Bottles Won't Work). *Res. Policy* 2010, 39 (8), 1011–1023.

Murmann, J. P.; Frenken, K. Toward a Systematic Framework for Research on Dominant Designs, Technological Innovations, and Industrial Change. *Res. Policy* 2006, 35 (7), 925–952.

Polanyi, M. *The Tacit Dimension*. 1967.

Porter, M. *Competitive Advantage: Creating and Sustaining Superior Performance*, 1985. 1985.

Rosenberg, N. *Inside the Black Box: Technology and Economics*; Cambridge University Press, 1982.

Schmidt, T. S.; Huenteler, J. Anticipating Industry Localization Effects of Clean Technology Deployment Policies in Developing Countries. *Glob. Environ. Chang.* 2016, 38, 8–20.

Trajtenberg, M.; Henderson, R.; Jaffe, A. University Versus Corporate Patents: A Window On The Basicness Of Invention. *Econ. Innov. New Technol.* 1997, 5 (1), 19–50.

The Transatlantic Trade and Investment Partnership – A risk for the dynamic efficiency at both sides of the Atlantic?

Carsten Schwäbe and **Carsten Dreher***

(Freie Universität Berlin)

*Carsten.Dreher@fu-berlin.de

KEYWORDS: Transatlantic Trade and Investment Partnership, Innovation policy, Dynamic efficiency, Entrepreneurial State

1.) Relevance

The Transatlantic Trade and Investment Partnership (TTIP) offers the opportunity for creating the world's biggest free trade area. Therefore, it is supposed to enhance growth and employment at both sides of the Atlantic. Referring to the negotiation mandate of the EU member countries for the European Commission, TTIP shall create "a true transatlantic market" with a "higher regulatory compatibility" in order to smooth the way for worldwide regulatory standards which could not been established by the multilateral negotiations within the World Trade Organisation (EU COM, 2014).

According to the arguments of absolute and comparative cost advantages the proponents of TTIP highlight the large impact of free trade on economic growth and employment due to barrier-free cross-border economic activities allowing an optimal allocation of resources. However, the estimated economic benefits for Europe analysed so far seem to be not significant: Two studies ordered by the EU Commission and the German Federal Ministry of Economic Affairs and Energy use "Dynamic Stochastic General Equilibrium" (DSGE) models for an estimation of the macroeconomic effects of TTIP. Both conclude that even if TTIP leads to positive outcomes for growth and employment, these effects are estimated to be very low and even lower than the statistical errors of growth predictions (Francois et al. 2013; Felber-mayr et al.; 2013, Stephan, 2015).

These studies are based on the neoclassical understanding of static efficiency and do not consider the consequences of TTIP on the innovation capacity of the economies in Europe and the USA. However, already Robert Solow, pioneer of the neoclassical growth theory, pointed out that economic growth is mainly caused by technical progress – in his study even for 87,5 percent. Therefore, the proposed article aims at an enlargement of the analytical perspective on TTIP and its effects on technical progress and economic growth. The article contributes to this discussion by focusing on the consequences for the participating economies to enhance their innovative capacities by referring to the insights of the Neo-Schumpeterian evolutionary innovation economics.

2.) Research aims and questions

By using the literature on innovation policy instruments, regulatory instruments in particular, and on innovation policy mixes (cf. e.g. Borrás and Edquist, 2013; Flanagan, 2011) this article attempts to give insights into the consequences of TTIP on the capability of economies to innovate induced by regulatory and financial instruments. As technical progress represents the main source of economic growth, the research aim of this article concerns the potential consequences of TTIP on economic growth as well.

3.) Theoretical frameworks

The literature of Neo-Schumpeterian evolutionary innovation economics delivers the theoretical foundation of the proposed article. The author refers to the basic assumptions and approaches such as the evolutionary approach on economic growth (Nelson and Winter, 1982, 2002), dynamics of innovation processes (Dosi, 1982; Sartorius and Zundel, 2005; Meyer-Krahmer and Dreher, 2004), the innovation system approach (Freeman, 1987; Lundvall, 1982; Hekkert et al., 2007) and the conclusions of these approaches for innovation policy. Furthermore, the article considers the current discussion on innovation policy making guided by a "new mission orientation" (Foray et al., 2012; Dreher et al., 2014). As the "new mission orientation" is based on much more flexible, adjustable and complex innovation policy making, the article needs to conclude the basic requirements for innovation policy making. In a second step, it is analysed if or if not policy makers will be still able to fulfil these requirements within the legal framework of TTIP.

4.) Empirical Material

The proposed article refers to the official documents of the European Commission on the current status of the negotiations between the USA and the EU on TTIP. As the involved politicians still suppose that the agreement is supposed to be finished and implemented until early 2017, the article cannot refer to the original documents of

secondary literature analysing the final agreement. Therefore, the article uses several sources or official documents in order to identify the main characteristics of TTIP and their impact on the innovative capacity of the economies in Europe and the USA.

5.) Description of the methodologies

In a first step, the article concludes the requirements for innovation policy making according to the different approaches of the evolutionary innovation economics. The article refers to both, the literature on general innovation policy making and on mission and technology-specific in-novation policy strategies.

The second part of the article identifies those aspects of TTIP that concern these requirements for innovation policy making. Innovation policy making is mainly installed at the level of the nation states (and to some extent at the level of the EU). The authors identify the following four aspects of TTIP as relevant for the innovation policy debate:

- Regulatory co-operation and harmonisation of regulatory standards
- Compliance of common regulatory standards
- TTIP as an immutable and permanent international treaty
- Investor-State Dispute Settlement (ISDS)

In the concluding discussion, the article uses the insights of the evolutionary innovation economics into innovation policy making in order to evaluate in how far TTIP enhances or harms “The Entrepreneurial State” (Mazzucato, 2013), in particular the capacity to implement and adjust innovation policies.

6.) Expected outcomes

Referring to the insights of the Neo-Schumpeterian evolutionary innovation economics, the article concludes that according to the currently published documents the legal properties of TTIP may harm the ability of the participating states to adjust their regulatory standards – one main instrument for a dynamic and technology-specific innovation policy. TTIP as an international treaty tries to implement transatlantic market rules, but does not install a supranational regulatory institution that is able to control or to adapt the common standards. This missing flexibility for the new supranational standards can be a major reason for difficulties in the reform of standards aiming at a “creative disturbance” of market processes by the state in order to stimulate innovative activities and induce additional growth

References

- Borrás, S. and C. Edquist (2013): The choice of innovation policy instruments, in: *Technological Forecasting & Social Change* 80, 1513-1522.
- Dreher, C.; M. Kovac and C. Schwäbe (2014): Competing technological innovation systems as a new challenge for mission-oriented science, technology & innovation governance, Paper presented at Eu-SPRI Conference, 18-20 June 2014, Manchester.
- Dosi, G. (1982): Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change, in: *Research Policy* 11, 147-162.
- European Commission (2014): Directives for the negotiation on the Transatlantic Trade and Investment Partnership between the European Union and the United States of America, 9 October 2014, accessible by <http://data.consilium.europa.eu/doc/document/ST-11103-2013-DCL-1/en/pdf>.
- Felbermayr, G.; M. Larch Mario; L. Flach; E. Yalcin and S. Benz (2013): Dimensionen und Auswirkungen eines Freihandelsabkommens zwischen der EU und den USA. Study ordered by the Federal Ministry of Economics and Energy, ifo-Institut für Wirtschaftsforschung, München.
- Flanagan, K.; E. Uyarra and M. Laranja (2011): Reconceptualising the ‘policy mix’ for innovation, *Research Policy* 40, 702-713.
- Foray, D.; D. Mowery and R. Nelson (2012): Public R&D and social challenges: What lessons from mission R&D programs?, in: *Research Policy* 41, 1697-1702.
- Francois, J.; M. Manchin; H. Norberg; O. Pindyuk and P. Tomberger (2013): Reducing Trans-atlantic Barriers to Trade and Investment. An Economic Assessment, Centre for Economic Policy Research (CEPR), London.
- Freeman, C. (1987): *Technology, policy, and economic performance: lessons from Japan*, London: Pinter Publishers.
- Hekkert, M. P.; R. Suurs; D. Negro; D. Kuhlmann and R. Smits (2007): Functions of innovation systems: A new approach for analysing technological change, in: *Technological Forecasting and Social Change* 74, 413-432.
- Lundvall, B.Å. (1992): *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, London: Pinter Publishers.
- Mazzucato, M. (2013): *The Entrepreneurial State. Debunking Public vs. Private Sector Myths*, London: Anthem Press.
- Nelson, R. and S. Winter (1982): *An Evolutionary Theory of Economic Change*, London: Cambridge University Press.
- Nelson, R. and S. Winter (2002): Evolutionary Theorizing in Economics, in: *The Journal of Economic Perspectives* 16, 23-46.
- Sartorius, C. and S. Zundel (Eds., 2005): *Time Strategies, Innovation and Environmental Policy*, Cheltenham, Northampton: Edward Elgar Publishing.
- Stephan, S. (2014): TTIP – Das Märchen vom Wachstums- und Beschäftigungsmotor, WISO direkt Oktober 2014, Friedrich-Ebert-Stiftung, Abteilung Wirtschafts- und Sozialpolitik, Bonn.

6D. TRACK THEME 6: (RE)SEARCHING THE CRITICAL 'MESO' LEVEL: LEARNING INNOVATION AGENCIES AND ENTREPRENEURIAL ECOSYSTEMS

Towards next generation RDI programs – policy-makers insights from the past and reflections for the future

Christopher Palmberg*(Tekes) and Sylvia Schwaag Serger(Vinnova)
*christopher.palmberg@tekes.fi

KEYWORDS: RDI programs, Ecosystems, Transitions, Impact assessment, Policy rationale

The innovation systems approach has been very successful in inspiring public policies and funding agencies around the world to design research, development and innovation (RDI) promoting programs that span various actors in the system. The innovation system approach was originally mainly developed in the Nordic countries, based on earlier analysis of the Japanese post-war model of industrialization. Thereafter the model spread globally through work at the OECD and other think tanks.

Key features of this innovation system model include the idea that knowledge transfer should be supported in a more systematic way and that the state can play an important role in this by, among other things, facilitating public-private-partnerships (PPP). The role of science-technology-industry collaboration has been at the core of many subsequent PPP-oriented models such as the center of excellence program in Finland (specifically the SHOK program), Sweden and other European countries. However, while these basic insights of an innovation system approach still holds globalization, digitalization and the changing nature of innovation bring new challenges for RDI programming. In addition the increasing urgency and complexity of societal challenges is also calling for new approaches.

This paper will take a policy-makers perspective from the viewpoint of two advanced innovation promoting agencies (Tekes in Finland and VINNOVA in Sweden). It will discuss how the policy-making landscape for RDI program design and implementation is changing due to increasing societal challenges, globalization, digitalization and multifaceted nature of innovation, and analyze which the implications are/may be for next generation RDI programming. Specifically, the paper addresses the following research questions:

1. Which developments in the global policy-making landscape are the most challenging for RDI programming at the national level?
2. How are traditional innovation system-based RDI program designs and implementations challenges by developments in the global landscape?
3. How should RDI programs be designed and implemented in the future for better alignment with global landscape developments?

The paper will draw on years of joint practical experience and empirical findings from existing studies and impact analysis of RDI programs especially in Sweden and Finland, but also in some other European countries. It will complement the innovation system perspective with new insights from the literature on innovation ecosystems and global value chains as well as transition management as a possible way forward for policy-making in a complex global world where societal challenges are increasingly wicked and urgent.

The main points to be advanced further in the paper relate to governance issues, incentive structures and their design, as well as challenges of impact assessment practices for next generation RDI programming. Regarding governance, it appears that next generation RDI programs have to be designed to better facilitate emergence and self-organization from the bottom-up as innovations originate from an increasingly broader spectrum of activities and actors throughout the system. This is in contrast with an innovation system approach that has tended to superimpose structures and top-down planning on bottom-up activities in practical policy-making. However, if next generation RDI programs are more allowing in terms of bottom-up self-organization an important issue is how a public RDI funder nonetheless can ensure sufficient control and steering, as well as which types of the incentive structures should be created. Finally, RDI programming that cover a broader range of actors and aim to stimulate a broader range of PPPs, beyond technology-industry collaboration, also need to rethink how impacts

are measured e.g. beyond bibliometrics and other traditional RDI indicators.

The paper concludes with some ideas for further research, one of which relates to how the rational for public intervention in R&D and innovation processes should be justified for next generation RDI programming.

The policy relevance of measuring diversity of Entrepreneurial Ecosystems

Manuel Laranja(ISEG - Lisbon School of Economics and Management), **John Friar***(Amore-McKim School of Business Northeastern University) and Alistair Cole(Sciences PO Lyon University of Lyon)

*j.friar@neu.edu

KEYWORDS: Entrepreneurship, Innovation, Ecosystems, Social Networks, Policy

1. Relevance

New business creation appears to be passing by what the Economist calls A Cambrian Moment (Economist, 2014). New entrepreneurial communities, also designated as “Entrepreneurial Ecosystems”, are increasingly occupying an important role in social and economic development. (Economist, 2014; Florida, 2014; Compass, 2015). Unlike the typical Valleys, Corridors, Routes or Science Parks of the late 20th century, these new startup ecosystem communities emerge in smaller areas, often inner-city zones, or in some cases in sub-urban rehabilitated areas and buildings for coworking. These areas have specific characteristics such as, being physically compact, transit-accessible, internet-wired and offer a mixed use of office, retail and leisure at relative short distances from major research universities and housing facilities (Katz and Wagner, 2014). According to Compass (2015) cities like New York, Boston, Tel Aviv, London, Berlin, Singapore, Bangalore, Vancouver, Amsterdam and others, are amongst the 20 most attractive to start a business.

Apparently, this new surge of entrepreneurial activities involves many different types of startups: from information and web-technologies, to bioscience, robotics, digital health, medical devices, culture and creative industries, commerce, nanotech applications, etc. Also, it involves both the so called “the vital 6%” (NESTA, 2009) high impact entrepreneurship that leads to more innovation and create a disproportionate share of employment and “low impact” entrepreneurship, often called displacement entrepreneurship or unproductive entrepreneurship (Stam, 2014).

2. Objectives and argument

Despite the recognized important of these entrepreneurial ecosystems for regional and urban development, research is still scarce. We need a better understanding of components of an entrepreneurial ecosystem, and of the differences between types of ecosystems.

Existing approaches such as BEEP (2010), Compass (2015), amongst others, focus only high-growth, high-impact startups, overlooking other forms of rather slower resilient entrepreneurship. We argued that in any region or city there is a variety of different entrepreneurial ecosystems. Also the unit of analysis in current approaches and frameworks is the national or regional level, therefore does not capture grass-root differences between types of start-ups and corresponding types of communities. Moreover, the most common metrics available appear to rely on indexes and rankings and therefore, in our view, potentially misleading as evidence-base for policy making in innovation and entrepreneurship.

The objective of this paper is to explore the existing literature and propose methodological guidelines to map, measure and evaluate entrepreneurial ecosystems in a given territory.

While the literature will enable to identify the multitude or components that strongly influence entrepreneurial activities in specific ecosystems, mapping and evaluation as input for policy makers, would be done using different methodologies at the local level. Namely, the use of asset mapping, local surveys to actors of the ecosystems on how they perceive and use local assets/resources, and possibly the use of Social Network Analysis (Scott, 2000). The use of Social Network Analysis centered on entrepreneurs and other key actors, follows from the need to understand their important role in building the community and in promoting processes of entrepreneurial capability building through “recycling” (Mason and Harrison, 2006) i.e. retaining older

experienced entrepreneurs in the ecosystem.

3. Defining “Entrepreneurial Ecosystems”

Entrepreneurial Ecosystems have no common widely accepted definition (Feld, 2012; Isenberg, 2011a 2011b; Mason and Brown, 2013; Katz and Wagner, 2014, amongst others). Usually, the concept appears to refer both to the context (the environment) and the actors, but placing great emphasis on entrepreneurs as key players. It stresses entrepreneurial discovery as a process of ideas experimentation and validation enacted by a complex network of interactions between entrepreneurs and a diverse set of local resources deployed by individuals and organizations including amongst others, physical infrastructure (e.g. wifi), business services involving lawyers, accountants, specialized IP services, banks, government agencies, universities, etc. Because this interplay appears to require face-to-face contacts and therefore entrepreneurial ecosystems tend to form in relatively compact areas.

Overall and despite the difficulties, according to the OECD definition put forward by Mason and Brown’s (2014, p.6) an entrepreneurial ecosystem should be defined as:

“a set of interconnected entrepreneurial actors (both potential and existing), entrepreneurial organizations (e.g. firms, venture capitalists, business angels, banks), institutions (universities, public sector agencies, financial bodies) and entrepreneurial processes (e.g. the business birth rate, numbers of high growth firms, levels of ‘blockbuster entrepreneurship’, number of serial entrepreneurs, degree of sell-out mentality within firms and levels of entrepreneurial ambition) which formally and informally coalesce to connect, mediate and govern the performance within the local entrepreneurial environment.”

In our view, however, we see entrepreneurship activities as multi-sector and including different types of start-ups. Although we tend to agree that high growth firms need a distinctive set of resources and networks, and special favorable environments, we think the concept and corresponding methodologies are useful to other types of start-ups.

4. Brief identification of some existing models

The literature on entrepreneurial ecosystems is fueled by a number of frameworks such as BEEP(2010), WEF(2013), WEF(2015), Acts, Laszlo and Autio, (2015), OECD (2008), Compass(2015), Koltai 6+6, Endeavor, etc. that essentially focus on characterizing entrepreneurial activity at national or regional levels and its impact on innovation and/or competitiveness.

Some of these are purely conceptual models such as the BEEP framework developed by Daniel Isenberg at the Babson College (BEEP, 2010). There are also frameworks proposed by consultancy companies such as Endeavor or Koltai Six plus Six.

Frameworks based on existing international surveys e.g. OECD (2008), StartupGenome/Compass, WEF, GEDI propose to use “pillars”, “factors” or “components” to decompose ecosystems. For example Compass (2015), proposes an index to rank regions and cities (entrepreneurial cities) along 5 major factors: Performance, Funding, Talent, Market Reach, and Startup Experience. Information used to build each factor is gathered from standardized statistical indicators, complemented by interviews to entrepreneurs and a survey to startups.

In general these frameworks appear to be useful to compare countries (regions) with regards to shopping-list differences captured at a broad level e.g. the presence of a university, an adequate physical infrastructure or the presence of major large firms, human capital, access to finance, etc. However, they fail to acknowledge interdependencies between factors/domains and how these may vary in time and across countries. As pointed out by the Kaufman Foundation (Strangler and Bell-Masterson, 2015) these frameworks overlook process indicators associated with the internal dynamics of entrepreneurial ecosystems at a lower level. They also overlook the need to understand social networking aspects and differences arising from different types of start-ups and their supporting communities at the grass-root level.

5. Methodology and expected outcomes

We need a more specialized view of Entrepreneurial Ecosystems, one that highlights that different kinds of start-ups stand for differences in the relationship between individual initiatives, enterprises and the social-institutional

context in which they evolve. For example the needs of fast growing scalable high-tech start-ups and the interactive relations they establish with the available resources and respective community ecosystem are likely to be much different from the needs and interactive relations that lifestyle start-ups or creative and cultural start-ups establish with their respective ecosystems. Nevertheless, they share the same territory and use common resources.

Based on existing literature we are proposing to develop a new methodological approach to map and measure the development of entrepreneurial ecosystems. First we will propose a framework that decomposes entrepreneurial ecosystems in different factor-components.

Next we will explore different methodologies that not only map local assets and networks (using for example Asset Mapping developed by the CoC, 2007) but also assess how entrepreneurs and other key actors value the use/intensity of these assets and networks (relative to their ecosystem). Also we will explore whether Social Network Analysis - SNA is useful in mapping social relations behind the processes of building entrepreneurial capabilities.

The next stage involves setting up an international project to pilot test the methods developed and disseminate preliminary results.

6. References

- Acts, Zoltan, J., Laszlo Szerb, Erko Autio, (2015). Global Entrepreneurship Index, Report 2015, <http://thegei.org/> (accessed in 22/09/2015)
- BEEP, (2010). Babson College Entrepreneurship Ecosystem Project <http://entrepreneurial-revolution.com/>
- Council of Competitiveness (2007). Asset Mapping Road Map <http://www.compete.org/publications/detail/33/asset-mapping-roadmap-a-guide-to-assessing-regional-development-resources/> (accessed 21/9/2014)
- Compass, (2015). The Global Start-up Ecosystems Ranking 2015.
- The Startup Ecosystem Report Series Compass (formerly Startup Genome) <http://startup-ecosystem.compass.co/ser2015/> (accessed 12/11/2015)
- The Economist (2014). A Cambrian Moment. Special Report Tech Startups, January 18th 2014
- Feld, B (2012). Startup Communities: building an entrepreneurial ecosystem in your city, Hoboken: NJ, Wiley.
- Florida, R. (2014). Start-up City: the Urban Shift in Venture Capital and High Technology. Martin Prosperity Institute. Available at http://martinprosperity.org/media/Startup%20City_14-03-14.pdf (accessed 09/12/2014)
- Isenberg, D (2011a). The entrepreneurship ecosystem strategy as a new paradigm for economy policy: principles for cultivating entrepreneurship, Babson Entrepreneurship Ecosystem Project, Babson College, Babson Park: MA
- Isenberg, D (2011b). When big companies fall, entrepreneurship rises, Harvard Business Review <http://blogs.hbr.org/2013/03/when-big-companies-fall-entrep/>
- Katz and Wagner (2014). The Rise of Innovation Districts: A new Geography of Innovation in America. Brookings, The Metropolitan Policy Program at Brookings.
- Lerner, J. 2009. Boulevard of Broken Dreams: Why Public Efforts to Boost Entrepreneurship and Venture Capital Have Failed and What to Do About It. Princeton University Press, Princeton: NJ.
- Mason, C., and Brown, R. 2013. Entrepreneurial ecosystems and growth oriented entrepreneurship. Background paper prepared for the workshop organized by the OECD LEED Program and the Dutch Ministry of Economic Affairs on Entrepreneurial Ecosystems and Growth Oriented Entrepreneurship The Hague, Netherlands.
- Mason, C. and Harrison, R. (2006). After the exit: Acquisitions, entrepreneurial recycling, Regional Studies, 40, 55 – 73
- NESTA (2009). The Vital Six per cent: How High-Growth innovative businesses generate prosperity and jobs. NESTA – National Endowment for Science Technology and the Arts. www.nesta.org.uk (accessed 20/10/2015)
- OECD (2008). Measuring Entrepreneurship: A Digest of Indicators, OECD-Eurostat Entrepreneurship Indicators Program, Organisation for Economic Co-operation and Development (OECD), Paris. <http://www.oecd.org/industry/business-stats/>
- WEF (2013). Entrepreneurial Ecosystems Around the Globe and Company Growth Dynamics. Report Summary for the Annual Meeting of the New Champions 2013. Stanford University, Ernst & Young, Endeavor: World Economic Forum, Davos, <http://www.weforum.org/>
- WEF (2015). Leveraging Entrepreneurial Ambition and Innovation: Global Perspective on Entrepreneurship, Competitiveness and Development, WEF and GEM
- Senor, D. and Singer, S. (2011). Start-Up Nation: The Story of Israel's Economic Miracle, Twelve.
- Scott, (2000). Social Network Analysis. A Handbook. Sage
- Stam, Erik. (2014). The Dutch Entrepreneurial Ecosystem. Available at SSRN: <http://ssrn.com/abstract=2473475> or <http://dx.doi.org/10.2139/ssrn.2473475>
- Stangler, Dane and Bell-Masterson, Jordan, (2015). Measuring an Entrepreneurial Ecosystem. Kauffman Foundation Research Series on City, Metro, and Regional Entrepreneurship, <http://www.kauffman.org/what-we-do/research/2015/03/measuring-an-entrepreneurial-ecosystem> (accessed 12/04/2015)

Matching public and private funds to foster innovation: the case of EMBRAPII in Brazil

Sergio Salles-Filho(University of Campinas), Adriana Bin(University of Campinas), **Nicholas Vonortas***(The George Washington University), Rafaela Marcelly Andrade(University of Campinas) and Fernando Antonio Basile Colugnati(Federal University of Juiz de Fora)

*vonortas@gwu.edu

KEYWORDS: Innovation, Policy, Collaboration, Research organizations, Companies

One of the main issues regarding the practice of innovation and research policies in developing countries is the mismatch between scientific production and the introduction of new products, services and processes. This means that developing countries have been more successful in their research policies than in their innovation policies. That reinforces the structural problem of promoting linkages between science and industrial actors. Brazil falls into this category. On the one hand, the country has increased its position in terms of scientific production – quantity of publications and citations – in indexed databases such as Scopus and Web of Science. On the other hand, aggregate data from Brazil shows that the efforts and results from innovation processes are still far below the OECD median. Even with a significant number of firms declaring some kind of technological innovation, few of them are new to the country or to the world, R&D expenditure is limited as it is the number of researchers with master or PhD degree working in the productive sector.

Brazil has implemented some important initiatives in innovation policies, mainly related to the construction of its institutional framework and instruments designed to foster innovation through fiscal incentives, direct support to R&D and innovation in firms, collaboration between research organizations and universities and firms, and more recently, publicly supported venture capital and loan guarantees (Salles-Filho et al., 2012; Kannemblem Jr. and Porto, 2012; Suzigan et al. 2009; Hochstetler and Montero, 2013). However, as pointed out by Pacheco and Corder (2010) such initiatives are characterized by lack of prioritization, insufficient resources, discontinuity and the already mentioned mismatch between research and innovation.

In an attempt to add a new approach in the established Brazilian innovation policy mix, a new instrument was launched in 2013. The initiative, inspired by other national models (for instance, the German Fraunhofer, the French Carnot Institute, and the Korean Kaist, among others), was implemented through the creation of the Brazilian Industrial Research and Innovation Association (EMBRAPII), linked both to Ministry of Science, Technology and Innovation and to the Ministry of Education.

EMBRAPII's mission is to foster innovation in Brazilian industry through pre-competitive R&D projects in collaboration between companies and industrial research organizations, lowering innovation risks, following the common rationale for intervention in this kind of policy (as discussed by Cunningham and Gök, 2012).

This manuscript has two complementary research aims. The first one is to present the results of an in-deep evaluation carried out by the authors in 2015 and 2016 of the EMBRAPII's Pilot Phase; the second one is to discuss the EMBRAPII's model – and the results of the evaluation - against similar experiences related in the literature. Two questions are to be answered: a) How this model has performed and which lessons can be drawn from it in comparison to regular instruments of promoting R&D and innovation in companies? b) What this case can add to the set of similar experiences that has recently been implemented in different countries? In this way, the manuscript brings scientific contributions in research and innovation policy and research and innovation evaluation domains, as well as inputs to policy-makers engaged in this kind of initiative.

From 2013 to 2015 EMBRAPII coordinated a pilot phase, regarding 63 R&D and innovation projects executed by three Brazilian research organizations (ROs) - Institute for Technological Research (IPT), National Institute of Technology (INT) and National Service of Industry's Integrated Campus for Manufacturing and Technology (SENAI-CIMATEC), in collaboration with 44 firms. Some of these projects are still running, with deadlines foreseen to mid-2016.

The pilot phase represented a total investment of circa US\$ 50 million, being one third supported by EMBRAPII, one third by the ROs and one third by the companies. After the pilot phase EMBRAPII initiated its steady-state phase, with 13 ROs and a budget of circa US\$ 350 millions to be invested until 2018.

EMBRAPII can be considered a new policy instrument in Brazil in at least three main characteristics: a) companies are involved since the initial phases, presenting their demands, specifying their focus and approaches and negotiating with ROs the conditions to be contracted; b) once a RO is accredited as an EMBRAPII Unit it has immediate access to funds in order to contract R&D projects directly with companies; c) contracted projects are executed by ROs and monitored by companies, and a project only concludes when it receives a "letter of acceptance" from the company directly involved. There are other relevant traits that make this model different

from the regular instruments employed in Brazilian STI policies, but these three give a general idea of some that are expected to make a difference.

The evaluation of the EMBRAPII's Pilot Phase was oriented to identify and measure two main themes: the outputs and outcomes of the R&D and innovation projects (technological results and its appropriation) and the behavioral changes of involved actors (following good practices of R&D and innovation planning and management). It was based on guidelines of evaluation methodologies suitable for research and innovation policies and programs explored in Edler et al. (2012) and Link and Vonortas (2013).

Data collection was done through four different instruments: i) semi-structured interviews with ROs managers; (ii) web survey applied to project coordinators from ROs (62 responses from 63 projects – or 98% of response rate); (iii) web survey with counterparts of projects in firms (44 responses from 63 projects – or 70% of response rate); and (iv) semi-structured interviews conducted by five experts with project coordinators and counterparts of projects in firms of a selected sample of 25 projects.

Data from surveys were analyzed using descriptive and multivariate statistics. In addition they were compared to each other and with experts views in order to identify if and to which extent perceptions from the different actors (RO's project coordinators, companies and experts) do converge.

Concerning project outputs, evaluation results show that expected technological results such as new products, processes and methodologies, were achieved in the majority of projects – although ROs were more optimistic about this issue than companies. These results were predominantly perceived as new to the country and in not-few-cases as new to the world. They were considered satisfactory by firms, taking part of their broad strategic plans. Intellectual property rights were generated in more than 50% of the projects, but there are still some opportunities not yet explored in this matter. Moreover, projects contributed to the creation of new research areas or the consolidation of existing ones both in ROs and firms.

Experts confirmed that projects were pre-competitive in their design and execution, as foreseen in the EMBRAPII's model. Some firms were already able to use project's results in their internal processes or to commercialize these results, meaning that companies reported innovations. Impacts from these innovations are expected primarily in terms of added value and quality improvement, but also in revenues and market share. One important finding refers to the less importance of impacts in creating new business models and expanding product and service exports.

EMBRAPII influence was measured employing the “redundant causality identifier” – RCI, proposed by Salles-Filho et al. (2010; 2011). Results revealed that the EMBRAPII's model had an important weight in promoting both behavioral and output additionality. That suggests the EMBRAPII's model has accomplished most of its initial intends.

Beyond projects' output and outcomes ROs improved their research and innovation management processes, such as the ones related to prospecting opportunities and partners, negotiating and contracting projects, managing projects and raising financial resources. A Multiple Correspondence Analysis followed by a Cluster analysis showed marked differences among ROs bringing evidences that organizational traits may have influenced the differences. Particularly, the legal and managerial models seemed to have much to do with this. Some behavioral changes were found also at firms, although the influence of EMBRAPII's model has been perceived as less evident.

There are differences in perceptions of ROs, firms and experts concerning project's outputs and outcomes and behavioral changes. They occurred mainly about how projects were motivated, allocation of human and material resources from firms in project development and, as pointed out before, about the achievement of expected technological results.

The preliminary conclusion about EMBRAPII model, based on evidences of evaluation of its pilot phase, is that the model is pretty effective in promoting linkages between ROs and firms towards R&D and innovation. Although evaluation show more success in the achievement of technological results than in innovation itself, this seems to be a matter of timing, since firms showed satisfaction with almost all projects executed in the Pilot Phase.

Results are consistent with evidence from other studies (Cunningham and Gök, 2012; Marzucchi et al., 2015; Martin et al., 2015) in which this kind of policy affects input additionality (mainly through resources increases in ROs), output additionality (through increase in collaborations and the consequent technological results, innovation and its effects) and also behavioral additionality (changing of management practices). Secondly, the evaluation reinforces Bienkowska et al. (2010) conclusions that a shift towards greater diversity, flexibility and multiple functions in R&D and innovation with multiple performer categories and multiple funding sources (in our case EMBRAPII, ROs and companies) can support the consolidation of national innovation systems. Nevertheless, positive effects on the innovation efforts of Brazilian industry depend on long-term, stable

commitment of government funding and support, including a reinforcement and expansion of EMBRAPII's model in years to come.

References

- BIENKOWSKA, D.; LARSEN, K.; SÖRLIN, S. (2010). Public-private innovation: Mediating roles and ICT niches of industrial research institutes. *Innovation: Management, Policy & Practice*, 12(2), p. 206-216.
- CUNNINGHAM, P.; GÖK, A. (2012). Impact of Innovation Policy Schemes for Collaboration. Part of the Compendium of Evidence on the Effectiveness of Innovation Policy Intervention. London: NESTA.
- EDLER, J.; BERGER, M.; DINGES, M.; GÖK, A. (2012). The practice of evaluation in innovation policy in Europe. *Research Evaluation*, 21(3), p. 167-182.
- HOCHSTETLER, K.; MONTERO, A.P. (2013). The Renewed Developmental State: The National Development Bank and the Brazil Model. *The Journal of Development Studies*, 49(11), p. 1484-1499.
- KANNEBLEY JR, S.; PORTO, G. (2012). Incentivos Fiscais à Pesquisa, Desenvolvimento e Inovação no Brasil: Uma avaliação das políticas recentes. Discussion Papers, 236. Washington: Interamerican Development Bank.
- LINK, A.N.; VONORTAS, N.S. (Ed.) (2013). *Handbook on the Theory and Practice of Program Evaluation*. Cheltenham: Edward Elgar.
- MARTIN, S.; PAHOR, M.; JAKLIC, M. (2015). The structure of policy-induced innovation networks in Slovenia. *European Journal of Innovation Management*, 18(4), p. 428 – 450.
- MARZUCCHI, A.; ANTONIOLI, D.; MONTRESOR, S. (2015). Industry–research co-operation within and across regional boundaries. What does innovation policy add? *Papers in Regional Science*, 94(3), p. 499-524.
- PACHECO, C.A.; CORDER, S. (2010). Mapeamento institucional e de medidas de política com impacto sobre a inovação produtiva e a diversificação das exportações. Documentos de Proyectos. Comisión Económica para a América Latina e o Caribe (CEPAL).
- SALLES-FILHO, S.; AVILA, F. D.; SEPULVEDA, J.; COLUGNATI, F.A.B. (2010). Multidimensional assessment of technology and innovation programs: the impact evaluation of INCAGRO-Peru. *Research Evaluation*, 19(5), p. 361-372.
- SALLES-FILHO, S.; BONACELLI, M.B.; CARNEIRO, A.M.; CASTRO, P.F.D.; SANTOS, F.O. (2011). Evaluation of ST&I programs: a methodological approach to the Brazilian Small Business Program and some comparisons with the SBIR program. *Research Evaluation*, 20(2), p. 157-169.
- SALLES-FILHO, S.; STEFANUTO, G. N.; MATTOS, C. V.; ZEITOUN, C.; CAMPOS, F. R. (2012). Avaliação de impactos da Lei de Informática: uma análise da política industrial e de incentivo à inovação no setor de TICs brasileiro. *Revista Brasileira de Inovação*, 11(n.esp). p. 191-218.
- SUZIGAN, W.; ALBUQUERQUE, E.; GARCIA, R.; RAPINI, M. (2009). University and Industry Linkages in Brazil: Some Preliminary and Descriptive Results. *Seoul Journal of Economics*, 22(4), p. 591-611.

From Cluster to Co-creation of Innovation and Entrepreneurial Competences- Learning innovation agencies and entrepreneurial ecosystems as observed in the Optoelectronics industry in Wales and Scotland in the UK

Fumi Kitagawa
(University of Edinburgh Business School)
fumi.kitagawa@ed.ac.uk

KEYWORDS: Emerging industries, Competence building, Embedded agencies, Entrepreneurial ecosystems, UK

Innovation and entrepreneurship activities seem to emerge in locations that have place-specific assets, sometimes depending on the previous or existing industrial traditions and the combinations of skills as well as other resources and organisational capabilities (Teece, 2007). Understanding economic changes of places is about unpacking innovation driven changes –how they are brought about, and what their consequences are (Dosi, 2013). The economic literature on the spatial determinations of innovation has largely emphasised the fact that the environment in which a firm is located influences the ability to innovate or to adopt innovations (Galliano et al, 2015). The geographical pattern of local innovation and entrepreneurship takes place in national as well as local and regional contexts. The combination of factors at local, national and global, as well as technological means different levels and patterns of interactions, with a deeply intertwined story of both the “natural trajectory of the technology itself and the national and institutional context in which it has developed” (Hendry et al 2000).

There is no generally agreed theoretical or empirical framework for answering what makes some places grow while other do not (Simmie et al 2008). More longitudinal studies are still needed, with more understanding on how places can anchor new industries and harness their economic potential. Recent literature on micro-foundations of innovation (see Dosi, 2013) highlights that actors as embedded agencies have the capacity to innovate and transform through combinations and adaptations between micro and macro processes (Thornton et al 2012). The entrepreneurial ecosystem concept has risen in recent years with a wide range of different theoretical frameworks trying to understand determinants new venture creation, strategies and growth processes as well as the effectiveness of policy frameworks and institutional support mechanisms (e.g. Wessner, 2004; Stam, 2013; Mason and Brown, 2014; Spigel, 2015). Mason and Brown (2014) argue that the entrepreneurial ecosystem concept approach has emerged as a response to the limits in existing policy frameworks.

Through the micro-processes of innovation driven changes and entrepreneurial activities, industries evolve from new to growth, maturity to decline, with changing geographical scopes of activities. Zahra and Wright (2011) identify four contextual dimensions related to the entrepreneurial activity – social, spatial institutional and temporal. These dimensions help analyse “placed-based” innovation and entrepreneurship activities. We need to better understand the temporal and social dimensions of entrepreneurial process embedded in a particular space through its successive stages (identification of opportunities, development of the idea, intention, creation, survival, growth, closure) in various phases of economic and innovation cycles at different stages of economic development (Guerrero and Pena-Legazkuem 2013). This exploratory paper illuminates the co-evolution and dynamics of place-based innovation and the entrepreneurial ecosystem by providing a case of particular emerging industries over years. The paper develops a conceptual lens by focusing on the critical ‘meso’ level through the evolution of the innovation agencies and entrepreneurial development of co-specialised technology in emerging industry settings.

It has been acknowledged that entrepreneurship and innovation are interlinked (Dahlstrand and Stevenson, 2010). In the recent policy as well as academic literature, entrepreneurship is seen at the heart of innovation-led local economic development. However, the effectiveness of policy in such process is not well evidenced. First, the diversity of such policy contexts needs to be more explicitly acknowledged and analyzed (e.g. Acs and Szerb, 2007; Meyer, 2013). Whilst entrepreneurial start-up companies may enhance innovation, industrial diversity of the region, job creation and economic growth, the diversity of the institutions, industrial and policy contexts of each of the regions remains as policy challenge (Acs et al., 2009). Secondly, as Driver and Oughton (2008) argue, for public policy, characterising accurately the “interplay of causal factors” and “identifying the nature of what is required (or how to intervene) is methodologically difficult”. One of the objectives of this

paper, therefore, is to synthesise the insights from both innovation and entrepreneurship literature to understand and analyse the diverse issues related to place-based innovation and entrepreneurship policies.

In this paper, by drawing on both innovation and entrepreneurship literature, three areas of policy targets are discussed. One is building of innovation and entrepreneurial networks, and the second is about the development of entrepreneurial skills and competence buildings in the innovation system (Borras and Edquist, 2014). The third broad issue discussed is the financing of entrepreneurship and innovation activities in “less favoured” regions.

The following questions are asked:

- What are the forms and patterns of institutional and spatial interactions at the ‘meso’ level that condition the emergence and evolution of co-specialised technologies and industries in particular places?
- In what ways have local economic development policies supporting place-based innovation and entrepreneurship activities changed over time?

An emerging industry is considered to be the “fusion of a new technology with prior antecedent technologies” (Feldman and Lendel, 2010, 149). New science-based industries are associated with innovation and entrepreneurial activities, by combining knowledge in new and novel ways. Hendry and Brown (2007) point out that optoelectronics (OE) is a good industry for studying such developmental processes. The industry is characterised by large numbers of high technology small and medium-sized enterprises (SMEs), many engaged in symbiotic relationships with multinational firms in relatively mature sectors (Stuart, 2000) such as telecommunications, defence and consumer electronics, and in other emerging sectors such as medical and industrial applications.

Previous studies in different national contexts (e.g. Hassink, 1998; Hendry et al 2000; Hassink and Wood, 2006; Clark, 2013) provide contested evidence on different geographical features of OE and photonics industry. Drawing on the studies of six regions in different countries, Hendry et al (2000) conclude that international relationships are found to be much stronger than localised inter-company trading and network relationships, with increasing national and international relationships and linkages developed in optoelectronic industry both through supply chains and customers. Based on the study of photonic clusters in Germany, Hassink and Wood (2006) suggest that local geographical clustering does not necessarily lead to R&D collaboration and innovation. On the contrary, Clark (2013) emphasises the importance of co-locating research, development, design and production functions in the same place, drawing on the analysis of concentration of photonics professionals in the regions specialised in different portfolios of technology applications in the USA.

The paper focuses on a particular institutional and policy contexts by illustrating the development and institutional transformation of opto-electronics industry over years in the two devolved regions, in Wales and in Scotland in the UK. This paper looks at the optoelectronics industry as emerging technologies and industry set in different geographical and institutional contexts embedded in particular places, national contexts and technological trajectories.

The methodology underlying this paper takes a mixed-methods approach, combining qualitative and quantitative data collection and analysis. The research methods include secondary data analysis including review of policy documentations as well as exploratory primary data collection with the industry associations, research institutes, companies of different sizes and universities (e.g. research groups with industry interactions, doctoral training centres). In the main, the key data set relates to the public policy strategies concerning economic development, higher education, science and technology, innovation, and entrepreneurship activities.

The contribution of this paper would be as follows. The institutional frameworks that constitute the critical ‘meso’ level are analysed by illuminating the social, spatial institutional and temporal dimensions as part of the entrepreneurial ecosystems. The paper aims to shed light on the role of embedded agencies as part of the policy intervention at local level, which constitutes the dynamic industrial and technological evolution in a global context.

References (under construction)

- Acs, Z. J., and Szerb, L. (2007): Entrepreneurship, Economic Growth and Public Policy, *Small Business Economics*, 28, 109-122.
- Audretsch, D. B., and Keilbach, M. (2004) Entrepreneurship Capital and Economic Performance , *Regional Studies*, 38:8, 949-959.
- Borras, S and Edquist, C (2014) Education, Training and Skills in Innovation Policy, *Science and Public policy*
- Clark, J (2015) Hidden in Plain Sight: The Optics and Photonics Industry in the World Economy. In Bryson, John R., Jennifer Clark, and Vida Vanchan, eds. *The Handbook of Manufacturing Industry*
- Clark, J (2013) "Working Regions Reconnecting Innovation and Production in the Knowledge Economy"
- Feldman, M and Desrochers, P 2003 The evolving roles of research universities in technology transfer. *Industry and Innovation* 10:5-24.
- Guerrero, M. and Peña-Legazkue (2013) Entrepreneurial activity and regional development: an introduction to this special issue *Investigaciones Regionales*, 26-5 -15
- Hassink, R & Wood, M (1998) Geographic 'clustering' in the German opto electronics industry, *Entrepreneurship & Regional Development*, 10:4, 277-296
- Hendry, C. and J. Brown (1998), Clustering and Performance in the UK Opto- Electronics Industry, *Conference on Regional Advantage and Innovation*, Conference Universidade Catolica Portuguesa, Porto, October 23-24.
- Hendry, C and Brown, J (2007) Dynamics of clustering and performance in the UK opto-electronic industry, *Regional Studies* 40 (7) 707-725.
- Henrekson, M., Johansson, D. (2009). Competencies and Institutions Fostering High growth Firms, *Foundations and Trends in Entrepreneurship*, Vol. 5, No. 1, pp.1-80.

6E. TRACK THEME 7: DESIGNING TRANSFORMATIVE CHANGE: ATTEMPTS TO BRIDGE MISSION-ORIENTED R&I AND THE DYNAMICS OF SOCIO-TECHNICAL CHANGE (II)

Demand-sided financial incentives for innovations – concept and challenges based on the example of the German feed-in tariffs for renewable energy

Carsten Schwäbe
(Freie Universität Berlin)
Carsten.Schwaebe@fu-berlin.de

KEYWORDS: Demand-sided innovation policy, Dynamic efficiency, Feed-in tariffs for renewable energy

1.) Relevance

With her famous book “The Entrepreneurial State” Mariana Mazzucato (2013) has begun a new debate on the role of the state in economic affairs. By referring to many successful innovation processes crucially been induced by state activities she argues in favour of an active government fostering specific technological trajectories in order to enhance innovative economic growth. Fixing market failures should not be the main rationale for economic policy. Policy makers should induce the creation of new technologies and markets which strengthen economic growth, but can also address grand societal challenges such as the mitigation of climate change. Consequently, the new mission orientation (Foray et al., 2012) represents an additional rationale for economic policy (Aghion et al., 2009; Weber and Rohracher, 2012), but also requires new policy instruments and governance concepts (Dreher et al., 2014). Mazzucato (2015) herself points out that “the state must be armed with the intelligence necessary to envision and enact bold policies” in order to act as such a public entrepreneur focusing on societal missions. But what does it mean to make this “Entrepreneurial State” work?

The proposed article tries to exemplify the demanding requirements for policy makers to act as an “Entrepreneurial State” by the analysis of one specific policy instrument. The literature on demand-sided innovation policy instruments was mainly focusing on soft awareness instruments, regulatory measures and innovative public procurement (Falck and Wiederhold, 2013; Georghiou et al., 2014). Although several examples for it can be counted, demand-sided financial incentives for the purchase of innovations has still not yet been in the focus of the academic debate. The proposed article fills this gap by delivering a theoretical and empirical analysis of the German feed-in tariff scheme for renewable energies.

This feed-in tariff scheme stands in the centre of the German mission-oriented policy mix for the “Energiewende”, the economic transition of the energy generation towards renewable energy. It has been introduced by the Renewable Energy Act (Erneuerbare-Energien-Gesetz, EEG) and supports the feed-in of electricity from renewable energy sources (wind, solar, biomass, hydro, geothermal, landfill and sewage gas) as well as mine gas (sec. 2 (1) and 5 (14) EEG, 2014) and consists of the following principles (EFI, 2013: 54-57):
Feed-in obligation: The EEG obligates the transmission grid operators to guarantee the grid connection of plants generating electricity from renewable energies

Feed-in priority: The complete electricity supply from renewable energies has to be fed into the grid with priority over conventional electricity.

Feed-in tariffs: Plant operators receive energy source specific remunerations for the fed EEG electricity by the grid operator. The feed-in tariffs for new installed plants are adjusted every year and shall fall (degressive scheme), but for each plant the related feed-in tariff remains constant for 20 years (sec. 22, 23 (1) and 26 (1) EEG, 2014). The costs for the feed-in tariffs are passed to the power consumers through the EEG apportionment. As the additional costs for electricity caused by the renewable energy feed-in tariff scheme are continuously rising, policy makers tried to adjust the guaranteed feed-in tariffs and introduced flexible caps for the extension of renewable energy capacities. However, the adjustment of the feed-in tariffs do not follow a reasoning based on a theoretical concept and empirical indicators regarding the extension and the cost development of the renewable power generation. It is the key objective of the proposed paper to deliver a theoretically founded concept for the implementation and readjustment of demand-sided financial incentives for innovations because this instrument is discussed not only for renewable energies, but also for other innovations such as electric cars

(Kunert, 2016).

2.) Research aims and questions

The paper aims at the development of a theoretically founded concept for demand-sided financial incentives for innovations. This instrument is crucial in order to support those innovations which suffer from lock-in effects advantaging the older, established alternatives, but which have the potential to achieve the objectives of societal missions.

Therefore, the article answers on the following research questions:

- Which are the theoretical rationales for the implementation of demand-sided financial incentives for innovations?
- In how far can these theoretical rationales be identified by the observation of the cost development (learning curves)?
- What is the optimal time to implement demand-sided financial incentives for innovations?
- How can demand-sided financial incentives for innovations be adjusted to the dynamics of the innovation processes in order to guarantee the dynamic efficiency of the instrument?
- What is the optimal time to abolish demand-sided financial incentives for innovations?

3.) Theoretical frameworks

Demand-sided financial incentives for innovations represent one key instrument for the new mission-orientation as it helps new technologies to substitute older alternatives within the markets. Therefore, the new mission orientation aims at the abandon of an established technological trajectory (Dosi, 1982) in favour of a societally or environmentally more desirable alternative and, hence, a disruptive technological path (Christensen, 1997). The author defines the new mission orientation according to Aghion et al. (2009): Mission-oriented innovation policy does not just support the generic, “neutral” functions of the innovation system, such as knowledge generation and diffusion. The mission itself is the reason why the related policies contradict “the principle of ‘neutrality’ because specific technological and innovation projects will receive particular support” (Aghion et al., 2009: 688) in order to fulfil the mission. Neutrality in this sense means to abandon the state selection of technology-specific projects related to a prioritised field. Thus, neutrality cannot be compatible with the new mission-orientation being neither technology-specific nor neutral, but intermediate.

Zundel et al. (2005) deliver a dynamic perspective on technological change. They conceptualize transitions as processes of competing technologies and differentiate a competition of an old and a new technology (old-vs.-new) from a competition only between new technological solutions (new-vs.-new). Both perspectives are important for the Energiewende: While the conventional energy sources such as coal or nuclear energy compete with the renewable alternatives, the different alternatives are still in another kind of competition with each other because it is still unsure which renewable energy mix will be optimal in the future.

Besides, Zundel et al. (2005) identify several reasons of path dependencies stabilising the old technological alternative. Economies of scale, for instance, can only be developed after a successful phase of diffusion. The exploitation of economies of scope as synergies through the common production of different product lines requires time and established structures. Furthermore, the longer technological progress follows the established trajectory, the higher are the cost-saving and quality-increasing learning-by-doing effects which a new technological path cannot immediately realise. All these aspects are the reason why innovations at the beginning of the market diffusion are often not able to compete because of the much lower costs of the established technology: the higher the maturity difference, the higher the additional costs for the production of the new technology. The demand-sided financial incentives try to compensate this disadvantage. But after the state-supported diffusion of an innovation the producers will be able to compensate this disadvantages by themselves. Therefore, it is necessary to shrink the financial support for the innovation with reference to its cost and price development.

4.) Empirical Material

The legislative texts of the Renewable Energy Act as well as the related secondary literature is used for the description and analysis of the main properties of the German renewable energy feed-in tariff scheme.

Besides, the proposed article uses the publications of the Federal German Ministry of Economic Affairs and Energy on the development of the market for renewable energies in Germany in order to analyse the diffusion and the cost development of the different renewable energies (see for example BMWi, 2014). Furthermore, other public research institutes such as the Fraunhofer Institute for Solar Energy Systems have collected and calculated an indicator for the costs of the power generation per unit of electricity: the levelised power generation costs

(Fraunhofer ISE, 2013; ISE, 2012), which make the costs of the different energy sources comparable. However, they do not deliver dynamic analysis of this indicator.

5.) Description of the methodologies

After the description of the current state of the literature the proposed article contributes to the debate by connecting the idea of a demand-sided financial instrument for the support of the diffusion of an innovation with the new mission orientation. Furthermore, the article will re-view on theoretical work on the idea of “dynamic efficiency” in order to define how a demand-sided financial incentive for innovations can achieve the goal of dynamic efficiency.

The empirical part of the article gives insights on the German feed-in tariff scheme for renewable energies. It is analysed in how far the feed-in tariffs fulfil the theoretical requirements described in the first part of the article. This analysis also comprises data on the diffusion and the cost development of the renewable energy technologies in Germany. The methods of the data analysis depend on the data availability.

6.) Expected outcomes

As a result of the theoretical and the empirical analysis the proposed article concludes the main properties for “dynamically efficient” demand-sided financial incentives for innovations. These properties show that the new mission orientation as policy concept demands complex and re-flexive innovation policy instruments.

References

Revisiting the Role of University in Developing Countries: Transforming Power Relations towards an Interdisciplinary Institute

Ata Heshmati and **Ali Maleki***

(Sharif University of Technology Research Institute of Science, Technology, and Industrial Policy)

*a.maleki@sharif.edu

KEYWORDS: Interdisciplinary, Institutional Flexibility, Developing Countries, Power

Introduction

Economic development needs universities to seek proper solutions for local and national problems. However, a university in developing countries, including Iran, primarily should be able to graduate people who are capable to solve complex problems. Because of the substantial interdisciplinary character of complex problems, this goal, training problem-solvers in universities, is possible only if the universities in developing countries reach to the interdisciplinary education and research. Hence, the function of interdisciplinarity is to train problem-solvers in order to respond to the major requests of society. Iranian society sees a failure in its universities exactly at this point: Universities in Iran have a serious problem in their paths to make a difference in economic development. Although interdisciplinary education and research theoretically is a key to improve domestic economy, there are a great number of barriers formed against them to reach interdisciplinary institutes. This paper focuses on the experience of the Sharif University of Technology (SUT), one of the top-ranked Iranian universities. Using qualitative methods, particularly semi-structured interviews and panel of experts, we understood that there is a highly established capability of disciplinary education in SUT, which is the most emphasized competency of this university. Thus, from these interviews it may be crystal clear that SUT's core competency is becoming its core rigidity. According to this experience, we conclude that facilitating interdisciplinary education and research requires institutional flexibility in order to smooth the way for a structural transformation towards an interdisciplinary organization. Regarding this, universities in emerging economies must expect strong resistance against this transformation. Consequently, being an interdisciplinary institute in these countries needs a long term negotiation with dominant powerful actors holding top levels of decision-making roles inside the university.

The role of universities in economic catch-up in developing countries

In spite of an increasing emphasis on the role of universities in many ways in developing countries in general and in Iran in particular, there is a considerable doubt on the effectiveness of universities in their expected problem-solving missions. This spreading doubt, which is raised mainly by business and industrial practitioners,

has not convinced policy-makers not to invest on universities yet. Even though there might be understandable evidences showing that universities cannot have an effective influence on the local and national economics, we should ask for policies resolving this critical issue. Core question here is how policy makers can reach to a practically sound mechanism for promoting participation of universities in national innovation system? This paper focuses on a potential response to above-mentioned question. This response includes a close consideration on the structural organization of an Iranian university and its lack of institutional flexibility. Moreover, we shed light on the role of incumbents and their influence as a resisting actor against institutional transformation.

Mazzoleni and Nelson have a major contribution in the key elements resulted economic catch up, especially among developing countries. They show that the most crucial condition for technological development in large companies is a ceaseless current of human resources educated by universities (Mazzoleni & Nelson, 2005). Giving several examples, they also emphasized on the experiences of South Korea and Taiwan in catch up process. Firms in these countries highly improved their technological capabilities in a short period from 1960s to 1980s. It was not possible if they could not access to an active labor force, who are officially trained and prepared in universities to do their crucial role to developing new technologically innovative products and processes (Mazzoleni & Nelson, 2005). However, they cite to a few failure cases, like Argentina and Israel, which shows that there are some conditions for catch up other than the educated human resources. Lundvall and his colleagues also clearly express how universities in emerging economies can contribute in the industrial prosperity by training 'problem-solvers' and promoting problem solving skills in graduated students (Lundvall, et. al. 2011). Therefore, universities play a mediator role in the developing countries through educating human resources who are capable for problem-solving. Although university merely is not assumed as a problem-solving organization, we can call universities the 'problem-solver builder' institution. According to briefly mentioned literature, there is an emerging question about the approach should be held in the education system of developing countries, led to a problem-solver output of human resources. Consequently, there should be an internal and organizational shift within the universities for providing an appropriate context for effective higher education. This paper tends to point on this issue by raising a case study from Sharif University of Technology, Tehran, Iran.

Interdisciplinary education and problem-solving

If universities want to improve their role in solving the local and national problems, they should be open to an interdisciplinary research and education atmosphere. By definition "interdisciplinary research is a mode of research [whose purpose is] to advance fundamental understanding or to solve Problems" (National Academy of Sciences, 2004). There is an urgent need for interdisciplinary research and education for finding feasible and right solutions for critical issues. Nowadays, problems are going to be more complex than before and regular disciplinary education cannot prepare a proper conditions for solving those complex multi-aspects issues. Students need more interdisciplinary and problem-oriented experiences, which can make them suitable for developing new skills after graduation. As Sá holds, problem-solving research will not be developed until there is an effort for interdisciplinary education (Sá, 2007).

Institutional structure for interdisciplinary education

Many scholars emphasized on the necessary conditions facilitating interdisciplinary research and education. Casey cites to a dynamic management and flexible structure as the main pre-condition of interdisciplinary atmosphere (Casey, 1990). Vengroff and Léger showed that the most common barrier towards interdisciplinarity is a sustained flexible organization, which support interdisciplinary research and education efforts (Vengroff & Léger, 2009). Because established disciplinary structures may raise several barriers against newly emerging modes of research and techniques of education. This should be considered as a battle of power in the field of university, which involves a great number of battlers. Following SUT case study, we will review an example containing invaluable lessons for policy-makers who want to improve the effectiveness of universities.

The case of Sharif University of Technology

In Iran, shifting from a disciplinary college to an interdisciplinary problem-solver university needs a deep institutional change in organizational forms. In consequence, a comprehensive consensus among every management part of a university is needed. Change process in such professional organizations, like universities, is a collective and soft process. It means that formalist leaders of a university should convince incumbents to agree with forthcoming changes. Sharif University of Technology, as first ranked university of the country is forced with this issue. Analyzing our interviews and panels of experts held in the university, we found out that

there is several obvious evidences that shows how a rigid traditional structure gives rise to a barrier for interdisciplinary research and education. Our evidences are as follows:

1. A bureaucratic departmental structure
2. Strong constraints against establishment of new research institutes and Lack of supports for newly established departments
3. Inflexible arrangement of administrative council of university

Conclusion

We learn from above case study that a rigid academic structure supported by powerful practitioners of university may give rise to a limitation for interdisciplinary education. Lacking interdisciplinary agendas, makes a university to be subject to non-effectiveness in social and economical development. Therefore, academic institutes should face a radical transformation in their structures by negotiating with their incumbents.

References

- Casey, B. (1990). The Administration of Interdisciplinary Programs : Creating Climates for Change. *Issues in Integrative Studies*, 110(8), 87–110.
- Lundvall, B. _., Joseph, K. J., Chaminade, C., & Vang, J. (Eds.). (2011). *Handbook of innovation systems and developing countries: building domestic capabilities in a global setting*. Edward Elgar Publishing.
- Mazzoleni, R., & Nelson, R. R. (2005). The Roles of Research at Universities and Public Labs in Economic Catch-up, 1–38.
- NAS. (2004). *Facilitating Interdisciplinary Research*. Washington, D.C.: National Academies Press. doi:10.17226/11153
- Sá, C. M. (2007). “Interdisciplinary strategies” in U.S. research universities. *Higher Education*, 55(5), 537–552. doi:10.1007/s10734-007-9073-5
- Vengroff, R., & Léger, T. (2009). Approaches to Managing and Sustaining Interdisciplinary Programs at Comprehensive Learning Centered Universities, 1–21.
- Aghion, P., David, P.A., Foray, D., 2009. Science, technology and innovation for economic growth: Linking policy research and practice in ‘STIG Systems’. *Research Policy* 38, 681-693.
- BMWi, 2014. *Zweiter Monitoring-Bericht "Energiewende der Zukunft"*. Federal Ministry of Economic Affairs and Energy (Bundesministerium für Wirtschaft und Energie), Berlin.
- Christensen, C.M., 1997. *The Innovator’s Dilemma*. Harvard Business School Press, Boston, MA.
- Dosi, G., 1982. Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change. *Research Policy* 11, 147-162.
- Dreher, C., Kovac, M., Schwäbe, C., 2014. Competing technological innovation systems as a new challenge for mission-oriented science, technology & innovation governance. . Paper presented at Eu-SPRI Conference 18-20 June 2014, Manchester.
- EEG, 2014. *Renewable Energy Act - Gesetz für den Ausbau erneuerbarer Energien (Erneuerbare-Energien-Gesetz)*, passed by the German Bundestag on 12/07/2014, into effect since 01/08/2014.
- EFI, 2013. *Gutachten zu Forschung, Innovation und technologischer Leistungsfähigkeit Deutschlands. Gutachten 2013. Expert Commission Research and Innovation (Expertenkommission Forschung und Innovation, EFI)*.
- Falck, O., Wiederhold, S., 2013. *Nachfrageorientierte Innovationspolitik: Bestandsaufnahme und ökonomische Bewertung*. ifo Beiträge zur Wirtschaftsforschung, München: ifo Institut.
- Foray, D., Mowery, D.C., Nelson, R.R., 2012. Public R&D and social challenges: What lessons from mission R&D programs? *Research Policy* 41, 1697-1702.
- Fraunhofer ISE, 2013. *Stromgestehungskosten Erneuerbare Energien*. Fraunhofer Institute for Solar Energy Systems (Fraunhofer-Institut für Solare Energiesysteme), Karlsruhe.
- Georgiou, L., Edler, J., Uyarr, E., Yeow, J., 2014. Policy instruments for public procurement of innovation: Choice, design and assessment. *Technological Forecasting and Social Change* 86, 1-12.
- ISE, F., 2012. *Studie Stromgestehungskosten Erneuerbare Energien*. Fraunhofer Institute for Solar Energy Systems (ISE), Karlsruhe.
- Kunert, U., 2016. *Subventionen für E-Autos? - Kommentar*. DIW Wochenbericht 83.
- Mazzucato, M., 2013. *The Entrepreneurial State: Debunking Public Vs. Private Sector Myths*. Anthem Press, London.
- Mazzucato, M., 2015. *The Innovative State - Governments Should Make Markets, Not Just Fix Them*. *Foreign Affairs*, January/February 2015 Issue, accessible at <https://www.foreignaffairs.com/articles/americas/2014-12-15/innovative-state>.
- Weber, K.M., Rohrer, H., 2012. Legitimizing research, technology and innovation policies for transformative change. *Research Policy* 41, 1037-1047.
- Zundel, S., Erdmann, G., Kemp, R., Nill, J., Sartorius, C., 2005. Conceptual framework, in: Sartorius, C., Zundel, S. (Eds.), *Time Strategies, Innovation and Environmental Policy*. Edward Elgar, Cheltenham, Northampton.

Moving beyond the innovation focus: from innovation system and multi-level perspective towards an integrated concept of transformative socio-technical change

Matthias Weber*(AIT Austrian Institute of Technology) and Harald Rohrer(Linköping University)
*matthias.weber@ait.ac.at

KEYWORDS: Transformative socio-technical Change, Paradigm shifts, Innovation Systems, Multi-level perspective

Background

The multi-level perspective on long-term transition processes has attracted quite some interest in academic as well as in policy circles over the past year, but the innovation systems approach is still the dominant perspective when it comes to devising research, technology and innovation policies, which are a crucial element on any transition agenda. In recent years, the approaches have been converging: innovation systems approaches have adopted a more differentiated perspective on the specificities of individual technologies and sectors, and taking into account the role of broader sectoral policies (Dolata 2009), and the multi-level perspective of niches, regimes and landscapes has been adjusted to take account of different types of criticism (Geels 2011). More recently, the grounding of the regime concept has been elaborated by Fuenfschilling and Truffer (2014). The respective strengths and weaknesses of both perspectives are well known (Markard and Truffer 2008a), and they have been used for exploring a comprehensive set of rationales for policy intervention in processes of transformative change (Weber and Rohrer 2012). In spite of obvious complementarities, a closer conceptual integration of the transition perspective and innovation systems perspective is still missing, but would be important for two reasons in order to strengthen our theoretical understanding of transformation dynamics, and thus to inform policies for fostering transformative change in a coherent manner. Moreover, we argue that an extension of both approaches is needed in order to be able to take into account emerging cross-cutting developments (e.g. digitalization or globalization) that affect several socio-technical systems at the same time.

Research aim and questions

With this paper we want to make a step in the direction of integrating and expanding both perspectives, and thus explore the synergies between the multi-level and innovation system approaches for explaining processes of transformative change in society. We want to move the current debates forward in five main regards.

First of all, we want to use system concepts to describe and understand sustainability transitions in order to make this kind of thinking more compatible with prevailing research, innovation and sectoral policy debates on how to tackle major societal challenges, which is dominated by systems thinking (Smits, Kuhlmann, Shapira 2010). Second, we want to benefit from the appealing notion of functions of innovation systems (Bergek et al. 2008), while at the same time not losing the advantages of the actor-centred perspective on innovation systems. Actor-centred approaches have dominated research and policy debates for many years, but have been complemented by functional perspectives on innovation systems more recently, which are very amenable to policy discourses. Third, we aim to make the main types of mechanisms driving the dynamics of system transition more explicit, and we argue that the actor-centred approach to innovation systems is particularly suitable for that purpose (Markard and Truffer 2008b). It allows putting explicit emphasis on the roles of actor strategies and of the orientating function of institutions.

Fourth, a major conceptual challenge consists of moving beyond innovation when it comes to explaining transformative change. It requires taking into account the (often sectorally but also geographically delimited) production systems in which innovations are embedded, as well as the user and consumer side which is ultimately decisive for the diffusion of innovations. Moreover, social and organisational innovations tend to imply a significant role for users in innovation activities as well.

Fifth, we want to consider the embedding of sectorally and geographically delimited processes of socio-technical change in wider and cross-cutting change processes in society.

Theoretical framework

We propose two key concepts to address these five issues. First, Systems of Innovation, Production and Consumption (SIPC) are proposed as a comprehensive framework for explaining processes of transformative change, which combines key elements of transition thinking with a functional perspective on innovation, production and consumption systems, underpinned by an explicit actor-centred foundation that is essential to explain how transformative change comes about.

Secondly, SIPC need to be complemented by changes in what we call socio-technical paradigm shifts, in order to address change processes that cut across several different SIPC. This element is inspired by the work on techno-economic paradigm shifts (Freeman and Perez 1988).

Empirical materials

A key challenge to any such framework is whether it has value added to offer as compared to other already existing frameworks. We will therefore look at the case of digitalisation (as change in socio-technical paradigm) in which change processes in different domains are embedded, and which should allow us to assess the advantages and limitations of the SIPC and socio-technical paradigm framework.

More specifically, we will draw on empirical material from cities for illustration purposes, because it is in cities where the cross-cutting influence of a change in the socio-technical paradigm of digitalisation and its consequences for several SIPC (e.g. around mobility, smart grids, health, etc.) become particularly visible.

Methodologies

This is a largely conceptual paper that draws extensively on existing literature from both transition studies, innovation systems literature, and theories of techno-economic paradigm shifts and social change. The empirical aspects are tackled on the basis of case-studies on the emerging changes in meta-regimes and SIPC in the cities of Vienna, Malmö and Stockholm.

Expected outcomes

We expect the paper to deliver novel insights in two regards. First of all, the conceptual framework we propose provides a new inroad to the analysis of patterns and impact of changes in socio-technical paradigm shifts on transformative change in economy and society as captured by SIPC. Secondly, with this perspective, we argue that current innovation policies for addressing transformative socio-technical change not only need to be expanded to the couplings with production and consumption, but also with policies addressing other SIPC and the paradigm shift of digitalisation.

References

- Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., Rickne, A., 2008. Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. *Research Policy* 37, 407-429.
- Dolata, U., 2009. Technological innovations and sectoral change: transformative capacity, adaptability, patterns of change: an analytical framework. *Research Policy* 38, 1066-1076.
- Fuenfschilling, L., Truffer, B. (2014): The structuration of socio-technical regimes—Conceptual foundations from institutional theory, *Research Policy*, 43, 772-791
- Geels, F.W., 2011. The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions* 1, 24-40.
- Markard, J., Truffer, B., 2008a. Technological innovation systems and the multi-level perspective: towards an integrated framework. *Research Policy* 37, 596-615.
- Markard, J., Truffer, B., 2008b. Actor-oriented analysis of innovation systems: exploring micro-meso level linkages in the case of stationary fuel cells. *Technology Analysis & Strategic Management* 20, 443-464.
- Freeman, C., Perez, C. (1988): Structural crisis of adjustment, business cycles and investment behavior, in: Dosi, G. et al. (ed.): *Technical Change and Economic Theory*, Pinter, 38-66
- Smits, R., Kuhlmann, S., Teubal, M., 2010. A system-evolutionary approach for innovation policy. In: Smits, R., Kuhlmann, S., Shapira, P. (Eds.), *The Theory and Practice of Innovation Policy: An International Research Handbook*. Edward Elgar, Cheltenham, pp. 417-448.
- Weber, M., Rohracher, H., 2012. Legitimizing research, technology and innovation policies for transformative change. *Research Policy* 41, 1037-1047.

From national challenges to emerging new innovation systems: role of Institutional entrepreneurs beyond formal policies; Case of Biopharmaceutical sector in Iran

Rouhollah Hamidi Motlagh*, Mohammad Taghi Isaai, Ali Maleki and Ali Kermanshah
(Sharif University of Technology)

*Hamidimotlagh@yahoo.com

KEYWORDS: institutional Entrepreneurship, Innovation system change, Institutions, Strategic needs

Which elements and conditions drive change in innovation systems? Many scholars of innovation system studies, such as Socio-technical system literature, emphasis on the role of tensions, landscape pressures and jolts as a driving force (Geel, 2004, Sine, 2003). According to these studies, institutional change was caused by exogenous shocks that challenged existing institutions in a system. Based on neo-institutionalists approach, this article is a search for a missing part of the puzzle of linking nationwide challenges and exogenous forces to innovation systems change: institutional entrepreneurs as endogenous sources of change and the role of influential actors in bridging problems to innovative technical as well as institutional solutions.

Health challenges is a good example of triggering innovation in developing countries. Developing countries have a publication intensity in health biotechnology fields that are relevant to the health needs of their own populations (Morel, 2005). For example the first effective meningitis B vaccine, developed at the Cuban Finlay Institute and recently licensed to GlaxoSmithKline; (ii) new innovative processes for engineering local versions of the recombinant hepatitis B vaccine in Cuba, Korea, and India; and (iii) the antimalarial drug arteether (a semi-synthetic artemisinin derivative), developed at India's Central Drug Research Institute and transferred to Themis Chemicals for commercial development, now sold under the brand name E-mal in 48 countries (Morel, 2005). Cinnovex Developed by CinaGen an Iranain company due to the high prevalence of Multipl Scelerosis in Iran (Mahboudi, 2012).

In many such cases developing new innovations and technologies is not possible unless change in institutional setting of the innovation system occur and new organizational forms, new routines, new beliefs and values and new socio-technical regimes emerge (Geels, 2005). In this paper we argue that this inevitable change will not be possible unless some influential actors, Institutional entrepreneurs, capable of changing institutions and technologies reciprocally, exert power, break existing inertia forces and develop new techno-institutional solutions to existing problems.

Existing literature on evolution and dynamics of innovation system emphasizes on co-evolution as a change process which leads to more efficiency in a way that technology path put pressures to accompany and direct institutional change path and vice versa (Geels, 2005, Murmann, 2003). Similarly Socio-Technical System (STS) framework (Geels, 2004) emphasis on change pressures from landscape and niche novelties as a driving force to change socio-technical regimes. As these theories constructed to explain change they might undermine the ceasing power of inertia. Economic Sociologists argue that change occurs when change forces (often new entrants) dominated on inertia forces (often incumbents) (Fligstein, 2001, 2007). From this perspective Incumbent actors and networks influence institutional structures, government, regulatory bodies and existing beliefs and norms to retain their power and interests (fligstein, 1996, podolny, 1993) and change process conceptualizes as breaking existing power relations (Fligstein, 1996). This view differs from those scholars who argue social structures stretch toward reducing transaction costs (Williamson, 1985) and more efficiency (baker, 1984 and Uzzi, 1996). From this view Incumbent networks deliberately try to exert isomorphic power on new entrants and new entrants challenge existing institutions to absorb more resources and more power. To where a socio-economic system goes, depends on who is the winner (Fligstein, 1990). Although material forces (inefficiency, crisis, ...) are important to put pressures to socio-technical system change, new institutionalists emphasis on the role of powerful and influential agents who exert some strategies to facilitate and let change become possible (Dimaggio, 1988, Eisenhardt ?). These agents are Institutional Entrepreneurs (Battilana, et al, 2009).

In this article, based on Iran empirical data from 1985 to 2010, we first, elaborate how national program of vaccination against Hepatitis B and also need for vast procuring of biosimilars lead to emergence of Iran biopharmaceutical sector. Second we explicate how at the first place, institutional structure of pharmaceutical industry failed in producing essential biosimilars and a chain of failures triggered institutional change and emergence of privately owned science based (POSB) firms. Third, we present evidences which shows to what extent role of institutional entrepreneurs have been critical in this change process, where those IEs originate

from, and which roles they played in creating a new innovation system?

Iran's Pharmaceutical sector (IPS) has been successful in developing and commercializing Biosimilars. Biosimilars are imitative biopharmaceuticals which develop and commercialize after the original product lunches in the market by its first producer. Some Iranian biosimilars, such as Cinnovex, are the first developed ones in the world. Over 40 private science-based pharmaceutical firms are working to commercialize biopharmaceutical products. In recent years Iranian science based companies are capable of developing new Biosimilars in less than three years after the original product has been launched by pioneer companies. These science based companies were the result of transformation from government owned supplier dominated companies (GOSD) to privately owned science based (POSB) ones in two decades. Early attempts in producing biosimilars took place in GOSD companies and they failed. Then a transitory form as government owned science base (GOSB) forms emerged, they were successful in technology acquisition but they commercially failed. Finally PSB form emerged and they were successful both in technology acquisition and commercial completion. Our case study shows that a network of academic entrepreneurs who have the opportunity to work and take key positions concurrently in government agencies, universities and business sections (in GOSD, GOSB and POSB) obtained position and power for trial and error and learning, develop technologies and orchestrate institutional change. This mechanism, which we call Socio-Technical Circulation of entrepreneurs, led to rapid transfer of firms' needs to government agencies and university sector and effective adaptation and response of businesses, government and universities to each other's change. Most of these IEs have two major origins. The first group were a group of socio-political active pharmaceutical students (members of students Islamic society) at Tehran university of medical sciences (TUMS) who received government funding and sent out to Europe and Canada to learn biopharmaceutical technologies from 1985 to 1988. The second group were a group of technicians and managers who sent out to Cuba to transfer production technologies of Hepatitis B vaccine from Cuban institutions to Pasteur Institute of Iran (the most Important GOSB institution). These two generation formed a powerful network of academic Entrepreneurs who perform most of the practices of emerging Iran Bio-pharmaceutical sector.

IE literature can provide fruitful answers and comments to some unanswered questions and unnoticed issues in innovation system literature. Here we emphasize on two issues. First, As this article showed, innovation system change is a learning and problem solving oriented process, rich of successive failures and successes. As entrepreneurs encounter with interwoven technical and institutional challenges of existing system, they should act collectively and closely to overcome those challenges, and gradually a new path emerges. Since inventing a new techno-institutional path is hard and uncertain, networks may fail at the initial stages, so they change their practices to get better outcomes. In this process, network of entrepreneurs learn how to examine new methods to develop technologies or products, and how to impose some changes in existing institutional and power structure of a system. The question should be asked in innovation policy literature is which elements cause innovation system change not to cease after failures? Who learns from failures and who have enough legitimacy and power to continue inventing new institutions after undesirable consequences? IE literature can provide fruitful answer to these kinds of questions.

Second, based on our framework, powerful agents are beyond the state and their practices are beyond formal policies. Pioneer firms (Aldrich, 1994), government agencies (Wade, 1990), professional associations (Demil & Bensédérine, 2005), key individuals and politicians (Lawrence & Phillips 2004) and informal networks play important roles to change innovation systems (Dorado, 2005). These IEs perform bundles of purposeful interrelated activities as practices (Bourdieu, 1990). Most of these practices are not formal ones which we overemphasize in innovation studies as "formal policies". Lobbying for new regulations, framing new concepts and interpretations among key actors, promoting collective action, creating new relationships among actors and highlighting an issue as critical, and taking others focus of attention toward an issue as well as developing formal policies are some strategies which IEs use to create new paths for existing challenges and problems.

References:

- Aldrich, Howard E., and C. Marlene Fiol. "Fools rush in? The institutional context of industry creation." *Academy of management review* 19.4 (1994): 645-670.
- Baker, Wayne E. "The social structure of a national securities market." *American journal of sociology* (1984): 775-811.
- Battilana, Julie, Bernard Leca, and Eva Boxenbaum. "2 how actors change institutions: towards a theory of institutional entrepreneurship." *The academy of management annals* 3.1 (2009): 65-107.
- Bourdieu, Pierre. *The logic of practice*. Stanford University Press, 1990.
- Demil, Benoît, and Jabil Bensédérine. "Processes of legitimization and pressure toward regulation: corporate conformity and strategic behavior." *International Studies of Management & Organization* 35.2 (2005): 56-77.
- DiMaggio, Paul J. "Interest and agency in institutional theory." *Institutional patterns and organizations: Culture and environment* 1 (1988): 3-22.
- Dorado, S. (2005). Institutional entrepreneurship, partaking, and convening. *Organization studies*, 26(3), 385-414.
- Fligstein, Neil, and Ryan Calder. "Architecture of Markets." *Emerging Trends in the Social and Behavioral Sciences: An Interdisciplinary, Searchable, and Linkable Resource* (2001).

Fligstein, Neil, and Luke Dauter. "The sociology of markets." *Annu. Rev. Sociol.* 33 (2007): 105-128.

Fligstein, Neil. "Markets as politics: A political-cultural approach to market institutions." *American sociological review* (1996): 656-673.

Edquist, Charles, and Leif Hommen. *Public technology procurement and innovation*. Vol. 16. Springer Science & Business Media, 2000.

Geels, Frank W. "From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory." *Research policy* 33.6 (2004): 897-920.

Geels, Frank. "W (2005) Technological Transitions and Systems Innovations: A Coevolutionary and Socio-Technical Analysis."

Phillips, Nelson, Thomas B. Lawrence, and Cynthia Hardy. "Discourse and institutions." *Academy of management review* 29.4 (2004): 635-652.

Mahboudi, Fereidoun, Haleh Hamedifar, and Hamideh Aghajani. "Medical biotechnology trends and achievements in Iran." *Avicenna journal of medical biotechnology* 4.4 (2012): 200.

Morel, Carlos M., et al. "Health innovation networks to help developing countries address neglected diseases." *Science* 309.5733 (2005): 401-404.

Murmann, Johann Peter. *Knowledge and competitive advantage: The coevolution of firms, technology, and national institutions*. Cambridge University Press, 2003.

Podolny, Joel M. "A status-based model of market competition." *American journal of sociology* (1993): 829-872.

Sine, Wesley D., and Robert J. David. "Environmental jolts, institutional change, and the creation of entrepreneurial opportunity in the US electric power industry." *Research Policy* 32.2 (2003): 185-207.

Uzzi, Brian. "The sources and consequences of embeddedness for the economic performance of organizations: The network effect." *American sociological review* (1996): 674-698.

Wade, Robert. *Governing the market: Economic theory and the role of government in East Asian industrialization*. Princeton University Press, 1990.

Williamson, Oliver E. *The economic institutions of capitalism*. Simon and Schuster, 1985.

Parallel Sessions 8

8A. POLICY FOR SUSTAINABILITY

Aiming high and failing spectacularly - Lessons from a recent crisis in regenerative medicine

Maureen McKelvey*, Rögnvaldur Saemundsson and Olof Zaring

(Institute of Innovation and Entrepreneurship, School of Business, Economics, and Law, University of Gothenburg)

*maureen.mckelvey@handels.gu.se

KEYWORDS: Governance of change, Medical innovation, Regenerative medicine, Crisis of legitimacy

Within the field of regenerative medicine radical steps are taken in an attempt to relieve human suffering and save lives. This approach is not without risks and may lead to crisis of legitimacy in prestigious and fast-moving fields, (The Lancet 2014, van Hoorden 2011).

A recent Swedish television documentary tells the story of the thorax surgeon Paolo Macchiarini at the Karolinska Institute and his attempts to develop a new procedure for replacing parts of the trachea by growing stem cells on both biological and synthetic scaffolds. Originally presented as a groundbreaking achievement documented in prestigious medical journals and hailed by the press, it is now seen by many as a reckless and unethical experimentation enabled by research fraud. Four members of the Nobel Prize committee in Physiology or Medicine have resigned. The Vice-Chancellor of the Karolinska Institute has resigned. Police investigation is in process. A former minister and head of Swedish police is investigating whether unethical research practice can be verified. At the same time The Lancet (Horton 2016) has published a comment on why they have not retracted his article. Hence, while the Macchiarini crisis is not unique, it raises many interesting theoretical and practical questions about the governance of medical research and innovation in general, and regenerative medicine in particular.

The purpose of this paper is to identify and conceptualize the governance challenges related to major advances in medical research and innovation. Based on a previous conceptual model to explain technological collaboration (McKelvey et al 2015), this paper uses the case of regenerative medicine and of the crisis surrounding Macchiarini and the Karolinska Institute to identify three challenges facing policy makers and researchers. This paper is framed through theories of the specific site of medicine as an area for innovation. Recent research on medical innovation has focused on explaining how and why medical innovation emerges through heterogeneous and dispersed actors, such as hospitals, firms and universities, interacting through sequences of problem-finding, and problem-solving, processes (Metcalf et al 2005). In this research special attention has been given to the role of clinical practice and its mutual interaction with biomedical science, but at the same time noting the role of the physician in mobilizing and guiding industrial innovation (Blume 1992, Hopkins 2006). In this particular setting, we then apply and develop theories of governance and co-evolution of knowledge in medicine to describe the system challenges (McKelvey et al 2015). In line with Borrás and Edler (2014) we are interested in governance of change in socio-technical systems. Our conceptual model of the governance of technological collaboration recognizes that different types of organizations are involved in the production and use of knowledge, where each has a different set of incentives and networks. However, the governance requires the development of common norms and institutions for collective action. Some are set at the system level, through policy and regulation, but in our approach we focus on self-regulation at the micro-level.

The challenges identified here are: Firstly, role of research funding, especially the concentration of funding into strategic areas. The hiring of an internationally acclaimed researcher, Macchiarini, coincides with a strategic investment in regenerative medicine by the Karolinska Institute supported by large government grants for research excellence. High concentration of research funds, strong pressures for success, and global competition for talent put strains on existing systems of governance of research and innovation.

Secondly, close connections between medical research and practice. While employed by the Karolinska Institute, where he was a key figure in building what was supposed to be a world leading research group in stem cells and regenerative medicine, Macchiarini was also doing operations at the Karolinska hospital and other hospitals around the world. In some cases patients from other countries than Sweden were operated at the Karolinska

hospital, with follow-up and further treatment at their local hospital by local physicians who became co-authors on research papers. While university departments and university hospitals may employ the same people, which means they are involved both in research and practice, there are different rules and culture within medical research and clinical practice in terms of experimentation. In the former case the focus is on what is ethical when searching for new knowledge about diseases and their treatment. In the latter the focus is on what is ethical when trying to save lives. However, this distinction becomes less clear when operations that may save lives are an important source of new knowledge that can affect the direction of research. Furthermore, apart from academic pressures, these issues play out in a larger context, which involves development of stem cell technology and intellectual property rights to commercialize the technology. For example, Macchiarini is a co-inventor of a patent owned by Harvard Apparatus Regenerative Technology (HART), a biotechnology firm providing the stem cell technology that he used in his operations.

Thirdly, systemic problems due to the evolutionary nature of knowledge. Innovations may give rise to irreducible systems based on how bottlenecks direct the focus of attention in order to solve critical problems. As the search for new medical knowledge has a strong ethical dimension, is sought for the common good, and funded by public funds, oversight is required for what bottlenecks should be attended to and how. This oversight is provided through various regulatory bodies and procedures, both by government and individual organizations, such as universities, hospitals, and academic journals. In the Macchiarini case, as is typical for medical innovation, activities cut across a large and complex multilevel system crossing geographical boundaries that may be impossible to govern from above but requires self regulation.

Hence, this paper will apply a theoretical model of governance, as well as theories taking into account the specific characteristics of medical innovation, to the Macchiarini crisis. The three challenges identified above structure our analysis of future effects. We argue that the most likely responses are to blame one individual as a scapegoat, rather than the system, and strengthen the oversight and regulation, including monitoring, related to the interface between medical research and practice. While the latter is appropriate when regulatory frameworks are seen as instrumentation of the governance of change such responses do not solve the governance issues of self-regulation nor take into account actors others than hospitals and universities.. We argue, based on our conceptual model, that these responses may thus have the adverse effects of introducing bottlenecks in the system.

References

- Barberá-Tomás, D. and Molas-Gallart, J. (2014). Governance and technological change: the effects of regulation in medical devices. In Borrás, S. and Edler, J. (eds.) *The Governance of Socio-Technical Systems. Explaining Change*. Cheltenham, Edward Elgar Publishing.
- Blume, S. S. (1992). *Insight and Industry. On the Dynamics of Technological Change in Medicine*. Cambridge, MA: MIT Press.
- Borrás, S. and Edler, J. (eds.) (2014). *The Governance of Socio-Technical Systems. Explaining Change*. Cheltenham, Edward Elgar Publishing.
- Hopkins, M. (2006). The hidden research system: The evolution of cytogenetic testing in the national health service. *Science as Culture*, 15(3), 253-276
- Horton, R. (2016). Offline: Paolo Macchiarini - Science in conflict. *The Lancet*, 387, 732.
- McKelvey, M., Zaring, O., and Szűcs, S. (2015). Governance of Regional Innovation Systems: An Evolutionary Conceptual Framework of How Firms Engage in Technological Collaboration. Presentation at DRUID 2015 and AOM 2015.
- Metcalfé, S. James, A. Mina, A. (2005). Emergent innovation systems and the delivery of clinical services: The case of intra-ocular lenses. *Research Policy* 34 (9), 1283-1304
- The Lancet (2014). Retractions: the lessons for research institutions. *The Lancet*, 384, 104.
- van Noorden, R. (2011). The trouble with retractions. *Nature*, 478(6), 26-28.

Lock-in of mature Technological Innovation Systems, The transformation towards clean concrete in the Netherlands

Alexander van der Vooren(PBL, Netherlands Environmental Assessment Agency) and **Joeri Wesseling***(CIRCLE)

*Joeri.wesseling@circle.lu.se

KEYWORDS: System failures, System functions, Systemic lock-in, Vested interest

Introduction

Energy-intensive processing industries like the concrete industry are among the largest energy users and contributors of greenhouse gases and form the base of the economy by producing basic materials for most infrastructure and products. Research into the development and diffusion of clean processing technologies needed to meet 2050 emission targets is therefore crucial in these industries, but transition studies have largely omitted these sectors. The relevance of this paper lies first in analyzing one of these industries, the concrete industry, from a transition's perspective to provide insights into why sustainability transformation of these industries is lagging behind. Second, the relevance of this paper lies in applying the system functions approach to mature Technological Innovation Systems (TIS), as opposed to its predominant focus on emerging TIS (Bergek et al., 2008; Coenen and Díaz López, 2010; Hekkert and Negro, 2009; Kieft et al., 2016)., to understand systemic lock-in.

The research aim of this study is to analyze the interrelated systemic problems that inhibit the diffusion of clean concrete innovations (CCI) and constitute the lock-in of the mature TIS of concrete, for the case of the Netherlands.

Theoretical framework

Carlsson and Stankiewicz (1991, p.111) define a TIS as a “network of agents interacting in a specific economic/industrial area under a particular institutional infrastructure and involved in the generation, diffusion and utilization of technology”. The coupled structural-functional approach has been developed to identify systemic problems that inhibit the functioning of emerging technological innovation systems (Wieczorek and Hekkert, 2012) by relating them to the system functions that are “intermediate variables between structure and system performance” (Jacobsson and Bergek, 2011, p.46). This approach however tends to overlook the role of interdependent system components and of vested interests, most likely because these factors are more characteristic to mature instead of emerging innovation systems. By analyzing the interdependency of systemic problems we overcome these drawbacks and extend the application of the approach to the transformation of a mature sectoral innovation system towards the development and diffusion of CCI. The consequences of this extension for the results of the study are critically discussed.

Methods

We conducted interviews with 28 stakeholders and triangulated these data with reports, websites and other literature to identify what systemic problems inhibited the diffusion of CCI, how these problems are interrelated and what the role of vested interests is in these systemic problems. The analytical steps taken in this paper include:

- 1.Preliminary mapping out the SIS' structural components
- 2.Functional analysis to identify weaknesses in functional performance
- 3.Identification of systemic problems in the structural components that cause these weaknesses
- 4.Identification of interdependencies between systemic problems to detect more deeply embedded problems
- 5.Formulation of policy measures to alleviate potentially interdependent systemic problems

To assess the performance of the system functions depicted in Table 1, we used the established operationalization scheme used by various TIS studies (e.g. Hekkert and Negro, 2009; Negro et al., 2008, 2007; Suurs and Hekkert, 2009; Wieczorek and Hekkert, 2012) that attributes indicators to this set of functions.

Results

We identify a list of interdependent systemic problems that inhibit CCI and that originate along the supply chain

of concrete within actors, institutions, networks, technology and infrastructure. These problems significantly affected the performance of all system functions, with the exception of knowledge development which continued to perform relatively well. Figure 1 (link: <http://joeriwesseling.com/wp-content/uploads/2015/08/Figure-1-EU-SPRI.pdf>) provides an overview of the interdependence between systemic problems (rectangles) and the effects they have on system function performance (ovals). An example of systemic interdependency on the demand side, is the procurer's conservative attitude, which inhibits knowledge diffusion, resulting in a perception of CCI as being "too risky". This behavior has become institutionalized in routinized procurement for high-quality, certified concrete that complies with conservative norms and preempts CCI.

As the Figure shows, vested interests induce various interdependent systemic problems. Established firms are for example influential in shaping technology roadmaps and norm and certification procedures; something that is reinforced by well-organized industry associations and enabled by the industry's self-regulative culture. They influence roadmaps to solidify and spread expectations regarding the direction of CCI. This affects firm behavior and reinforces the idea amongst procurers that CCI are too risky to procure, which translates into a barrier to market formation. Norm and certification procedures are conservative and not open to many CCI. Since the routinized procurement only includes certified concrete that complies with the norms, market formation is indirectly affected. Norm and certificate compliance is very time and capital consuming, which creates a barrier to entry and inhibits experimentation, particularly since low profit margins and the inability to attract external capital strain resources.

Conclusions

We conclude that the structural-functional approach has yielded valuable insights in the transformational dynamics of mature TIS. To get an understanding of how systemic lock-in prevents system transformation, it is important to take into account the interdependence of systemic problems; particularly the role vested interests play in these problems. Besides these theoretical contributions, the research approach has provided valuable practical insights into why so few CCI are diffusing in the Netherlands. We end the paper with policy recommendations on how to overcome systemic lock-in by mitigating the identified interdependent systemic problems.

References

- Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., Rickne, A., 2008. Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. *Res. Policy* 37, 407–429. doi:10.1016/j.respol.2007.12.003
- Carlsson, B., Stankiewicz, R., 1991. On the nature, function and composition of technological systems. *J. Evol. Econ.* 93–118.
- Coenen, L., Díaz López, F.J., 2010. Comparing systems approaches to innovation and technological change for sustainable and competitive economies: An explorative study into conceptual commonalities, differences and complementarities. *J. Clean. Prod.* 18, 1149–1160. doi:10.1016/j.jclepro.2010.04.003
- Hekkert, M.P., Negro, S.O., 2009. Functions of innovation systems as a framework to understand sustainable technological change: Empirical evidence for earlier claims. *Technol. Forecast. Soc. Change* 76, 584–594. doi:10.1016/j.techfore.2008.04.013
- Jacobsson, S., Bergek, A., 2011. Innovation system analyses and sustainability transitions: Contributions and suggestions for research. *Environ. Innov. Soc. Transitions* 1, 41–57. doi:10.1016/j.eist.2011.04.006
- Kieft, A., Harmsen, R., Hekkert, M., 2016. Interactions between systemic problems in innovation systems: The case of energy-efficient houses in the Netherlands. *Innov. Stud. Utr.*
- Negro, S.O., Hekkert, M.P., Smits, R.E., 2007. Explaining the failure of the Dutch innovation system for biomass digestion-A functional analysis. *Energy Policy* 35, 925–938. doi:10.1016/j.enpol.2006.01.027
- Negro, S.O., Suurs, R. a, Hekkert, M.P., 2008. The bumpy road of biomass gasification in the Netherlands: Explaining the rise and fall of an emerging innovation system. *Technol. Forecast. Soc. Change* 75, 57–77. doi:10.1016/j.techfore.2006.08.006
- Suurs, R. a, Hekkert, M.P., 2009. Cumulative causation in the formation of a technological innovation system: The case of biofuels in the Netherlands. *Technol. Forecast. Soc. Change* 76, 1003–1020. doi:10.1016/j.techfore.2009.03.002
- Wieczorek, A.J., Hekkert, M.P., 2012. Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars. *Sci. Public Policy* 39, 74–87. doi:10.1093/scipol/scr008

Innovation policy in the age of transitions

Gijs Diercks*(Imperial College London), Henrik Larsen(Imperial College London) and Fred Steward(Policy Studies Institute - Westminster University)

* g.diercks14@imperial.ac.uk

KEYWORDS: Transformative Innovation Policy, Grand Societal challenges, Mission-oriented innovation, Systems Innovation

Relevance

Modern societies are faced with a set of interconnected grand challenges that are deeply rooted in societal structures (Elzen et al. 2004). This structural entrenchment presents a dilemma on how to address grand challenges as prevailing policy approaches focusing on either market failures or individual behaviour do not produce an adequate policy response (Steward 2012). Consequently, alternatives are advanced by academics and policy makers from the STI community who have increasingly taken the interest in exploring the transformative potential of innovation to address accumulating grand challenges.

Research aims(s) and question(s)

The aim of this research is to gain a better understanding of the different policy initiatives that are currently occupying this new space for innovation policy that explicitly tries to address these ‘grand’ or ‘societal’ challenges. Questions that will be addressed are: what is transformative innovation policy? How do new challenge-led innovation policy initiatives draw on both mission-oriented innovation and systems innovation? What are the implications of a transformative innovation policy-mix for different actors, different modes of innovation and different geographies?

Definitions

This paper argues that the advent of grand challenges is giving rise to a third generation innovation policy, hereafter called transformative innovation policy, which is layered upon but not fully replacing the first generation of science & technology (S&T) policy and the second generation innovation systems (IS) policies (a.o. Borras, 2003; Borras 2007; Lundval 2007; Kemp 2011; Kallerud 2010; Kallerud, 2013; Fagerberg 2003).

Theoretical frameworks

We present a framework for understanding this new generation of innovation policy by specifying it around two dimensions: (1) the understanding of the innovation process and (2) its policy agenda. In doing so, transformative innovation policy is conceptualised as having a broad systemic understanding of the innovation process and a broad societal policy agenda. It thereby contests both the narrow linear understanding of the innovation process of the first generation (S&T) and the narrow economic policy agenda of the second generation (IS).

This new challenge-led agenda created for innovation policy is currently being occupied by two main groups. One group is advocating a mission-oriented approach, arguing for concerted action and picking winners (e.g. Mazzucato, 2013; King, 2015; Dechezlepetre et al 2016). The second group advocates the need for wider systems innovation i.e. the transitions of established socio-technical systems into environmentally sound ones (e.g. Geels and Schot 2007, Steward, 2008; Scrase et al 2009; Weber and Rohracher, 2012, Nesta, 2013). Rather than equating the two concepts, we argue that transformative innovation policy is a new generation of innovation policy that draws both on mission-oriented and systems innovation approaches. Transformative innovation policy acknowledges the technological aspects of grand challenges and the need of science-driven R&D programmes. At the same time, it emphasises the societal nature of the challenge, which ranges across different spatial scales and the necessity of a more broad-based agenda that aims to accelerate the diffusion of the technologies into daily practices and different local contexts

Transformative innovation policy is therefore about finding a balanced policy mix, but this is easier said than done. Although it is widely acknowledged that this mix calls for cooperation at both regional, national and international levels, it remains poorly understood how policy arrangements can be designed and coordinated for different levels of governance (Markard et al. 2012, OECD 2012). Following the networked model of innovation, this paper aims to contribute on this point by arguing that every single policy mix must be very explicit about the modes of innovation pursued, types of actors it addresses and the relevance of proximity that is a result of this. In this regard innovation activities are recognised to transcend conventional analytical boundaries and work between interrelated spatial scales; a proposition which runs counter much of the established literature on innovation that asserts that knowledge is spatially sticky i.e. innovation and interactive learning requires co-location.

The global local dimension in innovation systems has often been downplayed and referred to as a 'global technological opportunity set' to which all actors have equal access (Carlsson et al. 2002). This framing of innovation is increasingly questioned and replaced with a view of differentiated access to unevenly distributed resources and structural system failures. Furthermore, recent studies suggest that geographical proximity may not be a necessary nor sufficient condition for innovation and interactive learning as other forms of cognitive, organisational, social and institutional proximity may substitute to solve problems of coordination and knowledge asymmetries (Boschma 2005). The limitation of innovation systems to the national and regional scale seems less and less appropriate and some scholars have started to engage with these new realities and focus on the explicit conceptualisation of geographical context in innovation studies. The literature on geography of sustainability transitions particularly focus on this international dimension of innovation processes and looks into how transnational linkages play an important role in the emergence of new innovations (Binz et al. 2014, Coenen et al. 2015, Truffer and Battistini 2015).

Empirical materials

Focussing on climate change, the empirical part of the paper assesses a number of recently published policy strategies, such as 'Mission Innovation' and 'Breakthrough Energy Coalition' launched at the 2015 United Nations climate change conference (COP21), and a number of influential reports written by the OECD (The Innovation Paradigm, 2015), UNCTAD (Technology and Innovation Report 2015) and the EU (Innovation Union, 2010).

Methodology Applied

The methodology applied is argumentative discourse analysis. An argumentative analysis looks at the particular position that is being defended by a certain statement, or against which criticisms are being expressed. This builds on the so-called argumentative turn in discourse analysis (Billig, 1986), in which any expression of language is seen as part of a dialogue, embedded in but also actively shaping discursive structures.

The creation of discursive structures is not random, but it's the outcome of a struggle between various parties that have not necessarily met, but share similar storylines; particular ways of talking and thinking about a topic. By doing so, they form discourse coalitions responsible for producing, reproducing and at times transforming discourses (Hajer, 1995). Discourse are therefore the result of a constant underlying power struggle between different discourse coalitions competing for influence. Identifying different discourses will tell you something about this underlying power struggle. The importance of unravelling these power struggles lies in the Foucauldian model of social change in which structural changes in society can be conceptualized as shifts in the relevant influence of different systems of meaning, i.e. different discourses (Sharp and Richardson, 2001). Using Atlas.ti a basic (structural) coding procedure is done, followed by a further qualitative analysis.

Expected outcomes

The main outcome of this paper will be to gain a better understanding of the different challenge-led innovation initiatives that are currently entering the policy domain. It will assess the degree to which these policy strategies are grounded in both a challenge-led and broad-based approach to innovation. The paper will finish with a discussion on what might constitute a balanced transformative innovation policy-mix.

REFERENCES

8B. CREATIVITY, KNOWLEDGE AND INNOVATION

Skills Diversity and Firm Growth: The Complementary Role of Arts and Science Skills

Josh Siepel*(SPRU, University of Sussex), Roberto Camerani(SPRU, University of Sussex) and Monica Masucci(Dept of Business and Management, University of Sussex)

*j.siepel@sussex.ac.uk

KEYWORDS: Creative skills, STEM skills, Functional diversity, Firm Growth

1. Relevance

The importance of the skills base for national innovative competitiveness in much of the UK and elsewhere in Europe has focused on the key role played by STEM skills for both innovation and firm performance (Coad et al 2014). At the same time there has been an increasing interest in the role of creative skills and their role in the ‘creative economy’ and creative industries (Nesta 2013). There has also been an increasing convergence between these two areas, as researchers have begun to explore whether arts and science skills may indeed be complementary relationship. This notion suggests that the training and enculturation of professionals with arts and science skills may be particularly well suited to joint working. A complementary effect between employment of arts and science graduates has been identified at a local level in Sapsed et al (2014), who study firms in the creative industries and digital economy cluster in Brighton. This study found that within the cluster, firms that fused creative and technical skills outperformed firms that utilised only one or the other. This matches other findings in the literature more broadly that functional diversity has a strong positive relationship for design and product teams (see Bell et al 2010). This phenomenon, referred to as ‘fusion’ To our knowledge, however, these findings have not been replicated outside either the cluster level or the level of creative industries.

2. Research aims and questions

Our research question asks whether the combination of arts and creative skills and STEM skills is associated with higher levels of firm growth when considered across the entire economy. We propose that use of very different skillsets within an organisation enhances the search activities of a firm, and that consequently the utilisation of very different skillsets by a company enables it to outperform other similar firms. At the same time, we suggest that this process is lagged, meaning that the combination of skills takes a period of time to ‘bed in’ before performance dividends can be realised.

3. Definitions

While the academic literature on diversity has explored functional diversity, or diversity in training, educational background and tasks, little work has been done exploring possible complementarities between different types of skills. In this paper we consider the potential complementarities between two very different forms of skills: arts and creative skills, including design and multimedia skills; and science, technology, engineering, and mathematics skills (STEM). While STEM skills are widely understood to be linked with high levels of firm performance (Coad et al., 2014), the impact of arts and creative skills to firm performance is much less known, particularly outside the context of creative industries and specific localities (e.g. Sapsed et al., 2013).

4. Theoretical frameworks

Within the management literature on diversity, the role of functional diversity, the range of skills used by members of entrepreneurial or managerial teams or organisations (Ensley et al., 1998; Bunderson and Sutcliffe, 2002; Canella et al 2008), has emerged as an important field of its own. The literature on functional diversity identifies both benefits and drawbacks of diverse teams or organisations: on one hand functional diversity facilitates a broader range of routines and search patterns (e.g. Ostergaard et al., 2011), but on the other hand too much diversity may result in conflict, communications breakdown and poor performance (Zenger and Lawrence, 1989; Pelled et al., 1999, Keller, 2001).

The literature on functional diversity, as discussed above, has much to contribute to this emergent area of research. Indeed, while science and arts skills represent an element of functional diversity, we argue that the

unique tensions between the two make this a unique subset of functional diversity, which we identify as ‘creative diversity’. In line with the literature on functional diversity we propose a similar mechanism driving creative diversity as drives other variants of functional diversity: specifically the improved range of search mechanisms, generation of novel innovations and improved absorptive capacity. However, while much of the recent literature on functional diversity has focused on its impact on innovation (e.g. Ostergaard et al 2011 and Faems and Subramanian 2013), here we consider whether these creative and technical skills impact firm performance. In our proposed model, the broadened perspectives facilitated by a creatively diverse workforce allow a firm not only to develop new innovations, but also to commercialise them, resulting in higher levels of firm growth. This is not an inconsequential assumption: it is well understood within the literature that while innovation is persistent over time, growth is not (see Coad et al 2014). Further, given the length of time associated with commercialisation, it is not immediately clear if the time scale in which these effects would be identified would be manifested. However, given the precedent in the form of one geographic- and sector-specific evidence to this effect, our aim is to explore this phenomenon on a much broader scale.

5. Empirical materials

This paper combines data from two official UK government sources. First, we use a new set of questions included in the 2010 wave of the UK Innovation Survey asking respondents about their use of creative and STEM skills. The key independent variables for our analysis comes from a set of questions introduced in the 2010 UKIS which relate to skills accessed by the companies in question, asking if they used arts or creative skills (including design, multimedia, and graphic arts), or science skills (including software development/computer database skills, engineering, and mathematics). This allowed us to create binary variables that are positive if a firm has only arts, only STEM or both arts and STEM skills use. We then link this data with official performance data (employment and sales growth) from the UK Business Structure Database. This allows us to observe subsequent performance beyond the 2008-2010 timeframe captured by the survey.

For our dependent variables we use sales and employment growth, measured in two different periods of time. In particular, we measure firm growth using log difference measures for the 2008-2010 and 2010-2012 periods for both employment and sales. We also control for measures including age, size, R&D intensity, human capital, industry and UK region.

6. Description of methodologies

We use these data to estimate a series of OLS models that use growth (including sales and employment, for the period 2008-10 and 2011-13) as the dependent variables and the type of skills used (STEM and creative, STEM only, creative only, none) as the key independent variables. We use a variety of different specifications, alongside a range of robustness checks.

7. Expected outcomes

Our results indicate that firms only using STEM skills showed significantly higher sales and employment growth during the 2008-10 period, but this effect disappeared in the period 2011-13. We find firms combining STEM and creative skills showed significantly higher growth in this subsequent period. This effect was also associated with organisational change in the original period, suggesting that the boost to performance was lagged following organisational changes to allow the diversity of skills to be effectively used.

Our paper makes three contributions to the literature. First it presents to our knowledge the first cross-sectoral study of the complementary effects of investment in arts and science skills. Second, it extends the functional diversity literature from the team level to the organisation level. Finally, it presents a theoretical perspective that facilitates an initial understanding of the potential mechanisms and explains some inconsistencies in past literature.

Beyond this, the findings in this paper have the potential to make a significant contribution to broader innovation policy across Europe. Given the extensive current emphasis on STEM skills as drivers of innovation, our findings suggest that STEM skills on their own are not sufficient to drive superior firm performance, and that creative skills are a key element required to facilitate firm performance. This leads to policy recommendations at the local and regional level (in line with Sapsed et al 2013) but also emphasises how these firms combining

arts and science skills exist throughout the economy and in all sectors, not just in specific clusters or industries. Consequently this work has the potential to provide an economic logic for the burgeoning ‘STEAM’ (Science, Technology, Engineering, Arts, and Maths) movement in education, and the potential of creative and arts education as drivers of innovation more broadly.

References

- Ensley, M., Carland, J. & Carland, J., 1998. The effect of entrepreneurial team heterogeneity and functional diversity on venture performance. *Journal of Business and Enterprise*, 10(1), pp.0–9.
- Bunderson, J.S. & Sutcliffe, K.M., 2002. Comparing Alternative Conceptualizations Of Functional Diversity In Management Teams: Process And Performance Effects. *Academy of Management Journal*, 45(5), pp.875–893.
- Cannella, A.A., Park, J.-H. & Lee, H.-U., 2008. Top Management Team Functional Background Diversity and Firm Performance: Examining The Roles of Team Member Colocation and Environmental Uncertainty. *Academy of Management Journal*, 51(4), pp.768–784.
- Østergaard, C.R., Timmermans, B. & Kristinsson, K., 2011. Does a different view create something new? The effect of employee diversity on innovation. *Research Policy*, 40(3), pp.500–509.
- Zenger, T.R. & Lawrence, B.S., 1989. Organizational Demography: The Differential Effects Of Age And Tenure Distributions On Technical Communication. *Academy of Management Journal*, 32(2), pp.353–376.
- Pelled, L.H., Eisenhardt, K.M. & Xin, K.R., 1999. Exploring the Black Box: An Analysis of Work Group Diversity, Conflict, and Performance. *Administrative Science Quarterly*, 44(1), p.1.
- Keller, R.T., 2001. Cross-Functional Project Groups In Research And New Product Development: Diversity, Communications, Job Stress, And Outcomes. *Academy of Management Journal*, 44(3), pp.547–555.
- Sapsed, J., Nightingale, P., Mateos-Garcia, J., Camerani, R., Voss, G., Jones, P. and Byford, J., 2013. The Brighton Fuse. AHRC, available from: www.brightonfuse.com

Creativity, innovation and research in the Norwegian economy

Mark Knell

(NIFU Nordic Institute for Studies in Innovation, Research and Education)

*mark.knell@nifu.no

KEYWORDS: Creativity, Innovation, R&D activity, Norway

Background and research question. The creation, transfer and use of new knowledge depend critically on supporting and cultivating creativity and skills within the enterprise. This idea of innovation dates back to at least the time of Adam Smith who explained how skills and creativity could lead to higher productivity through a more sophisticated division of labor. As the division of labor evolves into new and different tasks, some tasks will appear routine and require little knowledge, while others may be knowledge intensive and require certain cognitive, learning and creative capacities. In a similar way, Joseph Schumpeter provided the entrepreneur with the creative ability to combine new and existing knowledge in different ways. Schumpeter was one in a chorus that deviated from the idea of a creator deity, instead reserving the word creativity to describe all fields of social production, including those that involve the creation, use, and recombination of new and existing knowledge. He introduced the phrase “creative destruction” to describe how old products, processes and organizational methods were destroyed and replaced by new ones. Herbert Simon considered invention and innovation as creative problem solving activities, including brainstorming sessions, multidisciplinary teamwork, and other methods that stimulate curiosity and creativity, and is related more closely with ideas in cognitive psychology that apply experimental methods. This suggests that the process of generating new ideas is different from the use or application of those ideas, and that these social processes underlying these activities are self-organizing, nonlinear, and rather messy. Thus, it is possible to have innovation without invention and creativity without innovation.

This paper is mainly about how creativity and skills within the enterprise can bring about different types of research and innovative activities. It focuses on certain creative activities within the firm and how they might affect the innovation process. It is not about the creative industries per se, but on how enterprises gain access to relevant creative skills and stimulate new ideas or creativity among its staff. Innovation and creativity are interrelated, but the main premise of this paper is that innovation drives creativity by turning creative ideas into economic use as new products, processes organizational practices, and marketing strategies. The objective is to demonstrate whether different methods to stimulate new ideas and creativity are successful or not and whether they lead to new research, or product, process and other types of innovation. The paper is roughly divided into two parts; one section develops a theoretical framework that combines innovation economics and cognitive psychology by exploring what lies underneath creativity and the innovation process, and a second part that builds a simple binary response (probit) model based on the combined R&D and innovation survey of Norway that can demonstrate the relationship between Creativity, innovation and R&D activity.

Empirical Methodology. The 2010 Norwegian survey on R&D and innovation of business enterprises contains a rich amount of information on the inputs, the outputs and the characteristics of research and innovation activities covering the period from 2008 to 2010. It's methodology follows the Oslo Manual and adopted a sampling methodology that drew a stratified random sample covering about 35 per cent of those firms with 5-49 employees plus all firms with 50 or more employees. Almost 7,400 enterprises responded to the survey, of which almost 3,300 enterprises indicated they were innovative. In addition to the usual questions included in the bi-annual survey, the 2010 survey contained a unique set of questions on creativity and skills. One set of questions asked whether the enterprise employed eight different skills whether in-house or obtained from external sources. Another set asked whether they successfully used one of six different methods to stimulate new ideas or creativity among the staff. Relevant skills included graphic arts, product design, multimedia activities, web design, software development, market research, engineering, or statistics and database management. And methods to stimulate creativity included brainstorming sessions, cross-functional work teams, job rotation, financial incentives, non-financial incentives, and training activities that stimulate new ideas or activities. Many different combinations can be made between these variables and traditional measures of R&D and innovative activity.

The paper estimates a simple binary response model (probit model with a maximum likelihood estimator).

Following Schumpeter, the CIS 2010 includes four types of innovation that the model wishes to explain: 1) new or significantly improved products; 2) new or significantly improved production processes; 3) new organisational methods; and 4) new marketing concepts or strategies. Independent variables include novelty, creativity and skills, among other determinants contained in the questionnaire. Large firms experience economies of scale of various kinds and the probability of having own R&D activity increase with the size of the firm. And it considers the industrial structure.

Preliminary results. About 28% and 25% of all Norwegian firms (about 71% and 67% of innovative firms) indicate they have successfully used brainstorming sessions and multidisciplinary or cross-functional work teams to stimulate creativity. Manufacturing was slightly below average and the service sector was slightly above. These remaining four methods averaged between 10% and 13%. Similarly, firms with specific skills, such as graphic arts, layout and advertising, design of objects, multimedia, web design, software development, market research, engineering, applied sciences, statistics and database management, tended to be much more innovative than those that did not have them. The paper analyses the influence of the creative process in Norway on its innovative and research potential using a probit model.

Expected outcomes. The starting point of the analysis is to think of research and innovation as problem solving activities. As a theoretical framework, it provides a fusion between innovation economics and cognitive psychology by exploring what lies underneath creativity and the innovation process. In this context, the process of generating new ideas appears different from the use or application of those ideas. This suggests that creativity is a different activity from both research and innovation and so should be measured differently. It also suggests that creativity is a key driver of innovation and evolution, and ultimately economic growth. From the empirical standpoint, brainstorming sessions and multidisciplinary or cross-functional work teams appear as the most important ways to stimulate new ideas and creativity, but there may be a wide variety of other incentives that can also stimulate creativity. But they do not necessitate research or innovation. Identifying the sources of creativity is the first step in identifying new ways to use and combine new and existing knowledge and it lies at the heart of any innovation policy.

Governance of knowledge base complexity: Implications for innovation policy in resource based countries

Ali Maleki* and Rouholah Hamidi Motlagh

(Sharif University of Technology, Research Institute for Science, Technology and Industrial Policy)

*a.maleki@sharif.edu

KEYWORDS: Governance of knowledge, Knowledge base complexity, Resource based countries, Upstream petroleum industry

Introduction:

This article aims to explain how the changing nature of knowledge base complexity is associated with the governance structure of sectoral knowledge bases and its implications for innovation policy in resource based developing countries. The case of upstream petroleum industry is used as our empirical setting of the analysis. Although seems very relevant, the role of increasing knowledge complexity as an important factor in organization of innovation and a cognitive barrier in technology development is an under researched area. This specific notion of knowledge complexity matters when 'the opportunities to generate new knowledge are conditional on the identification and integration of the diverse bits of complementary knowledge that are inputs into the knowledge production process' (Antonelli, 2003, p.507).

The question of knowledge governance (the role of different actors in production of sectoral knowledge base) has been the subject of different branches of organizational and innovation studies which commonly use a functional approach to the analysis of knowledge governance. This tradition tends to look at the division of knowledge between different players and their particular functions in the governance of sectoral knowledge base. In other words, the role of different actors is analyzed collectively and systematically to examine the dynamics of their innovation strategy in terms of direction (specialization vs. integration) of technological activity. According to this literature two complementary hypothesis are proposed. First, it proposed that the dominance of a technological specialization strategy for innovators is often associated with the decline of knowledge base complexity. This is because the decline of complexity, by definition, means less technological interdependency between different segments of the sector which allows for technological modularity. By contrast, the second hypothesis proposes that companies move towards technological diversification when systemic complexity of the knowledge base increases. This is because of the rise of technical interdependency and higher transaction costs between different segments of the sector which prevents modularity and needs higher integration of different segment of the sector.

Data and Methodology:

The knowledge base complexity and its governance in upstream petroleum is analysed using the Derwent Innovating Index, the patent database which classifies all upstream petroleum industry patents in class H01. I follow Cantwell and Santangelo (2000) who use the inverse of Coefficient of Variance of Revealed Technology Advantage as a direct measure of diversification to explore the changing nature of knowledge governance among different actors in the sector. The analysis of knowledge base complexity is also done using the method suggested by Maleki et al.(2016).

Results:

Our dataset allows us to distinguish between three main types of actors in the top 50 patentees in the sector, analysing their behaviour during two different periods. These are integrated oil companies (IOCs), integrated service companies (ISCs) and other specialized supply and service companies (SSCs)

The hypothesis of this research is supported by empirical evidence. It is shown that while systemic complexity is decreasing in first period, all three types of actors take a specialized growth innovation strategy. This evidence suggests that none of the actors see technological diversification as an efficient strategy to respond to the specific knowledge requirements of the industry. In contrast they differentiate themselves by sticking to and deepening their own area of technological expertise. This seems reasonable when technical inter-dependency in various parts of the sector is relatively low.

However during the rise of systemic complexity in the next period, the innovative behaviour of different actors began to diverge, signalling the emergence of new type of knowledge governance. Integrated Service Companies emerge as the new systems integrators of the sector with aggressive diversified growth innovation strategy to

cope with this excessive systemic knowledge base complexity. Exploiting the combination of economy of scope alongside economy of scale justifies this concurrent expansion of size and diversity in ISCs. Compared to other agents, they managed to benefit from the synergies and interrelatedness between the diverse and increasing number of technological domains in their knowledge portfolio. In fact the technological behaviour of ISCs looks like a new entity in the sectoral innovations system which deals with technological interrelatedness and systemic interactions within different domains of the knowledge base.

In contrast to ISCs, IOCs reduced the size of their innovative activities, following a technological specialization strategy. This seems to be a continuation of the specialisation strategy that they employed in the first period. They aim to refocus on technological 'core competencies' and leave non-core technological activities for other companies. We could characterize their behaviour as specialized de-growth or refocusing strategy. SSCs also continued their previous strategy, operating a specialized growth strategy during the second period. The combination of these three different innovation strategies clearly suggests a radical shift in the vertical division of knowledge, transformation of organizational patterns of innovation and emergence of a new knowledge governance system.

Implications for theory:

According to this analysis, it is shown that there is no unified theory which could consistently explain two novel aspects of the dynamics of the knowledge governance explored in the upstream petroleum industry. The first novel aspect is the full cycle of dis-integration and back to what was characterized as neo-integration. The second is the emergence of integrated service companies as the new system integrators following a forward integration strategy.

A co-evolutionary framework (Jacobides and Winter's, 2005) originally developed to explain the dynamics of vertical scope of production is proposed to be extended to the knowledge domain, as it seems very promising for the purpose of theoretical unity. This framework combines transaction costs as a partially endogenous variable and firm capabilities in order to explain the dynamics of governance structures. A tentative application of this unified theoretical framework in the case of upstream petroleum industry seems very promising.

The dominance of the specialized growth innovation strategy by most of agents in the dis-integration period is explained by the relative low transaction costs stemming from dominance of breadth complexity. The emergence of Integrated Service Companies as leading actors with aggressive diversified growth innovation strategies in the neo-integration period is interpreted as a sector-wide response to the emergent systemic complexity. It is explained that systemic complexity involves high transaction costs in knowledge generation processes and requires new system integration capabilities. In fact integrated service companies are understood as the new agents in the sectoral innovation systems of upstream petroleum industry which gradually emerge to serve a new function. This new function is the governance of excessive systemic complexity emergent in the most recent period.

Accordingly, a dynamic theory of governance of knowledge base complexity is suggested. It is also possible, on this basis, to analyse the role of geography in coping with the dynamics of complexity and how knowledge is integrated and coordinated across geographical distances, which is the subject of further research.

Implications for research and innovation policy:

The findings also paves the way to understand the role of knowledge base complexity in technological catch-up of latecomer countries. The empirical analysis presented suggests that the upstream petroleum industry involves both considerable opportunities and significant challenges for economic development in resource based countries. No innovation and industrial policy can be successful without deep understanding of the nature of the evolution of the industry and its underlying knowledge processes. The insights presented in this research with regard to evolving knowledge base complexity can inform research and innovation policy in several ways. First, the evidence presented clearly illustrates widespread and increasing innovation opportunities in upstream petroleum industry which justify policy interventions targeting knowledge-centred development agenda.

According to the new industrial and innovation policy approach (Rodrik, 2008), technological dynamism and potential knowledge spillovers are crucial for an industry to be the subject of policy interventions.

In addition, learning increasingly complex knowledge is subject to higher coordination costs, longer time periods, and perhaps wider externalities. In addition, it involves great levels of absorptive capacity and investment in research and development. This is why it is very unlikely that private companies will invest in the development of capabilities in complex industries. The aircraft industry as an example of complex sectors is an illustrative case. It is far from reality to believe that Boeing in the US and Airbus in Europe could have been developed without strong government support, not only in technological learning and R&D investments, but also

by securing the market (Niosi and Zhegu, 2008).

In sum, systemic knowledge base complexity calls for an 'additional' role to be played by government in support of catch-up processes in complex industries, if innovation opportunities are to be seized in latecomer countries. This is 'additional', because technological learning and capability building processes are not generally encouraged by market based mechanism even in non-complex sectors at basic levels, let alone in complex industries. The experiences reviewed show that such extra roles which involve integration and coordination of distributed learning, are often served through state-owned latecomer systems integrators as a policy tool for catch-up in complex industries.

References:

- Antonelli, C., 2003. Knowledge Complementarity and Fungeability: Implications for Regional Strategy. *Regional Studies*, 37(6-7), 595-606
- Cantwell, J. and G. D. Santangelo (2006). "The boundaries of firms in the new economy: M&As as a strategic tool toward corporate technological diversification." *Structural Change and Economic Dynamics* 17(2): 174-199.
- Jacobides, M. G. and S. G. Winter (2005). "The co-evolution of capabilities and transaction costs: explaining the institutional structure of production." *Strategic Management Journal* 26(5): 395-413.
- Maleki, A., Roseillo, A. and D. Wield (2016). "The effect of the dynamics of knowledge base complexity on Schumpeterian patterns of innovation: the upstream petroleum industry", Innogen working paper No. 116.
- Rodrik, D. (2008). "Industrial Policy: Don't Ask Why, Ask How? ." *Middle East Development Journal Special demo issue*: 1-29
- Niosi, J., & Zhegu, M. (2008). *Innovation system lifecycle in the aircraft sector*. DRUID, Copenhagen, CBS, Denmark.

8C. KNOWLEDGE TRANSFER AND INNOVATION

INTERGENERATIONAL TRANSFER OF SCIENTIFIC KNOWLEDGE AND SUSTAINABLE DEVELOPMENT OF SCIENCE

Sotaro Shibayama
(University of Tokyo)
sshibaya@gmail.com

KEYWORDS: Apprenticeship, Academic training, Scientific production, Knowledge transfer, Postgraduate education

The modern society is increasingly becoming knowledge-driven and major challenges our society faces today require solutions with scientific expertise, and accordingly, innovation and science policy literature emphasizes the role of the academic science. While scientific production is one of the primary functions of academic institutions, education is another. Formal teaching set aside, senior scientists (or principal investigators) are expected to train junior scientists including PhD students and postdocs as future scientists. Although these dual roles of academic institutions are indispensable for sustainable advancement of science, they could be incompatible, often leading to undersupply of training. Apparently, senior scientists' effort for training is made at the sacrifice of that for scientific production, and if scientists' primary objective is scientific production, less effort for training is made than is socially desirable. Despite its critical role in science, academic training has been relatively understudied both theoretically and empirically. This study aims to fill in the gap in literature by examining how academic training is incentivized and how it affects the shape of science.

To this end, this study draws on a sample of life science laboratories in Japan. I collected the data with a questionnaire survey conducted in May-July 2010 and from several databases of CVs, dissertations, and publications. To begin, I interviewed 30 Japanese life scientists concerning the context of lab activities, which was used to design the survey instrument. The survey was mailed to randomly sampled 504 professors in 20 Japanese universities, and 228 responses (response rate = 45%) were obtained. For the respondents, I identified their PhD students who graduated in 2000-2010. Removing professors who produced no PhD during the period, I have the final sample of 184 professors (i.e., lab heads) and their 1,126 PhD students. With this dataset, the current study obtains the following results.

In the academic lab context, this study distinguishes training for cognitive skills and that for technical skills, and finds that about half of the lab heads in my sample assign PhD students tasks requiring technical skills (e.g., doing experiment), while the other half assign students tasks requiring both technical and cognitive skills (e.g., planning research). In fact, many of my interviewees suggested the existence of two types of laboratories: one where students are treated like factory workers to concentrate on producing research results, and the other where students are trained as future scientists. This study empirically tests if the factory-like labs actually gain productivity compared to training-oriented labs, and indeed finds that training for cognitive skills is negatively associated with publication productivity in the short term. The result also suggests that cognitive skill training increases students' productivity in the long term after graduation. Therefore, cognitive skill training is collectively beneficial for the scientific community but does not directly benefit lab heads. This finding is consistent with the assumption on the incompatibility between research and education.

A potential solution to this incompatibility is to extend mentor-mentee relationships. For example, literally extending PhD periods and employing one's own graduates (i.e., inbreeding) is a straightforward option. Continuous relationships can be maintained also in indirect manners when graduates collaborate with ex-lab heads or follow ex-lab head's line of research. In fact, the result shows that even 10 years after graduation about 20% of PhDs' publications are coauthored with and cite their ex-lab heads. Regression analyses indicate that both forms of publications are positively associated with cognitive skill training, especially when students' dissertation subjects are closely related to their lab head's lines of research, and the result also shows a positive association between inbreeding and cognitive skill training. A plausible interpretation is that lab heads provide cognitive skill training only if they expect direct reciprocity such as labor supply through inbreeding, collaboration, and reputation gain through citations. Although these mechanisms might offer a solution to the incompatibility of research and education, they are not without a flaw. Restricting graduates' research paths might undermine the dynamics of knowledge production and cause excessive competition in narrow research areas. Indeed, the result suggests that employment as a faculty member is deterred when many graduates from

the same lab follow their lab head.

Finally, this study investigates if these results differ by contexts. The result shows a stronger association between cognitive skill training and reciprocal publications in applied research than in basic research. It also shows a stronger association for younger lab heads, who are under fiercer competition, than for senior lab heads. Since recent policies tend to emphasize applied research and competitive evaluation, these results imply that the policies can reinforce direct mentor-mentee relationships, whereby compromising the capacity of science community to adjust to changing scientific and societal needs.

In summary, this study suggests that longer-term incentive needs to be implemented for sustainable development of science.

Combining Centers of Excellence programs with the attraction of foreign research organizations: challenges and policy options in Complex International Science, Technology and Innovation Partnerships

Jose Guimon*(Universidad Autonoma de Madrid (UAM)) and Laurens Klerkx(Wageningen University)
*jose.guimon@uam.es

KEYWORDS: Globalization of innovation, Centers of excellence, Global innovation networks, Technological catching-up

1. Relevance

Creating new centers of excellence through the attraction of leading universities and public research institutes from abroad constitutes a powerful mechanism available for emerging countries to upgrade their industrial activities and engage in new growth sectors that “develop in the context of increasingly multipolar, interlinked and rapidly globalizing innovation systems” (quoted from full Track Theme 9 Proposal).

While the literature has paid much attention to the policies used by governments to attract the R&D centers of multinational corporations (Dachs, 2015), policy schemes that aim to attract the R&D activity of foreign universities and public research institutes remain largely unexplored.

2. Research aim and questions

The objective of this paper is to assess the combination of centers of excellence programs with the attraction of foreign universities and research organizations and to discuss the associated trade-offs and challenges, in order to inform innovation policies addressing internationalization of R&D.

This objective is approached through a critical review of the existing literature and a case study of Chile’s International Centers of Excellence program, launched in 2008 to attract leading foreign universities and public research organizations that would set up research institutes in the country in collaboration with local partners. How was the program designed and why were those design options taken? What challenges appeared during the implementation stage? How successful was the program at fostering technology learning and industrial upgrading? What were the different impacts of the program? What are the future risks and sustainability challenges?

3. Definitions

By now, a large literature has emerged on the internationalization of R&D, through different forms such as international collaboration, outsourcing and offshoring. During the last decades multinational companies have expanded their global innovation networks by transferring more of their R&D activities outside their countries of origin (Castelli and Castellani, 2013; Narula and Zanfei, 2004). More recently, a growing number of universities and public research organizations have also established R&D institutes in foreign locations (Berger and Hofer, 2011; Jonkers and Cruz-Castro, 2010). From the perspective of host countries, the attraction of global R&D can facilitate the absorption of foreign knowledge and strengthen national technological capabilities. This is of special importance for developing countries, where it can contribute to closing technology gaps and accelerating technological catching-up (Fu et al., 2011).

Centers of Excellence programs have become an increasingly popular approach around the world to build critical mass in strategic scientific areas and to reward research excellence. Such programs can also be used to foster the internationalization of national innovation systems by attracting foreign researchers and engaging in international scientific collaborations. More recently, some countries (e.g., Chile, Singapore and Portugal, among others) have gone a step further by creating new centers of excellence through the attraction leading universities and public research institutes from abroad (Guimon et al., 2016; Pfothenhauer et al., 2016). These programs were designed with the aim of attracting foreign institutions that would conduct world class research linked to local industry needs in collaboration with domestic partners, and can be defined as Complex International Science, Technology and Innovation Partnerships (CISTIP) (Pfothenhauer et al., 2016). CISTIPs are generally characterised by: 1) being limited term capacity building arrangements in a specific domain with the help of a foreign partner; 2) combining explicitly collaborative activities with a set of paid activities provided by

one partner to the other; 3) using local taxpayer money (from the host country) to fund research with a foreign partner; 4) often addressing multiple goals (e.g., research, innovation, education); and 5) generally large scale involving many people and substantial funds.

4. Theoretical frameworks

Our paper aims to contribute to theory building at the interface of three current topics in the literature on innovation policies, namely centers of excellence, technological catching-up, and internationalization of R&D. From the literature a number of potential advantages, but also challenges and risks as regards the involvement of foreign partners in centers of excellence can be distilled. Advantages are mainly in terms of knowledge spill-over and capacity building for innovation and advanced technological development. Challenges and risks mainly relate to making international collaboration work and assuring that benefits are well distributed.

One of the biggest challenges is the long-term and sustained effort needed to accrue returns on this kind of program (Hellström, 2014). Thus, efforts throughout the program lifecycle are needed to move the centers toward financial sustainability, balancing public and private funding and increasing their degree of self-sufficiency through other income sources, such as technology commercialization, research contracts, consulting, and additional sources of competitive funding. Another key risk relates to the potential crowding-out and loss of control over domestic innovative capacity (of host country), leading to a higher external dependency. Scholars and policy practitioners often advocate for science and technology transfer as a motor for economic growth, but some critics have indicated pitfalls of such top-down, North-South transfers in the form of scientific cooperation from the North, since it has often reproduced hierarchies that perpetuate dependency (Barandiaran, 2015).

5. Empirical materials and methodologies

The empirical contribution consists on an evaluation of Chile's International Centers of Excellence program, launched in 2008 as an explicit policy scheme to finance the establishment in Chile of R&D centers from leading foreign universities and public research organizations. Rather than engaging in ad hoc negotiations with potential international partners on a one-by-one basis, the Chilean government decided to organize the program around an open call for proposals with a structured application and selection process. A total of thirteen R&D centers coming from seven different countries have been established in Chile so far through the program.

This program represents a relevant case study to explore how centers of excellence schemes can be combined with the attraction of foreign research organizations in order to accelerate the absorption of foreign technology and know-how. Building on thirteen in-depth interviews in Chile with key informants and drawing on secondary sources, this paper analyses: 1) how the program was designed and the trade-offs that needed to be addressed in the design stage; 2) how the centers to be funded were selected; 3) how the program was implemented and what results were achieved in its first years of operation; 4) how the program is monitored and evaluated; and 5) the challenges that the program has confronted so far and those that will arise in the future.

6. Expected outcomes

In general, the expected outcomes are threefold:

- A novel theoretical framework to analyze the motivations and organizational modes behind complex international research partnerships leading to the establishment of centers of excellence by foreign universities and research institutes.
- A preliminary evaluation of the Chile's International Centers of Excellence program, drawing some useful insights to inform Chilean policymakers.
- A broader discussion of the policy options available to attract the global R&D activity of world class universities and public research institutes, and the associated challenges and trade-offs.

More specifically, some of the preliminary conclusions from the study include the following:

- Complex International Science, Technology and Innovation Partnerships (CISTIP) represent a shift from the traditional, one-way knowledge transfer mentality behind international scientific cooperation for development, towards a deeper collaboration and co-production of knowledge among equal partners with mutual benefits.
- In particular, Chile's International Centers of Excellence program illustrates well how emerging countries can accelerate technological catching-up through new forms of strategic collaboration with world-class research organizations. Early experience suggests that the program has been successful at attracting leading international institutions to conduct applied R&D and transfer it to local industries.

- However, it is important to stress that, to be effective, this kind of programs need to be grounded into a dynamic ecosystem where local researchers, universities, firms and entrepreneurs are prepared to absorb the expected spillovers derived from the attraction of global R&D.
- Despite its positive results, throughout its history the Chile's International Centers of Excellence program has often been criticized because of the generous funding provided to foreign institutions, which could be used instead to strengthen national universities and R&D institutes that are much needed of additional investments to build critical mass.

REFERENCES

- Barandiaran, J. (2015). Reaching for the Stars? Astronomy and Growth in Chile. *Minerva* 53, 141-164.
- Berger, M., Hofer, R., 2011. The internationalisation of research and technology organisations (RTOs)-conceptual notions and illustrative examples from European RTOs in China. *Science, Technology and Society* 16, 99-122.
- Castelli, C. and Castellani, D. (2013) The internationalisation of R&D: sectoral and geographic patterns of cross-border investments, *Economia e Politica Industriale* 1: 127-143.
- Dachs, B. (2014) Internationalisation of R&D: A Brief Survey of the Literature, in: Dachs, B., Stehrer, R. and Zahradnik, G. (eds.) *The Internationalisation of Business R&D*. Chentelham: Edward Elgar.
- Fu, X., Pietrobelli, C. and Soete, L. (2011) The role of foreign technology and indigenous innovation in the emerging economies: technological change and catching-up. *World Development* 39: 1204-1212.
- Guimón, J., Klerkx, L. and de Saint Pierre, T. (2016) How to bring global R&D into Latin America: Lessons from Chile. *Issues in Science and Technology* 32(2): 17-19.
- Hellström, T., 2014. Centres of excellence as a tool for capacity building OECD, Paris.
- Jonkers, K., Cruz-Castro, L., 2010. The internationalisation of public sector research through international joint laboratories. *Science and Public Policy* 37, 559-570.
- Narula, R. and Zanfei, A. (2004) Globalization of innovation: the role of multinational enterprises. In: J. Fagerberg, D. Mowery and R. Nelson (eds.) *Handbook of Innovation*. Oxford: Oxford University Press.
- Pfotenhauer, S.M., Wood, D., Roos, D., Newman, D. (2016) Architecting complex international science, technology and innovation partnerships (CISTIPs): A study of four global MIT collaborations. *Technological Forecasting and Social Change* 104, 38-56.

Innovation intermediaries: building bridges for global health (subtitle: Exploring the role of innovation intermediaries as institutional entrepreneurs in Product Development Partnerships for poverty-related diseases)

Marjolein Hoogstraaten*(Utrecht University), Wouter Boon(Utrecht University) and Remco de Vreeh(Lygateure)

*M.J.Hoogstraaten@uu.nl

KEYWORDS: Innovation intermediaries, Institutional Entrepreneurship, Mission-oriented innovation, Public Private Collaboration, Product Development Partnerships, Poverty Related Diseases

1. Relevance

Poverty-related diseases are conditions that are mostly prevalent in (sub)tropical, low-income areas (Feasey et al., 2010; Yamey & Hotez, 2007). They are jointly responsible for substantial morbidity and mortality rates and constrain affected countries economically (Chatelain & Ioset, 2011, Conteh et al., 2010). Low purchasing power of affected patients means that private pharmaceutical companies lack incentives to develop diagnostic tools and drugs for these diseases (Li & Garnsey, 2014; Trouiller et al., 2002), resulting in a market failure (Moran, 2005).

In the last two decades, a new type of innovation actor constellation has gained momentum that intends to countervail the market failure associated with poverty-related diseases: Product Development Partnerships (PDPs). PDPs are public-private partnerships specifically aimed at the discovery and development of a product (Chatelain & Ioset, 2011; Stolk, 2013). A PDP network consists of a diverse set of private and public parties who collaborate to develop a specific product for poverty-related diseases (Li & Garnsey, 2014; Trouiller et al., 2002). Studies have thus far highlighted the importance of PDPs in non-profit R&D collaborations and in overcoming market failures by acting as system integrators (Muñoz et al., 2014).

Important actors who function as system integrators in the context of PDPs are ‘innovation intermediaries’ (Howells, 2006), such as the Drugs for Neglected Diseases initiative. They are eminent examples of (semi-)public organizations that are able to influence mission-oriented innovation and research.

In general innovation intermediaries perform a variety of tasks within collaborative networks associated with brokering and facilitating information exchange and collaboration by ‘bridging’ gaps between diverse partners (Bessant & Rush, 1995). Innovation studies have identified general roles and activities innovation intermediaries can take on and described their agency as network orchestrators (Batterink et al., 2010; Howells, 2006). However, little research has been done on the role of innovation intermediaries in the context of addressing neglected areas of research and development nor on how these roles are shaped and influenced.

Understanding which roles intermediaries within PDPs focusing on poverty-related diseases play and how these roles are influenced can contribute to better formulations of innovation policies focused on increasing global health, i.e. a grand societal challenge. PDP intermediaries may be a useful tool to shape research and innovation from a policy perspective due to the (semi-)public and often neutral nature of these organizations. Insights from this research can thus lead to better innovation policy strategies expressed through (more) effective management of PDP consortia by intermediaries in the future.

2. Research aim and question

This paper aims to identify the roles intermediaries in PDPs play and explore internal and network factors influencing the functioning of these intermediaries. To conceptualize the internal and network factors, we draw upon literature on Institutional Entrepreneurship. Institutional entrepreneurs are actors initiating and actively sustaining innovative systemic changes (Åm, 2013). Innovation intermediaries within PDPs can be regarded as institutional entrepreneurs since they are actors initiating and actively sustaining innovative systemic changes in the pharmaceutical sector by creating and facilitating collaboration between public and private parties. These public and private parties are embedded in and adhering to certain institutional logics, i.e. a ‘state’ and a ‘market’ logic (Fuenfschilling & Truffer, 2014; Thornton et al., 2012). The market logic’s main strategy is to focus on increasing efficiency profit, whereas the state logic’s main strategy is to focus on increasing community goods (Thornton et al., 2012). Intermediaries within PDPs position themselves between these diverse parties and aim to consolidate the partly conflicting market and state logics. This intermediating and consolidating role characterizes them as institutional entrepreneurs (Bessant and Rush, 1995).

Battilana et al. (2009) have identified two categories of influential factors for institutional entrepreneurs, which we apply to the role of innovation intermediaries within PDP networks: external field characteristics and the actor's social position. Field characteristics – e.g. the degree of heterogeneity and institutionalization of actors within a field – influence whether actors become institutional entrepreneurs, but the way these actors perceive field characteristics in turn is dependent on their social position – i.e. their connectedness to other actors and their legitimacy as perceived by them – which influences their access to resources (Bourdieu, 1988).

We specify these two categories of influential factors to the case of intermediaries within PDP networks and thus focus on the influence of 1) external characteristics of the PDP network, including the degree of heterogeneity and institutionalization of network partners and 2) internal characteristics of the intermediary, including its social network position and legitimacy. This leads to the following main research question:

Which roles do innovation intermediaries within PDP networks employ and how do internal intermediary and external network characteristics shape and influence these roles?

3. Definitions

Innovation intermediary: a (semi)public, neutral organization facilitating and coordinating public-private collaboration in PDPs

PDP network: a social network comprising all actors collaborating in the realm of a specific project for poverty-related diseases

Institutional Entrepreneurship: the process in which actors initiate and actively sustain innovative systemic changes

Social network position: an actor's position in terms of degree, closeness and betweenness centrality measures offered by Social Network Analysis (SNA) methodology

Legitimacy: a generalized perception or assumption that the actions of an entity are desirable

Heterogeneity: the extent to which network partners are part of differing institutional arrangements

Institutionalization: the degree to which network partners are locked into their existing institutional arrangements

4. Theoretical frameworks

The theoretical framework of this paper builds on two strands of theoretical thought stemming from innovation theory and institutional theory; theories on innovation intermediation and intermediaries on the one hand, and theories on institutional change and entrepreneurship on the other.

5. Empirical materials

Gathering empirical data, we looked at three intermediaries in the field of poverty-related diseases: Lygature, the Medicine for Malaria Venture (MMV), and the Drugs for Neglected Diseases initiative (DNDi). We studied the role they employ and how this is influenced by network and intermediary characteristics within 10 of their PDP projects, as such using a multiple embedded case study approach.

First, qualitative interviews with 10 intermediary project leaders/coordinators contributed information about their activities within the PDP networks, the way they experience their social position and legitimacy and how they perceived the degree of heterogeneity and institutionalization of their network partners. Preparation of these interviews included structured analysis of documents about the intermediaries and the projects.

Second, surveys were distributed among all PDP network partners involved in the 10 projects. These surveys included questions on their frequency of contact with other partners - to determine the structure of the social network and subsequently the social network position of the intermediary –, and their perception of the intermediary in terms of legitimacy. Additionally, they were asked to what extent they feel they acted outside the boundaries of their existing institutional arrangements to get insight into their degree of institutionalization.

6. Description of methodologies

This study has an explorative, qualitative nature. Conducted qualitative interviews were transcribed, and coded in open-source NVivo software. These codes helped identify how intermediary representatives experienced their role within PDP networks and how they perceived the influence of their own legitimacy and social position. It

also shed light upon the challenges and opportunities they perceived in the degree of heterogeneity and institutionalization of PDP network partners.

Data on the frequency of communication/collaboration generated by the surveys served as input for matrices used to build visualizations of the PDP networks. The matrix contained information about the adjacency between nodes (PDP network partners) and about the weight of the edges in terms of frequency of contact. Using Gephi software, these adjacency matrices were visualized in graphs. This software also provided tools to describe centrality measures to determine the social (network) position of the intermediary in comparison to the other partners.

Additionally, answers to survey questions concerning the perception of the intermediary by the PDP network partner were scored to map how partners perceived the intermediary in terms of legitimacy. Questions concerning their experiences in the project contributed information about the extent to which they acted outside of the boundaries of their regular institutional arrangements.

7. Expected outcomes

The scientific contribution of this research is threefold. Firstly, we aim to enrich literature on innovation intermediation and the potential intermediaries have to overcome market failures and accompanying institutional rigidities (e.g. in the case of poverty-related diseases) by acting as institutional entrepreneurs. The concept of the innovation intermediary has been linked to institutional innovation in prior research (Kilelu et al., 2013) but it has not been explicitly linked to theory on institutional entrepreneurship.

Secondly, generated insights contribute to a better assessment of the added value of innovation intermediaries, which so far have been difficult to show since they often have an indirect impact on value chains (Klerkx & Leeuwis, 2009; Pittaway et al., 2004).

Lastly, results of this research will contribute to a better understanding of the functioning of intermediary organizations within PDPs and by which factors they are influenced. This can subsequently lead to better management of PDP consortia by intermediaries, innovative policy advice aimed at societal challenges such as global health and at directing R&D to neglected areas.

Literature:

- Åm, H. (2013). 'Don't make nanotechnology sexy, ensure its benefits, and be neutral': Studying the logics of new intermediary institutions in ambiguous governance contexts. *Science and Public Policy* 40, 466- 478.
- Batterink, M. H., Wubben, E. F., Klerkx, L., & Omta, S. W. F. (2010). Orchestrating innovation networks: The case of innovation brokers in the agri-food sector. *Entrepreneurship and Regional Development*, 22(1), 47-76.
- Battilana, J., Leca, B., & Boxenbaum, E. (2009). How actors change institutions: towards a theory of institutional entrepreneurship. *The academy of management annals*, 3(1), 65-107.
- Bessant, J., Rush, H., 1995. Building bridges for innovation: the role of consultants in technology transfer. *Research Policy* 24, 97-114.
- Bourdieu, P. (1988). *Homo academicus*. Stanford, CA: Stanford University Press.
- Chatelain, E., & Ioset, J. R. (2011). Drug discovery and development for neglected diseases: the DNDi model. *Drug design, development and therapy*, 5, 175.
- Conteh, L., Engels, T., & Molyneux, D. H. (2010). Socioeconomic aspects of neglected tropical diseases. *The Lancet*, 375(9710), 239-247.
- Feasey, N., Wansbrough-Jones, M., Mabey, D. C., & Solomon, A. W. (2010). Neglected tropical diseases. *British medical bulletin*, 93(1), 179-200.
- Fuenfschilling, L., & Truffer, B. (2014). The structuration of socio-technical regimes—Conceptual foundations from institutional theory. *Research Policy*, 43(4), 772-791.
- Howells, J. (2006). Intermediation and the role of intermediaries in innovation. *Research policy*, 35(5), 715-728.
- Kilelu, C. W., Klerkx, L., & Leeuwis, C. (2013). Unravelling the role of innovation platforms in supporting co-evolution of innovation: contributions and tensions in a smallholder dairy development programme. *Agricultural systems*, 118, 65-77.
- Klerkx, L., & Leeuwis, C. (2009). Establishment and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector. *Technological forecasting and social change*, 76(6), 849-860.
- Ioset, J. R., & Chang, S. (2011). Drugs for Neglected Diseases initiative model of drug development for neglected diseases: current status and future challenges. *Future medicinal chemistry*, 3(11), 1361-1371.
- Li, J. F., & Garnsey, E. (2014). Policy-driven ecosystems for new vaccine development. *Technovation*, 34(12), 762-772.
- Moran, M. (2005). A breakthrough in R&D for neglected diseases: new ways to get the drugs we need. *PLoS medicine*, 2(9), 828.
- Muñoz, V., Visentin, F., Foray, D., & Gaulé, P. (2014). Can medical products be developed on a non-profit basis? Exploring product development partnerships for neglected diseases. *Science and Public Policy*, scu049.
- 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(3-4), 137-168.
- Stolk, P. (2013). Background Paper 8.1: Public Private Partnerships. Retrieved from: http://www.who.int/medicines/areas/priority_medicines/BP8_1PPPs.pdf. Accessed on: 09-09-2015.
- Thornton, P. H., Ocasio, W., & Lounsbury, M. (2012). *The institutional logics perspective: A new approach to culture, structure, and process*. Oxford University Press on Demand.
- Trouiller, P., Oliaro, P., Torreele, E., Orbinski, J., Laing, R., & Ford, N. (2002). Drug development for neglected diseases: a deficient market and a public-health policy failure. *The Lancet*, 359(9324), 2188-2194.
- Yamey, G., & Hotez, P. (2007). Neglected tropical diseases. *BMJ: British Medical Journal*, 335(7614), 269.

8D. INNOVATION AND STRUCTURAL CHANGE

Small Firms' Access to Venture Capital: Innovation Policy and its Limits

Susana Borrás*(CBS) and Charles Edquist(CIRCLE)

*sb.dbp@cbs.dk

KEYWORDS: Venture Capital, Risk Capital, Seed Capital, Financing innovation, Innovation policy, Policy instruments

The availability of finance for new innovative firms and entrepreneurial activity is a key aspect in any innovation system. However, even if capital markets have developed significantly the past few decades, the availability of risk-willing capital remains unstable, expensive or simply scarce in most innovation systems. Likewise, in weak systems, stimulating the availability of more venture capital might not per se create growth of entrepreneurial activities. This paper makes three contributions. Firstly, it identifies some problems about venture capital and funding of entrepreneurial activities from the perspective of innovation systems, distinguishing between the contextual bottlenecks in the system, and the intrinsic logic of financial investments. Public policy plays an important role in addressing these generic types of problems, by fostering the private venture capital market and by directly supporting public seed funding activities. Secondly, while analyzing the most conventional policy instruments developed by governments, the paper shows how policy instruments can generate problems themselves in unanticipated ways. Thirdly and last, the paper puts forward some core considerations for the design and redesign of policies improving small innovative firms' access to venture capital from an innovation system perspective.

Innovation, structural change and employment: a long run perspective and some policy implications

Pier Paolo Saviotti
(Utrecht University)
pier-paolo.saviotti@wanadoo.fr

KEYWORDS: Innovation, Structural change, Employment, Labour market, Training

This paper analyzes the long run relationship between innovation, structural change and employment during the period from the industrial revolution to the present. The analysis will focus on the potential of technology to replace human labour, a potential that had been observed since the far past but that started to be analyzed systematically only since the late XVIIIth century. For example, Stuart (Vivarelli, 2014, 2015) pointed out that although technology could substitute human labour this did not necessarily imply that employment was systematically going to fall. Ricardo hypothesized that a potential compensation mechanism could come from the increase in demand following a fall in price due to the increased efficiency allowed by mechanization, which we will call compensation 1. Ricardo himself considered this as a potential compensation mechanism but became pessimistic about its capacity to ensure full employment. Today we know that this form of compensation did not and could not have provided all the employment growth which occurred since the industrial revolution. Other types of compensation mechanisms are described in Vivarelli (2014, 2015) as due to:

- 1) New machines
- 2) New investments
- 3) Decrease in wages
- 4) Increase in incomes
- 5) New products

Vivarelli seems to attach a particular importance to 'New products', which according to him have the potential to create employment, as opposed to process innovations, which in general tend to reduce employment. This paper will rather focus on the relationship between increasing productive efficiency, which reduces the amount of inputs per unit of output, and increasing output variety, which results from the emergence of a number of new types of output greater than that of the outputs which are being replaced and disappear.

Increasing output variety gives rise to another form of compensation that was first envisaged by Pasinetti (1981). He pointed out that in an economic system in which the rate of growth of productive efficiency tended to be higher than that of demand, a potential bottleneck could occur in that the demanded output could be supplied by a falling percentage of the labour force and of the other required inputs. For Pasinetti compensation did not come from within the sector but from the emergence of new sectors, which could absorb the labour force potentially made redundant by the imbalance between productive efficiency and demand. Compensation would thus come from a type of structural change which leads to a growing variety of the economic system. The considerable differentiation that took place in manufacturing output and employment throughout the XXth century shows that this mechanism was effectively at work.

A further related type of compensation mechanism consists of the growing output quality and internal differentiation of existing sectors. Although this type of compensation mechanism may not be as effective in creating employment as the previous one it tends to create better paid employment due to the higher competencies and wages required to produce higher quality goods and services.

In recent work (Saviotti, Pyka, 2004, 2008, 2013) it has been shown that the continuation of growth in the long run requires a form of structural change which involves the increasing differentiation of the economic system. An economic system at constant composition, that is producing only constant set of outputs of constant quality, would generate the type of bottleneck that Pasinetti had anticipated. As a result of the growing productive efficiency of each sector in its life cycle we could expect employment per unit of output t to fall. This rate of fall, which we could consider an intrinsic feature of structural change, would be accelerated by the entry of new producers (e.g. emergent countries) into the world economic system. Such producers could supply the same goods and services which were previously supplied at a higher cost in the most advanced countries. A compensation strategy that can be adopted by developed countries in this case consists of producing only the highest quality goods and services in each sector.

Yet, although this inter-sector compensation mechanism was more powerful than the intra-sectoral ones, it cannot explain a large part of the evolution of employment which took place in the second half of the XXth

century. This consisted of the rising share of employment in services, which now account for the majority of employment in advanced industrialized countries. This further form of compensation is more difficult to explain given the greater heterogeneity of the service sector. However, a large part of the shift of employment to services is due to the differential efficiency of matter manipulation and of information processing during the course of economic evolution. Starting from the industrial revolution and until the second world war the productive efficiency of technologies based on matter manipulation (mechanical, chemical etc) progressed more than that of information processing. The consequence of this imbalance was the progressive displacement of employment from matter manipulation to information processing activities. This third form of compensation occurred for the somewhat paradoxical reason that less efficient activities absorbed labour from the more efficient ones. The paradox is only apparent because the less efficient service like activities and the more efficient matter manipulation ones were complementary.

These three types of compensation mechanisms avoided long term secular unemployment, although not the cyclical one, until the recent past. Recently the imbalance between the relative productive efficiency of matter manipulation and of information processing activities has been reversed due to progress in ICT. In fact, now the rate of efficiency growth of ICT is substantially higher than that of matter manipulation activities. This raises doubts about the possibility that even the third form of compensation can allow sustained levels of employment in future. (See Brynjolfsson, McAfee, 2011)

A number of policy implications follow:

The quantity of employment in each economic system is always the result of a dynamic equilibrium between the destruction of old employment and the creation new one

In the normal development of an economic system we expect its composition, as described by the distribution of activities, outputs and employment in different sectors, to change towards a growing variety. Within this trend the employment share of each sector tends to fall a life cycle, increasing during the emergence phase, subsequently stabilizing and then falling. As a consequence it is wrong to try and keep employment stable in mature or declining sectors. If compensation depends on the emergence of new sectors and activities there is a need to change the distribution of competencies of the labour force to vary accordingly.

This gives rise to the concept of economic redundancy, to be sharply distinguished from arbitrary, prejudice based layoffs. The definition of economic redundancy must be based on objective criteria to be commonly agreed by different components of the economic system.

It is wrong to organize the representation of labour on the basis of existing sectors and activities. Labour representation needs to be designed to take care of aggregate employment. Job security is incompatible with employment security.

Depending on the rate of structural change, there may be a need to change competencies once or more during an individual working life. Adequate training facilities and programmes need to be provided and combined with unemployment benefits. However, these unemployment benefits need to be linked to participation in training. At any time the labour market needs to be redefined as constituted by (i) people who are working, and (ii) people who are being retrained, as it befits a learning society. Given the continuously growing knowledge intensity of most processes the need for retraining is likely to increase in the foreseeable future. Furthermore, growing knowledge intensity does not lead to the predictable emergence of new activities at the times they are required to support employment.

The employment towards which training is orienting people must not be exclusively or even predominantly oriented towards the replication of existing activities and routines but it should include a large share of search activities and of creation of other new activities, including not strictly economic ones.

In case ITC makes full employment impossible, a social salary partly compatible with a (low) private salary will have to be introduced. When a person previously unemployed and perceiving only his/her social salary finds a job, if the salary offered is too low* he/she will be allowed to retain a part of his/her social salary, at least for a while.

These policy implications will be discussed in relation to general ideas about economic development in the paper.

EU corporate R&D intensity gap: What has changed over the last decade?

Pietro Moncada-Paternò-Castello
(European Commission - Joint Research Centre)
pietro.moncada-paterno-castello@ec.europa.eu

KEYWORDS: Corporate R&D intensity deficit, Corporate R&D distribution, Decomposition analysis, Trend analysis, EU R&D intensity target, Research policy

Background and Motivation: Europe is challenged at the same time to overcome the economic crisis, to become more competitive and to create more and better job in a sustainable way. One of the most pivotal roles in such sought development is expected to be played by Research and Development (R&D). R&D expenditures, in fact, have long been an important concern for innovation analysts, who have used them as a proxy for innovation inputs and as a determinant of growth, productivity and competitiveness. This conviction has originated the R&D intensity targets as one of the main objectives of the new European Union's research and innovation policy agenda, namely the Lisbon strategy in 2000 and the related Barcelona target in 2003 (EU should spend 3% of GDP in R&D, 2/3 of which by the private sector), retaken and reinforced in the more recent Europe 2020 strategy and the related undertakings as the European Union Flagship initiative (European Commission, 2010): to support the increase in private research and innovation investment together with favouring the positive demographics (creation and growth) of companies operating in new/knowledge-intensive industries. In fact, these companies play an important role in shaping the dynamics of the economy's sectorial composition, favouring the transition towards a more knowledge-based economy and contributing to the overall economic growth coupled with more and better jobs (for a comprehensive overview on the subject, see Sheehan and Wyckoff, 2003; Moncada-Paternò-Castello et al., 2010; Moncada-Paternò-Castello, 2010).

There is an extensive literature that deals with the deficit in the EU's overall company R&D intensity compared to that of competing economies and the various factors that could determine it. Nonetheless, a large part of the scientific effort devoted to studying what are the main factors in shaping corporate R&D intensity seems to address one main issue - i.e. the "intrinsic" vs. "structural" effect - and reaches divergent conclusions (Moncada-Paternò-Castello, 2010, 2016a).

The paper addresses the causes of the under-performance of European firms in R&D investment, by answering the following research questions: (i) whether the explanation for the lower overall corporate R&D intensity of the EU vis-à-vis the competing (and emerging) economies lie mainly in an "intrinsic" vs. a "structural" effect; (ii) how (if) R&D intensity gap and its main determinants has changed over the 2005-2013 period; (iii) what the distribution of R&D investment across top R&D investing firms and group of sectors by world regions/countries is, and how this distribution has changed over time. This evidence allows appreciating the causes, trends and achievement of EU corporate R&D intensity (Barcelona)target.

Theoretical foundation of intrinsic reasons for corporate R&D intensity differences finds a solid anchorage in the Schumpeterian arguments that these also depends on the availability of internal resources, the access to external sources and in the high levels of product market competition on innovation (Aghion and Howitt, 2006). While theoretical arguments supporting the structural reasons for corporate R&D intensity differences, point at the diversities in industry sectors characteristics (Pakes and Schankerman, 1984, based on Scherer, 1982, and Griliches and Schmookler, 1963). This study will contribute to the empirical literature on this specific subject, Erken and van Es (2007), Moncada-Paternò-Castello et al. (2010), Cincera and Veugelers (2013), and Stančík and Bagi (2015). The concentration of corporate R&D relies on the Schumpeterian theory which points out that innovative activities at sector level may be concentrated in few innovators (Schumpeter Mark II model) characterized by high appropriability and cumulativeness, a stable core of innovators, and relevant barriers to entry (Malerba; 2005).

This study complements the empirical literature on this subject, e.g., Dosi; 1997; Pianta, 2005, Erken and van Es, 2007; Bartelsman et al. (2005), Coad and Rao (2010), Moncada-Paternò-Castello, 2010; Moncada-Paternò-Castello et al., 2010; Duchene et al., 2011; Reinstaller and Unterlass (2012), Cincera and Veugelers, 2013, Chung, 2015 and Moncada-Paternò-Castello (2016) by verifying empirically whether the EU corporate R&D investment gap is due to an "intrinsic" or to a "structural" effect, the direction and extent of the corporate R&D intensity gap between countries, as well as to the distribution of R&D across top R&D investing firms, sectors and countries in a decade.

The methodological approach of the study consists first in implementing a review of literature on the subject. Secondly, it implements a decomposition computation and analysis, following, e.g., van Reen (1997), Lindmark

et al., (2010), Cincera and Veugelers (2013). Third, it calculates the distribution of R&D investment relying on the cumulative average R&D intensity and other straightforward statistical computations methods (following Ciupagea and Moncada-Paternò-Castello, 2006 and Moncada-Paternò-Castello et al., 2010). It uses micro-data from the EU Industrial R&D Investment Scoreboard - covering the years 2005-2013 - of top 1250 R&D investing companies worldwide, representing on average more than 80% of the global private R&D expenditure in R&D (European Commission, 2014). The data are collected from publicly available audited annual reports and accounts of companies. The main variables of this database are firms' R&D investment, net sales, and R&D intensity, country/region, industry (sector), and group of sectors.

This study is novel in literature because holds altogether these characteristics: (a) based on micro-data, it investigates R&D intensity gap decomposition over a time span which includes the year(s) of financial downturn; (b) it disentangles the comparative differences in R&D intensities between ICB-4 digit level sectors within the same R&D intensity sector groups which determine the most the R&D intensity gap; (c) it compares both R&D intensity gap and R&D distribution results between EU and the US, Japan, Switzerland, Asian Tigers (Hong Kong, Singapore, South Korea, and Taiwan) Switzerland and BRIC (Brazil, Russia, India and China). After more than a decade from the Lisbon strategy and the Barcelona target there are still no scientific studies, in our knowledge which include altogether these characteristics for a comparative analysis of this kind.

The findings indicated first that the EU R&D intensity gap vis-a-vis US and Japan negative and structural (in line to the findings of Moncada-Paternò-Castello et al., 2010, and from Cincera and Veugelers, 2013), thus confirming our first research hypothesis. This study suggests that also the EU R&D investment gap with Switzerland is negative and mostly due to structural effects. It also finds that companies from BRIC and RoW have negative gap vs EU in the three years studied, BRIC gap being due to structural effect, and to intrinsic effect for the RoW. Asian Tigers show a negative R&D intensity gap in the first year and positive in the last two years of observation, both negative and positive gaps mainly due to intrinsic effects.

An interesting output of this decomposition analysis is that the EU solidly over perform in intrinsic effects all its competing economies - except Switzerland - and even improve their comparative performance over the period of time examined, especially vis-à-vis firms from US, Japan and BRIC samples and even improve their comparative performance over the period of time examined, especially vis-à-vis firms from the three mentioned countries/regions. Therefore, the structural effect overcomes the positive EU corporate R&D investment efforts (intrinsic effect) compared to all regions/countries considered, except Switzerland. A further analysis shows that sum-sector-by-sum-sector within the same high and medium-high intensity sectors groups, the EU firms perform often much better (in 10/14 sectors analysed) in R&D intensity than the US ones. Of course, such aggregate groups of sectors are those that make a difference in the overall intrinsic effects of the EU vis-a-vis comparing to most direct competing economies.

The second main finding of this research is that EU R&D intensity gap has broadened vis-à-vis main competitors in the in the last 9 years (ratifying results by Duchêne et al., 2011; Voigt and Moncada-Paternò-Castello, 2013; Veugelers, 2013), thus in part confirming our second research hypothesis. In particular, it shows an increase in the negative gap compared to US, and a quite stable negative gap compared to Japan and Switzerland.

Furthermore, EU shows a positive R&D investment gap compared to BRIC and RoW groups of countries, but it is decreasing during the three years considered. Asian Tigers have shifted from a negative R&D intensity gap vis-à-vis to EU in 2005, to a positive gap in 2009 and even more positive in 2013.

The third finding of this paper indicates that in the years considered corporate R&D is asymmetrically distributed with a significant difference in the degree of concentration between EU and non-EU sets of companies. In the overall, the study confirms that the bulk of global private R&D investment is concentrated in high and medium-high sector groups, in a few companies (2500 firms hold more than 90% of global BERD in 2013) and a few countries/regions (US, EU and Japan representing 82% of R&D investment of the total sample of 2500 firms, or 81% of the truncated sample of 1247 firms in 2013). A considerable concentration can be also found in the highest R&D intensities held by a small group of largest R&D investing firms; therefore differences in overall R&D intensities also reflect business R&D demographics. Furthermore, the analysis indicate that not only the R&D activity is more concentrated amongst the bigger corporate R&D investors in the EU sample than in the others, but also that there are more numerous large EU R&D-investing companies with lower R&D intensity compared especially to US. These results mainly confirm the findings from Ciupagea and Moncada-Paternò-Castello (2006), Moncada-Paternò-Castello et al., (2010) and, in part, from Reinstaller and Unterlass (2012).

In sum, the study provides new insides on the evolution of corporate R&D by examining one of the foundations which originated the EU 3% R&D investment policy target introduced in 2003. The study confirms that the

reason of the EU R&D investment gap, especially vs the US, Japan and Switzerland, is mainly structural, and there are not signals of an inverted tendency to be able to reach the EU policy target for the year 2020. Other sources of literature can help to understand the reasons why this phenomenon occurs. Among others, many authors indicate the dynamic of economic structure and the associated company demographics with the framework conditions as the most prominent reasons (for example, Mathieu and Pottelsberghe, 2010; Foray and Lhuillerey, 2010; Moncada-Paternò-Castello, 2010; Cincera and Veugelers, 2013). Policy-makers are called to correct main market failures, therefore to overcome these barriers evoked broadly by literature as conducive for a more dynamic EU economy and, with it, to play a more prominent role in the next waves of technological development and competitiveness frontiers of the increasing knowledge intensive economy and society.

In taking action to support R&D and innovation - as to help decreasing the EU R&D intensity gap -, policy-makers should consider not only horizontal policy options across all sectors and firms typologies. Tailored policies which address the barriers for the dynamics of new (risky, and oriented to solve societal problems) R&D and innovation intensive sectors and companies (favouring new entrants) should be also considered in the policy, together with other measures to stimulate an increase in R&D activities performed by established (large/medium) firms, such as absorbing more R&D and innovation also in less technological intensive sectors, and diversify sector of business activities towards more (new) knowledge-intensive ones.

8E. GOVERNANCE OF DISCONTINUATION

Exploring nuclear trajectories in Germany and the UK: understanding (dis)continuities and incumbency in socio-technical systems

Phil Johnstone* and Andy Stirling
(SPRU, University of Sussex)
*p.johnstone@sussex.ac.uk

KEYWORDS: Discontinuity, Nuclear, Incumbency, Sustainability transitions, Innovation systems, Germany, UK, Energy policy

This paper focuses on arguably the single most striking contrast in contemporary major energy politics in Europe (and even the developed world as a whole): the starkly differing civil nuclear policies of Germany and the UK. Germany is seeking entirely to phase out nuclear power by 2022. Yet the UK advocates a ‘nuclear renaissance’, promoting the most ambitious new nuclear construction programme in Western Europe. Here, this paper poses a simple yet quite fundamental question: what are the particular divergent conditions most strongly implicated in the contrasting developments in these two countries. With nuclear playing such an iconic role in historical discussions over technological continuity and transformation, answering this may assist in wider understandings of sociotechnical incumbency and discontinuity. After an in-depth exploration of ‘internal’ and ‘external’ factors related to socio-technical ‘regime theory’, two particularly important dimensions in influencing the differing directions of UK and German energy policy stand out. These are the ‘qualities of democracy’ and the presence (or in the case of Germany) absence, of military-related activities. This suggests the need for further research in these under-explored areas, but also opens up for wider discussion on more relational approaches to understanding incumbency, going beyond a focus on particular ‘sectors’, ‘systems’ or ‘regimes’ which may assist in developing further questions regarding how it becomes feasible for governance to reach a point of attempting to initiate the discontinuation of dominant socio-technical systems.

Relevance

This paper is relevant to the special session for which it is proposed and for the broader emerging themes of the conference overall. Increasingly there is focus on the ‘flip side’ to innovation, including ‘destabilisation’ (Turnheim & Geels 2012), the ‘destructive’ side of Schumpeterian creative destruction (Kivimaa & Kern 2015) and on processes of the active discontinuation of certain technological trajectories (Stegmaier et al. 2014). A key question is how governance reaches the point where it becomes feasible to actively discontinue incumbent technological trajectories. Germany has taken the decision to phase out the use of nuclear power for electricity production by 2022 following the Fukushima disaster (Wittneben 2012), and through detailed empirical comparison with the UK (which is aiming to construct multiple new reactors), the dynamics and drivers which have influenced this decision to discontinue of Germany are interrogated and discussed. In terms of the conference overall, this paper contributes to the emerging theme of ‘governance and institutions’ because through the comparison between Germany and the UK in relation to some of the broader governance dynamics, certain factors are discussed as relevant in influencing these starkly different directions of travel of two innovation systems. The comparative approach also clearly lends itself to contributing to the theme of focussing on innovation policies ‘across different countries or regions’, and given the empirical content, the theme of ‘tensions between innovation policies’ theme is also contributed to in terms of the dynamic between renewables and nuclear policies.

Research aims and questions

The research aims to develop understandings of the factors that influence different ‘directions of travel’ of innovation systems in relation to nuclear power (with broader implications for energy and innovation policy), and develop understandings of how two countries can reach such divergent positions in relation to their respective energy policies. In doing so, the research aims to contribute towards innovation systems and sustainability transitions.

Two central questions that this paper poses can be summarised as follows:

what factors have influenced the radically different nuclear trajectories of Germany and the UK?

What are the implications of these findings for understandings of socio-technical transitions and discontinuities in innovation systems and sustainability transitions?

Definitions

Discontinuity is understood as the governance of the *deliberate* phasing-out of particular technological trajectories (Stegmaier et al. 2012).

We draw on work around '*lock in*' (Unruh 2000), to understand the processes through which certain technological trajectories become entrenched and the ways that this occurs through 'increasing returns' and associated institutional, cultural, and political patterns of entrenchment which make change and 'break-through' of new technologies and indeed the realisation of discontinuation policies in socio-technical systems, highly challenging.

Related to this, *incumbency* is understood as certain networks of actors and institutions surrounding particular technologies that are in established positions of power in a socio-technical system. The factors through which such positions of incumbency are maintained (Smink et al. 2013), are explored in this paper.

Theoretical frameworks

In order to build the framework of nine criteria constituted by 30 parameters, a rich tradition of theoretical perspectives related to understanding 'technological trajectories' (Dosi 1982), evolutionary approaches to technological change (Nelson & Winter 1982), sectoral innovation systems approaches (Malerba 2002), and notions of socio-technical regimes understood in sustainability transitions (Kemp et al. 1998) and in particular the Multi-Level Perspective (MLP) (Geels 2002) are drawn upon. While all diverse, we pick up a similarity across these approaches in terms of what has been the primary focus on the 'internal' factors of a particular technological regime while other 'contextual' factors such as politics and institutions are considered 'external' (Geels & Schot 2007), and crucially, often secondary influences. In this paper we show how the external factors have in many ways been central to the differences between Germany and the UK but require further examination and research, in particular 'qualities of democracy' (Munk 2012) and the role of the military (Johnstone & Stirling 2016). This also has implications for the ways in which understandings of 'lock in' (Cairns 2014), 'entrapment' (Walker 2000), 'incumbency' (Lauber & Sarasini 2011) and 'obduracy' (Schoor et al. 2015) can be developed through attention towards these 'external' factors.

Empirical materials

The materials used in this research involves secondary source material including key policy documentation related to the evolution of energy policy in Germany and the UK, patent data, and statistical data from the International Energy Agency.

Description of the methodologies

This research uses a 'multi-criteria' approach, and through careful readings of literatures mentioned above as well as factors pertaining specifically to nuclear power (e.g. Sovacool & Valentine 2012; Jewell 2011; MacKerron 2004; Wynne 2010; Thomas 2010), nine criteria constituted by 30 parameters covering technical, resource-based, economic and political/ institutional factors are developed. The approach is non-deductive in terms that there are no assumed drivers, such as 'niches' in understanding socio-technical change, but rather each criteria is given equal weight and consideration and considered on a *ceteris parabis* basis. The driving question is, given the evidence gathered for each criterion (considered on a *ceteris parabis* basis), would discontinuation be considered a more likely event in Germany or the UK?. This allows particular criteria to be focussed on in the discussion section.

Outcomes

The desired outcomes are to show in a very detailed way, the different factors that have influenced the radically differing trajectories of German and UK nuclear power policies, and open up discussion on some of the lesser interrogated factors influencing these socio-technical systems more generally, including institutional differences, qualities of democracy and the role of the military in innovation journeys.

References

- Cairns, R.C., 2014. Climate geoengineering: issues of path-dependence and socio-technical lock-in. *Wiley Interdisciplinary Reviews: Climate Change*, Dosi, G., 1982. Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technological change. *Research Policy*, 11(147-162).
- Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research Policy*, 31(8-9), pp.1257-1274.
- Geels, F.W. & Schot, J., 2007. Typology of sociotechnical transition pathways. *Research Policy*, 36(3), pp.399-417. Available at: Jewell, J., 2011. Ready for nuclear energy?: An assessment of capacities and motivations for launching new national nuclear power programs. *Energy Policy*, 39(3), pp.1041-1055.
- Johnstone, P. & Stirling, A., 2016. Submerged politics of UK nuclear power. *The Spokesman*, 132, pp.75-86.
- Kemp, R., Schot, J. & Hoogma, R., 1998. Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. *Technology Analysis & Strategic Management*, 10(2), pp.175-198.

- Kivimaa, P. & Kern, F., 2015. Creative Destruction or Mere Niche Creation? Innovation Policy Mixes for Sustainability Transitions. *Research Policy*, 02(1), p.29.
- Lauber, V. & Sarasini, S., 2011. The responses of incumbent utilities to the challenge of renewable energy. In B. Sandén, ed. *System Perspectives on renewable power*. Göteborg: Chalmers University of Technology, pp. 393–403.
- MacKerron, G., 2004. Nuclear power and the characteristics of “ordinariness” - the case of UK energy policy. *Energy Policy*, 32, pp.1957–1965.
- Malerba, F., 2002. Sectoral systems of innovation and production. *Research Policy*, 31, pp.247–264.
- Munk, G., 2012. *Conceptualizing the Quality of Democracy: The Framing of a New Agenda for Comparative Politics*. Budapest.
- Nelson, R. & Winter, G., 1982. *An Evolutionary Theory of Technological Change*, Cambridge MA: Harvard University Press.
- Schoor, T. van der et al., 2015. Challenging obduracy: How local communities transform the energy system. *Energy Research and Social Science*, 13, pp.94–105.
- Smink, M.M., Hekkert, M.P. & Negro, S.O., 2013. Keeping sustainable innovation on a leash? Exploring incumbents’ institutional strategies. *Business Strategy and the Environment*, early onli, pp.1–16.
- Sovacool, B.K. & Valentine, S. V., 2012. *The International Politics of Nuclear Power: Economics, Security, and Governance*, Oxon: Routledge.
- Stegmaier, P., Kuhlmann, S. & Visser, V., 2014. The discontinuation of socio-technical systems as a governance problem. In S. Borras & J. Edler, eds. *The Governance of Socio-technical Systems: Explaining Change*. Cheltenham: Edward Elgar, pp. 111–131.
- Stegmaier, P., Kuhlmann, S. & Visser, V.R., 2012. Governance of the Discontinuation of Socio-Technical Systems. In *International Jean Monnet Conference on the Governance of Innovation and Sociotechnical Systems in Europe*. pp. 1–2.
- Thomas, S., 2010. Competitive energy markets and nuclear power: Can we have both, do we want either? *Energy Policy*, 38(9), pp.4903–4908.
- Turnheim, B. & Geels, F.W., 2012. Regime destabilisation as the flipside of energy transitions: Lessons from the history of the British coal industry (1913–1997). *Energy Policy*, 50, pp.35–49.
- Unruh, G.C., 2000. Understanding carbon lock-in. *Energy Policy*, 28(March), pp.817–830.
- Walker, W., 2000. Entrapment in large technology systems: institutional commitment and power relations. *Research Policy*, 29(7-8), pp.833–846.
- Witneben, B.B.F., 2012. *The impact of the Fukushima nuclear accident on European energy policy*.
- Wynne, B., 2010. *Rationality and Ritual: Participation and Exclusion in Nuclear Decision-Making* 2nd ed., London: Earthscan.

How obsolescent innovation must give way: The Governance of the Discontinuation of Incandescent Light Bulbs in the EU

Dr Peter Stegmaier* and Stefan Kuhlmann
(University of Twente)

*p.stegmaier@utwente.nl

KEYWORDS: Discontinuation, Governance, Incandescent light bulb, Phase-out, European Union, Obsolescence, Innovation, Governance-in-action, Socio-technical system, Eco-design framework, Destabilisation

In this paper, we reconstruct the governance and socio technical trajectories that led to the ban of the light bulb both in terms of the in-built phase-out of consumer products, called obsolescence, as well as politically, legally, and economically achieved phase-out (the case of the stepwise ban of the incandescent light bulb in the European Union). The European lighting industry pushed for stricter standards for old and new lighting devices (incandescent, compact fluorescent, halogen) on the EU market, to facilitate the protective provision of a space where higher priced products could be placed against the competitors from Asia. Another significant factor leading to substantial changes in EU light bulb policies also has been the EU eco-design framework and political pressure from key member states. Finally there was the decision industry made not to develop incandescent lighting technology anymore (there are options, as e.g. Illic et al 2016 claim in Nature Nanotechnology). We are thus also talking about a form of obsolescence for an entire product family through ceased efforts to renew the existing technology (often called ‘technical obsolescence’).

We offer an empirical sketch, concentrating on one example of discontinuation around the production or/and usage of incandescent light bulbs (ILB) in the EU. This case example builds on recent analysis of documented governance discourse (Keller), interviews (Spradley), process/trans-sequential (Scheffer) and situational analysis (Clarke). It shows the constellation of the window of opportunity when the bulb phase-out was actually initiated at the EU level, and it shows several transitional phases during which this most common lighting product became a mere niche technology (“inverse niche management”). Here, the roles of market and regulatory measures changed in the context of broader transformations in market, socio-technical and governance dynamics. We indicate lead actors (including the street-level work done by industry lobbyists, NGOs, and EU Commission services) and major forms of action taken to make discontinuation happen; the role of international pioneering efforts for banning the bulb, and the interplay between dedicated action and the background of emerging circumstances under which a phase-out policy appeared particularly feasible.

We conceptualize the governance aspect as being constituted by dual discontinuation processes in terms of the ‘governance of discontinuing a socio-technical system’ and as the deliberate ‘discontinuation of an incumbent governance framework of a socio-technical system’ (Stegmaier et al.). In order to do so, we introduce a ‘discontinuation governance stream’ heuristic, which combines heuristics from multi-level transition perspectives on socio-technical regimes and niches (Geels/Schot; Rip; Grin; Borrás/Edler), technological (Dosi) and organizational trajectories (Strauss) as well as approaches focussed on governance as problem structuring (Hoppe) and agenda work (Kingdon). The ‘discontinuation governance stream’ approach also builds on work related to ‘policy reversal’, ‘policy dismantling’, ‘policy termination’, and ‘exnovation’, as well as literature focussed on the destabilisation of socio-technical systems (Latour: Aramis; Turnheim/Geels: British coal industry).

Multiple stories of DDT: an international comparison of a notorious villain's ban

Pierre-Benoît Joly*, Alix Levain and Vincent Cardon
(INRA-LISIS)

*joly@inra-ifris.org

KEYWORDS: Socio-technical transitions, Discontinuation, Streams, Governance, Regulatory regime, Structuring technology, Detachment, Pesticides, DDT

So far, most of the literature on DDT represents its withdrawal as a major public decision that resulted from the mobilisation of environmental movements that drew public attention on the damages related to its massive and pervasive use. Hence, DDT ban is generally envisaged as a victory of the environmental movements in a period characterized by the emergence of an environmental policy stream. The literature perfectly captures the problematization process of DDT, a chemical compound that used to be considered as a magic solution to eradicate crop pests and fight insect-borne diseases like malaria, and which becomes an iconic poisonous product. Its ban occurred in 1972 in the USA. It took more time to France (1976) and Great Britain (1985) to drastically limit its agricultural use.

Based on comparative analysis of national dynamics of crop-protection regulation in three countries (USA, France and the UK), this contribution focuses on the missing parts of the DDT withdrawal narratives. The story of the DDT phasing out can then be re-written on a different ground: DDT ban wasn't a major challenge of the socio-technical regime of controlled use of pesticides. On the contrary and by many ways it has enhanced the legitimacy of the pesticide regulatory actors to control pesticide hazards. On this basis, we discuss general questions related to socio-technical transitions, and point out the dialectic relations between external contestation and restabilisation of the incumbent trajectory. In the case of pesticides, these relationships and their influence on regulation systems and on patterns of innovation are instrumental, although generally overlooked. From such a study emerge two main results. First, external contestation does not necessarily lead to a radical change of socio-technical trajectories. It rather may lead to major adaptations of the incumbent regime allowing its re-stabilization thanks to the integration of the critique and the invention of alternatives to limit some identified externalities. Second, from the study of such trajectories, two generic properties appear, that should be examined carefully when addressing discontinuation of socio-technical systems: the detachability of technologies and the divisibility of issues.

Parallel Sessions 9

9A. ALTERNATIVE APPROACHES TO EXPERIMENTATION AND SUSTAINABILITY

Between seedbeds and battlegrounds: emerging governance arrangements in Bristol's path to a low carbon future

Jonas C.L. Torrens*, Johan W. Schot and Phillip Johnstone
(SPRU - Science Policy Research Unit, University of Sussex)
*j.torrens@sussex.ac.uk

KEYWORDS: Strategic Niche Management, Strategic Action Fields, Urban Low Carbon Transitions, Governance

In Western Europe, there has been a recent surge in various forms of engagement of actors at subnational scales in the governance of energy and climate (Bulkeley & Kern 2006, Schoenberger 2013). Community energy groups, local authorities and intermediaries have been playing increasingly prominent roles in the quest for low carbon transitions (Roberts et al. 2010, Bulkeley et al. 2011, Seyfang et al. 2013, Barton et al. 2015), with novel means for coordinating and orchestrating local actions. These include developing intermediary organisations (Moss 2009, Hodson & Marvin 2009, Hodson et al. 2013) and arguing for the decentralised governance of the energy systems (Smith 2007, Fuchs & Hinderer, 2014, Späth & Rohrer 2015, Fudge et al. 2016). This is giving rise to distinctive forms of politics around urban low carbon transitions (Bulkeley et al. 2011, Bulkeley et al. 2012, Rutherford & Coutard 2014). Most academic contributions tend to foreground particular actors; there is an insufficient emphasis on the multi-stakeholder configurations that emerge in localities (Hoppe & Bueren 2015), and on how such arrangements influence the ensuing low carbon transitions. Most research implicitly assume that local actions constitute and help shape national and international approaches to the combined challenges of climate mitigation and energy security, thus raising questions about the viability of distinctively urban or regional transitions (Hodson & Marvin 2010, Späth & Rohrer 2014), and the possibility of civil society-led pathways for transitions at the national scale (Foxon 2013).

In the academic literature concerned with these engagements, it is possible to distinguish two broad framings. First, cities, with particular political and economic contexts, can act as 'seedbeds', protecting technological and social innovations from adverse selective pressures, and thus allowing the testing business models and new sources of finance, and normalising more sustainable practices (cf. Arentsen & Bellekom 2014, Romero-Lankao & Dodman 2011, Geels 2010). In the UK, and especially in Germany, such activities are seen to be flourishing, and increasingly integrated, leading observers to consider the emergence of a pluralistic 'community energy sector' (Hargraves et al. 2013, Seyfang et al. 2013, 2014) and 'civic energy sector' (Hall et al. 2014, Johnson & Hall 2014, Barton et al. 2015). Theoretically, such framing has been mostly apparent in studies that draw from Strategic Niche Management (Kemp et al. 1998, Schot & Geels 2008), and Grassroots Innovation (Seyfang et al. 2013, 2014) approaches, while seeking to broaden the otherwise technological focus of the former (e.g. Quitzau et al. 2012).

In a contrasting framing, evident in recent research stemming from Germany, the emphasis lies on political efforts for reinterpreting, reconciling and at times resisting local, national and international priorities (c.f. Moss et al. 2014, Becker & Kunze 2014). Here, the city is implicitly understood as a latent 'battleground', with coalitions of communities and local authorities implicated in political struggles about the decentralisation, democracy and ownership of the energy system. Potential institutional reforms driven through collective action, rather than by innovation, are in the foreground. Such framing emphasises the opposition such communities may face when advancing radical visions for the future of the energy system (Fuchs & Hinderer 2014, Blanchet 2015), for example by questioning the prevalent neoliberal and growth paradigms underpinning incumbents' accounts of low carbon transitions (Becker et al. 2015, Moss et al. 2014). Theoretically, such framing is informed by social movement theories, and more recently, by the analysis of the contentious politics of the German Energiewende (e.g. Fuchs & Hinderer, Blanchet 2015, Wasserman et al. 2015, Schmidt et al. 2016).

which rely Strategic Action Field framework (Fligstein & McAdam 2011).

At the junction of these framings, it is then pertinent to ask: Does local political contention stimulate the emergence of community and municipal energy groups? Do the emergence of community energy groups and local authority-led efforts prevent the development of overt contestation? How do community energy groups and local authorities coordinate or orchestrate their actions amid political contexts that uncertain are contentious? With the aim of further conceptualisations apt to address the questions at this junction, the present article mobilises the two theoretical approaches outlined above, Strategic Niche Management and Strategic Action Fields, to analysing a singular case study.

Empirically, the article focuses on Bristol, a city known an environmental movement that has ‘green roots’ dating back to the 1970s (Brownlee 2011) and by the vitality of the community and municipal energy fronts. Since 2010, the city has been pursuing the development of an energy service company and a fully-licensed supply company, integral to the city’s commitment to becoming carbon-neutral by 2050. This effort has occurred in parallel with the flourishing of community energy groups and cooperatives promoting energy efficiency measures and renewable energy generation. The city is also the stage to a large partnership that since 2007 has been successfully advancing the vision of Bristol as a Green Capital, culminated recently in the award of European Green Capital 2015. Such apparent success of a pluralistic approach to low carbon transitions, nevertheless begs the question of how such plural and potentially contentious priorities are coordinated, negotiated, reconciled or resisted.

References

- Arentsen, M. & Bellekom, S., 2014. Power to the people: local energy initiatives as seedbeds of innovation? *Energy, Sustainability and Society*, 4(1), p.2.
- Barton, A.J. et al., 2015. Distributing Power: a transition to a civic energy future, Report of the Realising Transition Pathways Research Consortium “Engine Room” Bath.
- Becker, S., Beveridge, R. & Naumann, M., 2015. Remunicipalization in German cities: contesting neo-liberalism and reimagining urban governance? *Space and Polity*, 19(1), pp.76–90.
- Becker, S. & Kunze, C., 2014. Transcending community energy: collective and politically motivated projects in renewable energy (CPE) across Europe. *People, Place and Policy Online*, 8, pp.180–191.
- Bird, C., Alcock, R., Morgan, B., McDermont, M. (2013) Maintaining Momentum in Bristol Community Energy, Project report, June 2013. Bristol: University of Bristol. [http://www.bris.ac.uk/media-library/sites/law/documents/Maintaining Momentum project report June 2013.pdf](http://www.bris.ac.uk/media-library/sites/law/documents/Maintaining_Momentum_project_report_June_2013.pdf)
- Blanchet, T., 2014. Struggle over energy transition in Berlin: How do grassroots initiatives affect local energy policy-making? *Energy Policy*, pp.1–9.
- Brownlee, E (2011) Bristol's Green Roots. Bristol: The Schumacher Institute.
- Bulkeley, H. et al., 2011. *Cities and Low Carbon Transitions* H. Bulkeley et al., eds., London and New York: Routledge.
- Bulkeley, H., Broto, V.C. & Edwards, G., 2012. Bringing climate change to the city: towards low carbon urbanism? *Local Environment*, 17(5), pp.545–551.
- Fligstein, N. & McAdam, D., 2011. Toward a general theory of strategic action fields. *Sociological theory*, 29(1), pp.1–26.
- Foxon, T.J., 2013. Transition pathways for to a low carbon electricity future. *Energy Policy*, 52, pp.10–24.
- Fuchs, G. et al., 2012. Adaptive Capacities, Path Creation and Variants of Sectoral Change. The Case of the Transformation of the German Energy Supply System, Stuttgart.
- Fudge, S. & Peters, M., 2009. Motivating carbon reduction in the UK: the role of local government as an agent of social change. *Journal of Integrative Environmental Sciences*, 6(2), pp.103–120.
- Fudge, S., Peters, M. & Woodman, B., 2016. Local authorities and energy governance in the UK: Negotiating sustainability between the micro and macro policy terrain. *Environmental Innovation and Societal Transitions*, 18, pp.1–17.
- Geels, F.W., 2010. The roles of cities in technological transitions: analytical clarifications and historical examples. In H. Bulkeley et al., eds. *Cities and Low Carbon Transitions*. Routledge, pp. 13–28.
- Hall, S., Foxon, T.J. & Bolton, R., 2014. The new “civic” energy sector: implications for ownership, governance and finance of low carbon energy infrastructure. In Presented at the BIEE 10th Academic Conference, St John’s College, Oxford.
- Hargrave, T.J. & van de Ven, A.H., 2006. A Collective Action Model of Institutional Innovation. *Academy of Management Review*, 31(4), pp.864–888.
- Hodson, M., Burris, E. & Barlow, C., 2016. Remaking the material fabric of the city: “Alternative” low carbon spaces of transformation or continuity? *Environmental Innovation and Societal Transitions*.
- Hodson, M. & Marvin, S., 2009. Cities mediating technological transitions: understanding visions, intermediation and consequences. *Technology Analysis & Strategic Management*, 21(4), pp.515–534.
- Hodson, M. & Marvin, S., 2010. Can cities shape socio-technical transitions and how would we know if they were? *Research Policy*, 39(4), pp.477–485.
- Hodson, M., Marvin, S. & Bulkeley, H., 2013. The Intermediary Organisation of Low Carbon Cities: A Comparative Analysis of Transitions in Greater London and Greater Manchester. *Urban Studies*, 50(7), pp.1403–1422.
- Hodson, M., Marvin, S. & Späth, P., 2015. Subnational, Inter-scalar Dynamics: The Differentiated Geographies of Governing Low Carbon Transitions — With Examples from the UK. In “Handbook on Sustainability Transition and Sustainable Peace.” pp. 1–13.
- Kemp, R., Schot, J. & Hoogma, R., 1998. Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. *Technology Analysis & Strategic Management*, 10(2), pp.175–198.
- Hoppe, T. & van Bueren, E., 2015. Guest editorial: governing the challenges of climate change and energy transition in cities. *Energy, Sustainability and Society*, 5(1), p.19.
- Moss, T., Becker, S. & Naumann, M., 2014. Whose energy transition is it, anyway? Organisation and ownership of the Energiewende in villages, cities and regions. *Local Environment*, (March 2015), pp.1–17.
- Quitau, M.-B., Hoffmann, B. & Elle, M., 2012. Local niche planning and its strategic implications for implementation of energy-efficient technology. *Technological Forecasting and Social Change*, 79(6), pp.1049–1058.
- Roberts, S., 2010. The role of local authorities in galvanizing action to tackle climate change: A practitioner’s perspective. In *Low Carbon Communities: Imaginative Approaches to Combating Climate Change Locally*. Edward Elgar Publishing Ltd., pp. 75–88.
- Romero-Lankao, P. & Dodman, D., 2011. Cities in transition: Transforming urban centers from hotbeds of GHG emissions and vulnerability to seedbeds of sustainability and resilience. Introduction and Editorial overview. *Current Opinion in Environmental Sustainability*, 3(3), pp.113–120.
- Schot, J. & Geels, F.W., 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. *Technology Analysis & Strategic Management*, 20(5), pp.537–554.
- Seyfang, G., Park, J.J. & Smith, A., 2013. A thousand flowers blooming? An examination of community energy in the UK. *Energy Policy*, 61, pp.977–989.
- Seyfang, G. et al., 2014. A grassroots sustainable energy niche? Reflections on community energy in the UK. *Environmental Innovation and Societal Transitions*, 13, pp.21–44.
- Späth, P. & Rohrer, H., 2014. Beyond localism: The spatial scale and scaling in energy transitions. In *Scale Sensitive Governance of the Environment*. pp. 106–121.
- Schmid, E., Knopf, B. & Pechan, A., 2016. Putting an energy system transformation into practice: The case of the German Energiewende. *Energy Research & Social Science*, 11, pp.263–275.

Schoenberger, P., 2013. Municipalities as Key Actors of German Renewable Energy Governance. Wuppertal Papers, (186), pp.1–39.

Wassermann, S., Reeg, M. & Nienhaus, K., 2015. Current challenges of Germany 's energy transition project and competing strategies of challengers and incumbents: The case of direct marketing of electricity from renewable energy sources. *Energy Policy*, 76, pp.66–75.

The Experimental City: new modes and prospects of urban transformation

James Evans
(University of Manchester, UK)
James.Z.Evans@manchester.ac.uk

KEYWORDS: Smart cities, Eco cities, Experiments, Low carbon, Society, Monitoring, Learning, Governance, Politics, Transition, Change

Experimentation is increasingly being promoted as an alternative to ‘urbanization as usual’ with cities serving as laboratories for radical change. In response to multiple wicked such as climate change, infrastructure provision and economic restructuring, policymakers, designers, private companies, and third sector organizations are initiating innovation activities to trial various future visions of local economic development, social cohesion, environmental protection, creative sector expansion, policy evolution, infrastructure provision, academic research, and so on. While the potential to enable cutting edge innovation lends experiments considerable rhetorical power, these activities are also reinterpreting and reframing the trajectories of contemporary urban development in ways that are often unrecognized.

This paper synthesizes insights from the about to be published *The Experimental City: new modes and prospects of urban transformation*, which includes 17 chapters by over 30 contributors from around the world. The book examines the drivers, pressures, and interests involved in the recent rollout of urban experiments in a wide variety of settings in the Global North and South. The contributors reveal how the concept of ‘experiment’ is being used to reshape practices of knowledge production with respect to carbon governance, energy services, technological innovation, transportation networks, economic growth and social organization. Using insights from science and technology studies, environmental governance, and political economy this paper will look specifically at how the concept of ‘experiment’ has emerged in urban debates about resilience, climate change governance, and socio-technical transitions. In doing so the paper presents a deeper and more socially and politically nuanced understanding of how urban experiments shape cities and drive wider changes in society.

The paper is organized around three cross-cutting themes:

1. Logics of urban experimentation: what are the different approaches to urban experimentation and why/ how are they being deployed?
2. Experimenting in cities: how are experiments being staged within cities, by whom, and with what effects?
3. Experimental cities: how are entire cities or groups of cities constructed and/or conceived as experiments and with what effects?

The paper draws together themes from across the chapters to address these key questions and map out the current research landscape in this exciting and important field.

The Sharing Economy: A Case of “Reverse” Technology Assessment

Koen Frenken
(Utrecht)
koen.frenken@uu.nl

KEYWORDS: -

The sharing economy generally has become defined as an economic system based on sharing underused assets or services, for free or for a fee, through peer-to-peer Internet platforms (Botsman 2015; Chase 2015). This includes people who lend out or rent out their house, car, parking space, boat, toys, appliances, books, clothes, et cetera as well people offering of personal services such as education, cleaning, taxi, cooking, gardening, etc.

This “sharing” practice – both of goods and of services – has always existed among friends and family members, but with the advent of Internet platforms people increasingly engage in “stranger sharing”. Airbnb is the main example of such a platform on a global level, while other examples include SnappCar and Drivy as European car sharing platforms and the Dutch Peerby platform, also expanding to other countries, where any type of good is being shared.

There has been a lively public debate about de pros and cons of the sharing economy (Schor 2014; Frenken et al. 2015). The question I ask is: what perspective can the field of innovation studies bring to the table? Indeed, the platform-based sharing economy can be considered as an emerging technology and practice. As such, platform-based sharing can be approached from a technology assessment angle. In this paper, I do so by sharply defining sharing economy, discussing all the (little known) economic, environmental and social impacts and analysing how these impacts affect different social groups to different extents.

I then introduce the notion of “reverse” technology assessment. In a traditional technology assessment, one examines the effectiveness of a technology as well as all its side effects and wider economic, environmental and social impacts. This then helps a normative discussion, preferably as a public debate, which cumulates in regulations to permit market introduction. In the sharing economy, however, this process is actually reversed. Companies first launch a new platform, and then follows regulation, and only hereafter the normative debate and scientific research. Although this kind of reverse technology assessment is not entirely new (think of patients experimenting with drugs for new uses), the scale and pace of this process in the sharing economy is arguably unprecedented.

I will illustrate this process using the examples of Airbnb (homesharing), Airdnd (home-cooking), Helping (cleaning), SnappCar (car sharing) and UberPop (ridehailing) in The Netherlands, based on in-depth interviews with some of the founders, relevant ministries and industry stakeholders, as well as using secondary sources. The key mechanism here, actively made use of by companies as “institutional entrepreneurs” (Battilana et al. 2009), concerns the process of legitimation through users’ daily practices. As sharing platforms tap into underutilized goods, the platform can scale very fast, and sharing practices diffuse rapidly. Governments, then, are forced to react quickly, and come up with ad-hoc measures that are aimed to balance the winners’ interests (esp. platforms and their users), and losers’ interests (esp. incumbents business, home-share neighbours) on the other. The normative discussion and scientific research that is desired to supports such a political process, however, is largely lacking due to the pace of the process as well as the very limited access to platform data granted to politicians and scientists. This poses a new challenge for governments and academics alike how to deal with revered innovation processes.

References

- Battilana, Julie; Leca, Bernard; Boxenbaum, Eva (2009) How actors change institutions: Towards a theory of institutional entrepreneurship, *The Academy of Management Annals*, 3, pp. 65– 107.
Botsman, Rachel (2015) Defining the Sharing Economy, *Fast Co.Exist*, <http://www.fastcoexist.com/3046119/defining-the-sharing-economy-what-is-collaborative-consumption-and-what-isnt>
Chase, Robin (2015) Peers Inc., *PublicAffairs*.
Frenken, Koen; Meelen, Toon; Arets, Martijn; Van de Glind, Pieter (2015) Smarter Regulation for the Sharing Economy, *The Guardian*, <https://www.theguardian.com/science/political-science/2015/may/20/smarter-regulation-for-the-sharing-economy>
Schor, Juliet (2014) Debating the Sharing Economy, *Great Transition Initiative*, <http://www.greattransition.org/publication/debating-the-sharing-economy>

Borrás, S. (2003): *The Innovation policy of the EU. From Government to Governance* Cheltenham: Edward Elgar publishers.

Borrás, S. and Conzelmann, T. (2007): "Democracy, Legitimacy and Soft Modes of Governance in the EU: The Empirical Turn" in *Journal of European Integration*, vol. 29, no. 5, pp. 531-548.

Boschma, R., 2005. Proximity and Innovation: A Critical Assessment. *Regional Studies*, 39 (1), 61–74.

Carlsson, B., Jacobsson, S., Holmén, M., and Rickne, A., 2002. Innovation systems: analytical and methodological issues. *Research Policy*, 31, 233–245.

Coenen, L., Hansen, T., and Rekers, J. V., 2015. Innovation policy for grand challenges: An economic geography perspective. No. 2015/13.

Dechezleprêtre, A., Martin, R. and Bassi S. Climate Change Policy, Innovation and growth. Policy Brief for the Grantham Institute at the London School of Economics. London

Elzen, B., Geels, F.W., and Green, K., eds., 2004. *System innovation and the transition to sustainability: Theory, evidence and policy*. Edward Elgar.

European Commission (2010) Europe 2020 Flagship Initiative Innovation Union SEC (2010) 1161. EC, Brussels

Fagerberg, J. (n.d.). *Innovation: A Guide to the Literature*. Working Papers on Innovation Studies. Retrieved from <http://ideas.repec.org/p/tik/inowpp/20031012.html>

Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy*, 36(3), 399–417.

Kallerud, E. (2010). Goal conflicts and goal alignment in science, technology and innovation policy discourse. EASST 2010 Conference: Practicing Science and Technology, Performing the Social, (1), 1–22.

Kallerud, E., Amanatidou, E., & Upham, P. (2013). Dimensions of Research and Innovation Policies to Address Grand and Global Challenges.

Kemp, R. (2011). Ten themes for eco-innovation policies in Europe. *S.a.P.I.En.S.*, (October), 1–19. Retrieved from <http://sapiens.revues.org/1169>

King, D., Browne, J., Layard, R., O'Donnell, G., Rees, M., Stern, N., and Turner, A., 2015. *A global Apollo programme to combat climate change*. London.

Lundvall, B.-Å. (2007). *Innovation System Research and Policy Where it came from and where it might go*, 1–50.

Markard, J., Raven, R., and Truffer, B., 2012. Sustainability transitions: An emerging field of research and its prospects. *Research Policy*, 41 (6), 955–967

Mazzucato, M. (2013) *The Entrepreneurial State: Debunking Public vs. Private Myths in Risk and Innovation*. London: Anthem Press

Mulgan, G. and Leadbeater, C. (2013) *Systems Innovation Discussion Paper*. Nesta, London.

OECD, 2012. Meeting global challenges through better governance: International co-operation in science, technology and innovation. Paris, France.

Scruse I, Stirling A, G. F., Smith A, & P., and V. Z. (2009). *Transformative Innovation: A report to the Department for Environment, Food and Rural Affairs*. SPRU.

Steward, F. (2008). *Breaking the boundaries*, (April).

Steward, F., 2012. Transformative innovation policy to meet the challenge of climate change: sociotechnical networks aligned with consumption and end-use as new transition arenas for a low-carbon society or green economy. *Technology Analysis & Strategic Management*, 24 (4), 331–343.

Truffer, B. and Battistini, B., 2015. *Global Innovation Systems and Sustainability Transitions – Towards a transnational perspective* (Forthcoming).

Weber, K. M., & Rohracher, H. (2012). Legitimizing research, technology and innovation policies for transformative change. *Research Policy*, 41(6), 1037–1047.

9B. SOCIAL INNOVATION

Challenges to Research and Innovation Policy for Social Problem Solving and their Policy Implications: The Case of South Korea

Hee-Je Bak*(Kyung Hee University) and Jieun Seong(STEPI)

*hbak@khu.ac.kr

KEYWORDS: Social Problem-solving, Research Policy, Participant Observation, RRI

The purpose of this study is to examine Korea's new research and innovation policy which explicitly aims at solving social problems and to discuss the policy implications obtained from the experience of implementing them. In particular, based upon our participant observations, we discuss what challenges research policy makers, research funding agencies, and researchers faced in the process of implementing the new research and innovation policy.

Science should compete with other social institutions to claim a portion of scarce national resource. Especially, in the present day of economic hardship, the successful justification of the public money is ever more important. In order to persuade the public and politicians to support for scientific enterprise, therefore, scientists and science policy circles have long emphasized the benefits of science for society. Since the mid-20th century in which the effect of science and technology on national economies became a growing concern, the justification of public investment on scientific research has relied overwhelmingly on economic concern. Thus, how to better harness national R&D capacities and position strategic technologies for industrial competitiveness have been the crucial concern of public science and innovation policy.

In South Korea which has long been known an exemplar of developmental states, the government has been devoted to mobilizing scientific and technological resources to bolster economic competitiveness, which was world-widely perceived as an exceptionally effective policy for the nation's economic development (Kim and Leslie 1998). Since the 1960s when Korea's economic development took off, national research capacities have been built-up and promoted by Korean government in accordance to its national economic development plan. For example, many state-funded research institutes were set up in order to assist Korean industries to move forward to capital-intensive heavy industries and knowledge-intensive high technology industries from labor-intensive light assembly industries. From the outset, scientific research and technological innovation was highly mission-oriented.

Such an experience has reinforced Koreans' perceptions of scientific research as the key instrument for developing its economy. Both scientists and lay people have tended to view scientific research as a tool for industrialization and identify scientific advance with national advance (Bak 2014). Thus, positive impacts of scientific research have been predominantly couched in economic and nationalistic terms, such as the prosperity of a nation and industrial competitiveness of Korea.

In the last few years, however, Korea has experimented an important research and innovation policy change. Both the central government and the local governments have begun to implement new research and innovation programs which explicitly announced the purpose of the research and innovation as solving social problems. For example, from 2013 to 2015, the Korean government invested 48.5 billion won (about 38.8 million Euro) in developing technologies to improve citizens' living conditions and 34.8 billion won (about 27.9 million Euro) to enhance public welfare and safety. It also launched new R&D projects to reduce the socio-economic gaps of the disadvantaged with the budget of 20 billion won (about 16 million Euro) for 2015 - 2017. In addition, in 2015, Seoul city implemented "the projects to support for technological innovation to solve urban problems" with the budget of about 14 billion won (about 11.6 Million Euros).

These new research and innovation policies Korea has been implementing, however, require new approaches in terms of objectives, processes, and main actors since they substantially differ from traditional innovation policies which aimed at developing industrial technologies (Song and Seung 2013). For example, public engagement is emphasized in the processes of planning, implementing, and evaluating research projects, as citizens have direct experience with those social problems in everyday life and their experience and knowledge are essential

elements to develop technologies aiming at solving such social problems. . Since the main goal of the project is solving social problems, the project needs indicators for evaluation other than the number of journal papers or patents. In actual practice, therefore, such a research policy has faced numerous challenges from selecting applications with considering its social effects, to pushing researchers to cooperate with lay people, and to evaluating the outcome compared to other traditional research projects.

We examine in detail those challenges to which research policy makers, research agencies, and researchers have to respond while implementing the research and innovation policy aiming at social problem solving. Furthermore, we discuss the theoretical and policy implications of the findings of this study. In particular, we discuss how to improve research programs for solving social programs using the theoretical discussion of RRI (Own et al. 2013).

For the empirical materials and methods for this study, first, we rely on our experiences of participant observations. One of the authors was engaged in the envisioning of and setting up the new national research policy. One of the authors participated in the process of selecting project applications for assigning research grants and served as a committee member for evaluating one of the research programs. Both authors were also members of the advisory committee on the management and enactment plan for research policy for social problem-solving and served the actual projects as citizen mentors. We also analyze documents such as the government policy reports, program proposals which each ministry submitted, RFPs, research grant proposals, and quantitative data of programs' outputs. Finally we conduct in-depth interviews on researchers who conduct actual research for social problem solving.

References

- Bak, Hee-Je. 2014. The Utilitarian View of Science and the Norms and Practices of Korean Scientists. In *Routledge Handbook of Science and Technology Studies* edited by Dainel L. Kleinman and Kelly Moore. London: Routledge.
- Kim, Dong-Won and Stuart. W. Leslie. 1998. "Winning Markets or Winning Nobel Prizes? KAIST and the Challenges of Late Industrialization." *Osiris* 13: 154-185.
- Owen, Ricjard, John Bessant and Maggy Heintz. 2013. *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*. West Sussex, UK: Willey.
- Song, Wichin and Jieun Seung. 2013. *Society-dreiven Innovation Policy*. Seoul: Hanwul.

New avenues for inclusive innovation in EU's social innovation policies?

Malin Lindberg
(Luleå University of Technology)
malin.lindberg@ltu.se

KEYWORDS: Inclusive innovation, Innovation, Innovation policy, Social innovation, Societal challenges

Introduction

Social innovation – in terms of the development of innovative solutions to societal challenges or social needs among underrepresented or underprivileged groups in various areas of society – is highlighted as one of the main tools of the European Union to deal with societal challenges such as poverty, inequality, unemployment and ageing populations. EU's new policy strategies for growth and innovation therefore include a strong commitment to promote social innovation (European Union, 2010a, 2010b). This social perspective on innovation contrasts with earlier innovation policies in EU and its member states, which mainly have focused technological product innovation, prioritising a predominantly narrow range of sectors, industries, organisations, disciplines and innovation types in public promotion of innovation (cf. Lindberg, 2012; Pettersson, 2007). The excluding prioritisation pattern in previous innovation policies seems to contrast with EU's new ambition of inclusive innovation, where the importance of broad engagement among citizens is emphasised (cf. European Union, 2010a, 2010b). This paper explores to what extent the increased focus on social innovation in EU's new growth innovation policies contributes to opening up new avenues for public promotion of inclusive innovation processes, enabling a wider range of sectors, industries, organisations, disciplines and innovation types to realise ideas of future goods, services, methods etc.

Research design

The research design of the presented study includes textual analysis of two key policy documents: Europe 2020, EU's main strategy for growth and innovation, promoting three mutually reinforcing priorities: smart, sustainable and inclusive growth (European Commission, 2010a), and Innovation Union, one of EU's seven flagship initiatives to catalyse progress within the three priorities of Europe 2020, aiming to ensure that innovative ideas can be turned into products and services that create growth and jobs (European Commission, 2010b). The methodological approach of discourse analysis is employed to analyse the texts by their statements on the social and inclusive aspects of innovation (cf. Fairclough, 2010; Phillips and Jorgensen, 2002). The implications of these statements on the range of sectors, industries, organisations, disciplines and innovation types being acknowledged are analysed by means of the discourse analytical approach 'What's the problem represented to be?' as outlined by Bacchi (1999).

Theoretical framework

Researchers have argued that the previously narrow focus in innovation policy and research motivates knowledge development on more inclusive approaches to innovation, in order to: 1) democratise the development and use of innovations in line with trends of user-involvement and co-creation, 2) make use of the multitude of innovative potential in the expanding knowledge and service economy, 3) avoid one-sided promotion of innovation in traditional actors and industries, since it is difficult to predict where the most important innovations of the future will appear (Alsos et al., 2013; Andersson et al., 2012; Lindberg and Schiffbänker, 2013). The articulated need for inclusive innovation is reflected in recent scientific knowledge development on inclusive innovation (cf. Lindberg, 2014). Broadening the spectrum of actors, areas and innovation types considered as relevant to innovation policy and research is in concordance with the general trend of opening up innovation to society, motivated by the transition from a primarily industrial to a more knowledge and service intense society (Blake and Hanson, 2005; Howaldt and Schwarz, 2010; Lindberg, 2014). It is reflected in the increased use of concepts such as 'open innovation' (Chesbrough et al., 2006), 'participatory innovation' (Buur and Matthews, 2008), 'democratic innovation' (Smith, 2009) and 'democratisation of innovation' (von Hippel, 2006), referring to the involvement of a broader range of actors (e.g. citizens, end-users, consumers etc.) than usual in the development and implementation of innovations.

Alongside the increased focus on inclusive innovation in research, social innovation has re-emerged as a strand in innovation studies, after having been predominantly ignored since the introduction in the early 1900s (cf.

Godin, 2012; Mouleart et al., 2005). Social innovation is in scientific studies generally defined as the development and adoption of new goods, services, methods, organisational forms etc. that are social in their means and ends, i.e. social in how they are developed and in what they are intended to attain (European Commission, 2013; Mulgan et al., 2007; The Young Foundation, 2012a). The term 'social' refers in this context to the quality of life, wellbeing, relations and empowerment of individuals and communities (Cajaiba-Santana, 2013; Dawson and Daniel, 2010; Pol and Ville, 2009). Recent studies have engaged in pinpointing four main components of social innovation: 1) the identification of unaddressed societal challenges or unmet social needs among underrepresented or underprivileged groups in society, 2) the inclusion of underrepresented and underprivileged groups in the development of solutions to address these needs and challenges, 3) the social newness in the developed solutions, in terms of entirely new solutions, innovative adaptations of existing solutions to new contexts, or innovative combinations of existing solutions, 4) the intended or attained social/societal improvements and transformations as a result of the adoption of these solutions (cf. Dawson and Daniel, 2010; Nicholls et al., 2015; Pol and Ville, 2009; The Young Foundation, 2012b, 2012c).

Preliminary findings

The spectrum of sectors, industries, organisations, disciplines and innovation types acknowledged in Europe 2020 is partly broad. Innovation across all sectors of the economy (i.e. the private, public, non-profit sectors) is expected to improve competitiveness and foster job creation. Public authorities on all levels (i.e. national, regional and local levels) are expected to contribute to the realisation of the strategy in order to bring the strategy closer to the citizens. Social partners and civil society as well as the citizens of Europe are encouraged to help implement the strategy by engaging in partnerships and taking action in various areas of the strategy. Europe is in the strategy described as having a strong industrial base, a vibrant services sector, a thriving high quality agricultural sector and a strong maritime tradition. The tourism sector is also highlighted as important to develop further, alongside efforts within the area of education, training and lifelong learning. The need for a more inclusive approach to innovation is emphasised in the flagship initiative Innovation Union, recommending a pursuit of a broad concept of innovation, unlocking the innovative potentials of the European people's creativity and diversity as well as the strength of European creative industries, by involving all actors and all regions in the innovation cycle, "not only major companies but also SMEs in all sectors, including the public sector, the social economy and citizens themselves (social innovation); not only a few high-tech industries, but all regions in Europe and every Member State" (European Commission, 2010a, p. 8).

The broad approach to innovation identified in the strategies seems to open up public innovation support to wider societal participation and benefit, by expanding the focus from technological to social aspects of innovation, on a general level, by means of the concept social innovation. This expansion seems to imply a more equal inclusion of various sectors, industries, organisations, disciplines and innovation types. A closer examination of this inclusive potential reveals, however, possible reinforcement of pre-existing patterns of exclusion is perceivable in the parallel recommendation of smart specialisation strategies, mobilisation of critical mass and scientific excellence. In order to counteract responses of resistance and restoration of predominant priority patterns when implementing the ambitions of inclusive innovation, the transformation of EU's strategies from theory to practice could be guided by the main components of social innovation in order to be truly transformative, basing the efforts on insufficiently addressed societal challenges or unmet social needs among underrepresented or underprivileged groups in various areas and promoting the development and application of new solutions that innovatively transform organisational and societal structures, including predominant norms of technological, industrial innovation as the most important for continued growth.

The main policy implications of the findings are based on the fact that the EU strategies underline the importance of an active innovation policy in order to incite the development of innovative solutions to existing needs and challenges. These solutions might not otherwise have seen the light of day because of the absence of a clear-cut market or due to market failures where the free market does not work optimally to satisfy social needs or the lack of proper support to other innovations than technological ones. According to the studied strategies, innovation policy can contribute to a well-functioning framework, an innovative public sector, public demand for innovation and direct efforts to incite innovation by advisory services, financial support, innovation networks, incubators etc. Innovation policy is thus able to influence which actors are given the opportunity to realise different types of innovations in various areas. So far, the innovation policies have mainly promoted innovation in a narrow spectrum of sectors, industries, organisations, disciplines and innovation types, but an active innovation policy could just as well be able to allocate resources in a way that better promotes innovation

in a broader spectrum guided by social incitements, alongside the economic and technological ones. This could require alterations of existing markets or the creation of entirely new markets, which is especially significant for inclusive innovation with predominant social elements, where traditions and support structures are largely lacking.

Exploring Social Innovation Policy – Empirical Evidence and Pending Questions

Maria Kleverbeck* and Dieter Rehfeld
(Institute for Work and Technology)
kleverbeck@iat.eu

KEYWORDS: Social Innovation Policy, Social Innovation Process, Qualitative Research

1. Relevance

This study examines the role of policy in the social innovation process as well as the institutional and cultural context dependency of social innovative solutions. It is argued that innovation and research policy ask for comprehensive frameworks to analyse social innovation as a highly complex phenomenon even with regard to the role of policy, policy failure and legal forms. Social innovations offer a new way to address social purpose and overcome the weaknesses of both market's and policy's capacity to solve social problems (Leadbeater, 2007). According to SIMPACT's understanding, social innovation refers to: «novel combinations of ideas and distinct forms of collaboration that transcend established institutional contexts with the effect of empowering and (re)engaging vulnerable groups either in the process of the innovation or as a result of it» (Rehfeld et al., 2015). So far, we know little about whether and to what extent policy is engaged in social innovation and interacts with social innovators. While national strategies on supporting 'traditional' innovation look back on a long history, no common strategy exists to understand and support social innovation. Compared to traditional innovation, the amount of money spent by governments, non-government organisations and foundations to facilitating the development of innovative solution addressing social needs was rather small. «Yet at present these initiatives represent a relatively small and emergent policy strand especially when compared with the frameworks for technological innovation» (Totterdill & Terstriep, 2015: 4). Exacerbated by the economic crises, governments across Europe are confronted with many complex and interrelated socio-economic challenges, which are expected to accelerate the pace of social innovation in the coming years. Already today, we can observe a shift in the social innovation ecosystem from ad hoc assistance to more coordinated formal involvement of policy as initiator, promoter or supporter.

In order to become a significant actor and reliable partner in the social innovation process, it is necessary to have a detailed understanding of the state of affairs. To allow for evidence-based decision-making and development of tailored policy instruments, compiled knowledge generated through field work within the European joint project SIMPACT – Boosting the Impact of Social Innovation across Europe through Economic Underpinnings helps advance understanding the social innovation process and the role of policy. The analysis of 60 social innovation cases collected across Europe by means of «Social Innovation Biographies» and business case studies, provides in-depth information about the role of policy in social innovation. Forasmuch, we will present new insights in the social innovation process in order to foster innovation policy and research as well as to point out weaknesses and chances of current policy involvement in social innovations.

2. Research Aims and Questions

The main research question is whether and to which extent policy is involved in the process of social innovation. Hereby it is explicitly important to shed light on the relevance for innovation and research policy in order to demonstrate a turning point in the innovation and research strategy from a static technical innovation approach to a flexible innovation approach including social innovation. As Terstriep and Totterdill (2015: 3) emphasise, «[c]reating a socio-economic system capable of understanding and generating effective social innovations represents a major policy challenge for Europe and its regions in the coming years». To reinforce policymakers' awareness of social innovation as social and economic value necessitates a better understanding of their role in the innovation process. As we can draw from SIMPACT's Meta-Analysis differences in countries' institutional and political contexts are well pronounced (Debref et al., 2015). In response to this, identified differences in institutional contexts and dimensions of political failure as well as country specific strengths and weaknesses in support of social innovation will be presented.

Besides the setting of exogenous context, policy also play a functional role in social innovation when actively participating in the innovation process as supporter, promoter or operative actor in the inner core (i.e. actors initiating and operating a socially innovative solution). This is why the presentation tends to highlight the active role of policy with the focus on political levels (European, national, regional, local) and time of interaction. The questions to be answered are whether social innovation initiatives/projects get a greater support from the

European, national, regional or local government, and at which stage in the innovation process policy get involved. With reference to the time of interaction, the study additionally aims to identify politics' motivations of getting on board, because it is argued that governments are more likely to get involved only in later development stages (e.g. scaling and diffusion of social innovation) where concepts have proven their meaningfulness and the risk of failure is substantially smaller.

3. Definitions

The special focus is on the analysis of role of policy in social innovation addressing vulnerable and marginalised groups in society. Due to market and policy failure, these groups in society are not able to fully participate in the economic, social, political and cultural life. Forasmuch, being marginalized is not viewed because of individual inadequacies, but is imputable to institutional blockings. Highlighting the potential for empowerment and re(inclusion) of vulnerable and marginalised constitutes a cornerstone in the social debate.

In this study, the role of policy is covered from two perspectives, in an indirect and direct way. The indirect perspective identifies political and institutional failure as reason why social innovation came into life.

Individuals search for alternatives to the policy system in order to cope with the social challenges. The direct perspective identifies policy as part of the actor network either as initiator, supporter, promoter or costumer. For instance, Dalpé (1994) argues that governments of industrialised countries including public administration and public enterprises are major costumers of goods and service.

4. Theoretical Framework

The examination of the role of policy in social innovation was conducted as part of SIMPACT's empirical phase in which evidence was collected by means of «Social Innovation Biographies» (SIBs) and business case studies (BCSs). SIBs base on narrative and secondary interviews with initiators, supporter and promoter providing in-depth information about the social innovation process, institutional context and networks. Social innovation business case studies build on sophisticated desk research with a high focus on business models. The conceptual application of these two methods and its questions base on the theoretical framework of SIMPACT project whose rational of social innovation ecosystem includes the role of actors defined as inner core, supporter, promoter and beneficiaries as well as their objectives and resources embraced by institutional context and governance.

The collected data have been analysed and interpreted along three directions with the focus on cases and research questions: (1) horizontally, where the case is analysed and discussed in all its aspects, (2) vertically, where specific aspects or mechanisms of SI, particularly evident in the case, are focused and deepened and (3) comparatively by combining findings along the two previous directions in a methodologically comprehensive manner (Terstriep et al., 2015).

5. Empirical Materials

The underlying research question asks for social innovation cases addressing vulnerable and marginalised groups in society. Focusing on the complex and multi-faced characteristics of social innovations, the use of reliable databases and application specific selection criteria tailored to the research question was of utmost importance when collecting the set of cases (Rehfeld et al., 2015). The main data collection criteria are welfare regimes and social challenges. Welfare regimes are chosen due to the high degree of differences in institutional contexts, which include welfare, political, social and economic institutions. In order to highlight the most famous social challenges in Europe the cases were typed in cases deal with employment, migration and demographic change with the underlying cross themes gender, children and poverty. In sum 60 social innovation cases in 20 European countries are analysed with the main focus on employment followed by migration and demographic change.

6. Description of Methodologies

Social Innovation Biographies envisage deepening our understanding of innovation processes, developmental trajectories and stakeholder interactions at the micro-level of the single social innovation. It is important to note that a Social Innovation Biography is not a biography of the organisation conducting the innovation, but rather of the innovation process. Innovation biographies are basically an in-depth biographic-interpretative methodology for analysing narratives of participants' experiences in relation to the larger cultural matrix of society or economy (Wengraf, 2001). Through the combination of interviewing techniques, network analysis and triangulation is possible to reconstruct innovation processes from the first idea to its implementation (Butzin, 2013; Butzin & Widmaier, 2015).

Business Case Studies are descriptions of cases of social innovation with a specific focus on their business

model and network. They advance the understanding of the economic aspects of already-known and described cases, by means of deep qualitative desk research (Strauss & Corbin, 1990; Denzin & Lincoln, 1994), during which the authors collected and compared information coming from different sources: Scientific publications, non-scientific publications, interviews or presentations of the initiators, websites of the enterprises or initiatives among others. The use of multiple sources enabled the exploration of complex situations, allowing for the gathering of multiple perspectives.

7. Expected Outcomes

This study examines the role of policy in social innovation with the focus on institutional context and active involvement of policy. The empirical findings indicate that political institutions at local, regional, national and European level constitute a building block of social innovation, and foster or impede social innovation processes. Social innovation also results from the combination of reaction to welfare or political gaps and its enabling conditions. It becomes obvious that marginalised people addressed as a result of existing laws and not as an original target. It is argued that social innovation suffers from unfavourable policies e.g. laws, regulations, lack of long-term funding options, which impede its development.

In addition, the analysis of the active involvement shows a high degree of governmental uncertainty with regard to social innovation and ignorance in working with social innovators. Selected examples illustrated that public authorities in European countries are not yet prepared to deal with social innovation in and its complexity. From this result we can draw the importance to adapt existing laws to the requirements of social innovation and increase the knowledge at all political levels. Moreover, policy is required to undertake task which support the operative work of social innovation projects. For instance, policy could act as gatekeeper with creating a public innovation platform, which bring together the public sector, private companies and social enterprises (Leadbeater, 2007).

References

- Butzin, A. (2013). Knowledge dynamics in innovation biographies: a methodological and spatial perspective. Marburg, Univ., Diss. 2014.
- Butzin, A., & Widmaier, B. (2015). Exploring territorial knowledge dynamics through innovation biographies. *Regional Studies*, 49.
- Dalpe, R. (1994). Effects of Government Procurement on Industrial Innovation. (E. S. Ltd, Ed.) *Technology In Society*, 16(1), pp. 65-83.
- Debre, R., Alijani, S., Thomas, L., Boudes, M., & Mangalagui, D. (2015). Meta-Analysis of Social Innovation across Europe. Deliverable D3.1 of the Project "Boosting the Impact of Social Innovation in Europe through Economic Underpinnings" SIMPACT. Brussels: European Commission - 7th Framework Programme.
- Denzin, N., & Lincoln, Y. (1994). *Handbook of qualitative research*. Thousand Oaks, CA: Sage.
- Leadbeater, C. (2007). *Social enterprises and social innovation: Strategies for the next ten years*. Cabinet Office, Office of the Third Sector.
- Rehfeld, D., Terstriep, J., Welschhoff, J., & Alijani, S. (2015). Comparative Report on Social Innovation Framework. Deliverable D1.1 of the Project "Boosting the Impact of Social Innovation in Europe through Economic Underpinnings" SIMPACT. Brussels: European Commission - 7th Framework Programme.
- Strauss, A., & Corbin, J. (1990). *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Thousand Oaks, CA: Sage Publications.
- Terstriep, J., & Totterdill, P. (2014, October 16-17). *Economic Foundation of Social Innovation: New Modes of Policy Production*. RIP 2014 - 9th Regional Innovation Policies Conference, University of Stavanger.
- Terstriep, J., Kleverbeck, M., Deserti, A., & Rizzo, F. (2015). Comparative Report on Social Innovation across Europe. Deliverable D3.2 of the Project "Boosting the Impact of Social Innovation in Europe through Economic Underpinnings" SIMPACT. Brussels: European Commission - 7th Framework Programme.
- Wengraf, T. (2001). *Qualitative Research Interviewing. Biographic Narrative and Semi-Structured Methods*. London: Sage Publishing.

9C. RESEARCH AND INNOVATION

Serendipity in research and innovation: Towards a taxonomy and a theory

Ohid Yaqub
(University of Sussex, SPRU)
o.yaqub@sussex.ac.uk

KEYWORDS: Serendipity, Science and technology policy, Research management

Serendipity as the centrepiece of science policy practice and theory

Serendipity, the notion of researchers making unexpected and beneficial discoveries, was a pillar of Vannevar Bush's blueprint for post-war science policy. Serendipity remains a central notion in today's political economy of research and innovation. Research funders increasingly emphasise their impact and relevance to specific missions, but cede considerable levels of control and accountability in the name of serendipity (Sarewitz 1996). Researchers have become accustomed to promising utility but, when justifying their autonomy, resort to invoking serendipity. NIH Director Varmus (1997) suggested that priority-setting may be misguided since "research aimed in one direction frequently provides benefits in an unexpected direction".

The idea of serendipity has been influential not only in practice, but also in theory. Economists have noted that research has valuable, but largely unanticipated outcomes (Nelson 1959). Although some philosophers of science have argued that discovery should be directed to social needs (Bernal 1939), others have argued that science should be self-coordinating (Polanyi 1962; Ziman 1978).

Serendipity thus has an important role in debates about the feasibility and desirability of targeting public R&D investments, and in theories about the rate and direction of scientific and technical change (Stirling 2008; Mowery et al. 2010). Despite this, there is surprisingly little evidence on the magnitude, frequency, or institutional determinants of serendipity (Sampat 2014; Murayama et al 2015). This has contributed to perennial debates about the benefits of untargeted research, relative to benefits of research targeted at specific goals.

In this paper, we clarify the meaning of term serendipity, principally by drawing attention to the heterogeneity of the phenomenon. By identifying different types and mechanisms of serendipity, we hope to improve our ability to measure its prevalence and develop implications for theory and policy.

Research Design

We are fortunate to stand on the shoulders of Robert K. Merton, whose obsession with words yielded a project in the sociological semantics of serendipity, charting its social, intellectual and lexicographical history, a project that began in the 1940s and culminated with his posthumous book on serendipity with Elinor Barber (2004).

We spent several months in the archive that holds Merton's notes, much of which have not been published. It contains his detailed reading notes relating to serendipity, countless clippings from magazines, newspapers, and journals citing any mention of serendipity, and correspondence with scientists and sociologists of his day. From the 513 manuscript boxes, we were able to hand-compile a qualitative database containing 103 examples of serendipity and build an extensive bibliography of serendipity.

The Merton archive was a good place to start our search for varieties of serendipity, not least because it was he, as one of the "most influential sociologists of the twentieth century" (Calhoun 2010:vii), who introduced the term into the social sciences (see figure 1).

Figure 1: The usage of the word serendipity coincides with Merton's introduction of the notion and term into the social sciences. Search undertaken July 2015.

We coded the examples according to various characteristics (because they initially appeared as similarities and

differences), before settling on the motivations underlying the discovery and the outcomes of the discovery. We iterated between the examples and emerging theory, and weaved in relevant literature whilst matching patterns identified with those reported by other authors. As a result, eight examples were dropped from the database following development of the typology. We developed a framework based on these two dimensions, yielding methodological ideal types (Doty and Glick 1994).

Findings: An illustrated typology of serendipity and possible mechanisms

We develop a framework of four types of serendipity whose dimensions are defined by the motivations behind the research and the outcomes of the serendipitous discovery: Orthodox-traditional, Unexpected-route, Just-browsing and Holds-interest serendipity types. We highlight some of the examples reviewed as illustrative of each type. The dimensions of our typology seem to resonate with other literature (Nightingale and Scott 2007; Calvert 2004; Stokes 1997; Senker 1991). The typology helps to identify and recognise serendipity in its different forms (see figure 2).

Figure 2: A typology of serendipity in research.

Next we sought similarities across examples of serendipity (factors), which we group into four mechanisms that help describe how serendipity happens: Observer-led; Theory-led; Error-borne; and Relational-serendipity. Serendipity may depend on the attributes of the observer and her situation (such as her perceptiveness and her observation systems), or it may depend on the characteristics of the field of inquiry itself (such as visibility, where anomalies emerging from the growth of theory become conspicuous). We noted that errors took a prominent position in many accounts of serendipity, where seemingly critical substances have been dropped, spilled, inadvertently heated or exploded, forgotten about in pockets or drawers or laid to rest over holidays, contaminated, or subjected to methodological blunder and/or equipment malfunction. Serendipity may depend on such ‘controlled sloppiness’, where experimental design is loosely directed enough to allow anomalies to emerge, but not so uncontrolled that variations cannot be traced back to a source. Lastly, we suggested that networks play dual, informational and teamwork, roles in serendipity.

The types help us to recognise some of the variety of serendipity that is possible, and allows us to appreciate that serendipity may exist across the research system. Measuring the relative magnitudes of the various types of serendipity may provide indications of where serendipity is occurring most. The mechanisms suggest that serendipity is not random, there may be important factors affecting its occurrence, and there may be scope for altering its prevalence. Identifying the loci of serendipity and altering its prevalence may be desirable if serendipity is believed to be associated with better research performance, or if serendipity is believed to be a hindrance to achieving targeted social goals. However, all this relies on the resolution, or at least acknowledgement, of some conceptual challenges that lie ahead for those wishing to measure serendipity. We discuss some of these difficulties. They relate to the unit of analysis (timeframes, embedded cases, and hunches), science and technology as distinct activities, and the possible suppression and exaggeration of serendipity that may be currently present.

Upcoming work that could also be presented

In a parallel project, we have been undertaking empirical measurements of serendipity using a large database of research grants, publications and patents. For an organisation that awards research grants in a largely mission-oriented manner (the NIH, the US government’s (and the world’s) largest biomedical research funder of \$30bn per year), our results indicate the presence of a surprisingly large amount of serendipity in the research system. That is, *if* what is actually being measured represents serendipity. We anticipate that the opportunity to present our taxonomy and engage in a discussion with participants about what serendipity is and is not, what can be measured and what cannot, will help us make progress on some of these issues.

Over the next few months, we plan to use the results from these empirical (quantitative) investigations to help us select a number of (qualitative) case studies. In the upcoming case studies, we plan to undertake semi-structured interviews and document analysis to see how robust the types and mechanisms proposed in this taxonomy paper are.

References

- Bernal, J. (1939) *The Social Function of Science*. Routledge, London.
- Nelson, R. (1959) Simple Economics of Basic Scientific Research *Journal of Political Economy* 67(3):297-306.
- Polanyi, M. (1962). The republic of science. *Minerva* 1: 54-73.
- Mowery, D. C., R. R. Nelson and B. R. Martin (2010). Technology policy and global warming. *Research Policy* 39(8): 1011-1023.
- Calhoun, C. (2010) Robert K. Merton: Sociology of Science and Sociology as Science. Columbia University Press, NYC.
- Calvert, J. (2004) The idea of basic research in language and practice. *Minerva* 42:251-268.
- Merton, R. and Barber, E. (2004) *The travels and adventures of serendipity*. PUP, Princeton.
- Doty, DH. and Glick, WH. (1994) Typologies as a unique form of theory building. *Academy of Management Review* 19:230–251.
- Murayama et al. (2015) Management of science, serendipity, and research performance. *Research Policy* 44(4):862-873.
- Nightingale, P. and Scott, A. (2007) Peer review and the relevance gap. *Science and Public Policy* 34(8):543–553.
- Sampat, B. (2014) Serendipity. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2545515
- Sarewitz, D. (1996). *Frontiers of Illusion*. TUP, Philadelphia.
- Senker, J. (1991) Evaluating the Funding of Strategic Science. *Research Policy* 20(1):29- 44.
- Stirling, A. (2008). Opening up and closing down. *Science Technology Human Values* 33(2): 262-294.
- Stokes, D. (1997) *Pasteur's Quadrant*. Brookings Washington DC.
- Varmus, H. (2009). *The Art and Politics of Science*. Norton, NYC.
- Ziman, J. (1978). *Reliable Knowledge*. CUP, Cambridge, UK.

TRANSFORMATIVE FUTURES OF RESEARCH AND INNOVATION. A META-ANALYSIS OF TWO SCENARIO-BUILDING EXERCISE

Matthias Weber(Austrian Institute of Technology) and **Stephanie Daimer***(Fraunhofer-Institut für System- und Innovationsforschung ISI)

*stephanie.daimer@isi.fraunhofer.de

KEYWORDS: European RTI policies, Meta-analysis, Transformative scenarios, European Research Area, Beliefs

Relevance

In this paper we analyse and compare scenarios stemming from the two recent EU-funded fore-sight projects VERA (Forward Visions of the European Research Area) and RIF (Research and Innovation Futures 2030), which both address transformative future of research and innovation by 2030. While sharing the interest in transformative futures of R&I, RIF puts more weight on the practice of research and innovation in a global context, and VERA focuses on the govern-ance of R&I at the European level. The meta-analysis of these two projects aims at extracting insights, for which the evidence base from just one of them would be too small. Considering the list of conference subthemes, it seems, the paper can at least be relevant in two potential debates:

- The “Knowledge foundations for research and innovation policies” are not only broad, future-oriented and transformative, but also have been generated in participatory proc-esses, engaging highly diverse and international groups of stakeholders.
- Research and innovation policies, and in some regards also education policies are re-garded in a highly integrated manner, all contributing to overarching policy goals which are horizontal (and transformative) in nature.

Research aims and questions

The objective of this meta-analysis of two sets of related scenarios is to disentangle specific features of the scenarios that are particularly relevant for our core interest: Research, technol-ogy and innovation (RTI) policies in Europe and in particular the questioning of widely held assumptions and beliefs underpinning these policies. It is necessary to be aware of the path-dependent nature of these beliefs and to question them in the light of fast-changing develop-ments in R&I.

Theoretical frameworks

The integration of findings from both projects is possible because they draw on similar conceptual models of how transformative change comes about: the multi-layered-perspective on socio-technical transitions (cf. Genus/Coles 2008; Smith et al. 2010) and other theories of social change (v.d.Poel 1998; Boudon 1986) and methodologically the “Three Horizons” futures technique (cf. Curry/Hodgson 2008). All these inroads start from the assumption that tensions and conflicts between emerging trends arise in a systemic context, and that the stalemate can only be overcome by self-reinforcing mechanisms leading to transformative system change. This logic is mirrored in the methodological approach underpinning both projects, which relies on a two-step scenario development approach. There “foresight is not understood as mere desk research, but as ‘collective strategic conversation with key actors actively engaged’, taking data and research results as its input” (cited from Teufel et al. 2013: 5).

Empirical materials

Overall, we find a recurrent pattern of complementarity between the five RIF and four VERA scenarios. There are three pairs of scenarios featuring similar characteristics and implications. Given that the projects applied different methods for scenario-building, finding this congruence of internal scenario logics, supports the consistency and validity of the scenarios overall. The meta-analysis of the RIF and VERA foresight concentrates on comparing the scenarios with some of the widely held beliefs (“key tenets”) underpinning today’s RTI policies in general, and the setup of the European Research Area (ERA) in particular. These key tenets have been identified on the basis of an analysis of recent policy documents, and they can be summarised as follows:

- Key tenet 1 “Scientific excellence is a central pillar on which European RTI policy builds and from which major long-term benefits are expected.” – Stronger purpose orientation, either for industrial or for Grand

Challenge purposes, is likely to question the excellence orientation as the established mode of doing basic research.

- Key tenet 2 “Public funding of “frontier research” is justified by market failure arguments, and is not questioned.” – The significant space that is currently being given to frontier research, may easily be questioned in the future, unless the economic or societal bene-fits can be demonstrated.
- Key tenet 3 “(Academic) scientific knowledge is claiming primacy over other forms of knowledge production.” – Academic knowledge comes under pressure, because of de-velopments internal and external to the science system.
- Key tenet 4 “The integration and/or coordination of resources at European level are a pre-condition for effective and efficient ways of organizing research by avoiding duplication of efforts, concentrating on harmonized roadmaps, and ensuring critical mass.” – ERA continues in many regards to be a meaningful frame, but global linkages and local concerns gain in importance.
- Key tenet 5 “The main purpose of R&I is to create jobs and growth (in the old industrial economy).” – VERA and RIF scenarios show clearly the need to rethink growth and competitiveness orientation in times where the meaning of these concepts is about to be re-defined

Description of the methodologies

The main purpose of this article is to test or check the long-term viability of these five assumptions or key tenets of European RTI policy in light of the scenarios developed by RIF and VERA. The assumptions underpinning RIF and VERA scenarios may actually differ quite considerably from the five assumptions of today, or – even if they are maintained in their basic claims – are taking a quite different shape.

Obviously, we cannot claim that the novel RIF and VERA assumptions are any better than current ones, but we want to show that the current assumptions should at least not be taken for granted. They may actually have to be revised, to the extent that key features of the RIF and VERA scenarios may materialize.

In order to substantiate and strengthen our argument, we recur to a comparison of RIF/VERA scenarios. The comparison aims to extract alternative perspectives on what today are commonly held beliefs that underpin large parts of European RTI policy making.

We argue that by taking a comparative perspective, we can obtain a more comprehensive and better validated perspective on the aforementioned issues/assumptions than by looking at one set of scenarios only.

The scope of the two sets of scenarios is different. RIF and VERA scenarios were developed with different focuses of analysis in mind. The respective dimensions and focuses addressed by RIF and VERA are partly overlapping and partly complementary. The scenarios differ to some extent in terms of the core image they suggest, but also in terms of the specific features they focus on. However, both sets address the underlying assumptions with regard to five key tenets of European RTI policy.

Both foresight projects vary not only as regards the focus of their core scenario storylines, but also as regards their focus in the complementary backcasting analysis. The RIF scenarios (Erdmann et al. 2013) are complemented on the hand by an analysis of future actor positions (and, and by a consideration of key governance and policy issues from an ERA perspective. The VERA scenario development (Teufel et al. 2013, VERA project 2014) has been followed by two different backcasting exercises: (1) a stakeholder debate about perceptions and strategic actions in light of scenarios with a backcasting element, where potential areas of joint interest and (joint) policy action for today are identified (Popper et al. 2015a, 2015b), and (2) a VERA-internal analysis deepening the governance and policy focus of scenarios with the aim to high-light policy issues cutting across the different political and societal contexts illustrated by the scenarios (Robinson et al. 2014).

Expected outcomes

The transformative scenarios draw future images and pathways that differ substantially from these key tenets. Being underpinned by two serious scenario-building exercises, the meta-analysis shows the limitations of framing policy issues around seemingly ‘strong’ individual trends of limited scope. It points out that we should not take current wisdom and individual trends at face value, but instead explore the full spectrum of possible futures. The two-step transformative scenarios methodology was a useful device for that purpose; it allows broadening our perspectives on the future of research and innovation and opens up avenues for novel options in RTI policy making.

References

- Boudon, R. (1986): *Theories of Social Change. A Critical Appraisal*, Polity Press, Oxford (UK).
- Curry, A./Hodgson, A. (2008): Seeing in Multiple Horizons: Connecting Futures to Strategy. In: *Journal of Futures Studies*, 13 (1), 1 - 20.
- Erdmann, L., Schirmeister, E., Warnke, P., Weber, M. (2013): *Modular Scenario Report – Syn-thesis. New ways of doing research: from explorative to transformative scenarios*, Deliverable D2.1, RIF project, Karlsruhe/Vienna
- Genus, A./Coles, A.-M. (2008): Rethinking the multi-level perspective of technological transitions. In: *Research Policy*, 37, 1436 - 1445.
- van de Poel, I. (1998): *Changing Technologies. A comparative study of eight processes of transformation of technological regimes*, Ph.D. thesis, University of Twente.
- Popper, R./ Velasco, G./ Edler, J./ Amanatidou, E./ Miles, I. (2015a), ERA Strategy Map, Report of the Forward Visions on the European Research Area (VERA) project. Manchester.
- Popper, R./ Velasco, G./ Edler, J./ Amanatidou, E./ Miles, I. (2015b): ERA Open Advice. Report of the Forward Visions on the European Research Area (VERA) project. Manchester.
- Robinson, D. et al (2014): "Policy-lensing of research and innovation system scenarios: a demonstration for the European Research Area", Paper presented to 5th International Conference on Future-Oriented Technology Analysis (FTA) - Engage today to shape tomorrow, Brussels, 27-28 November 2014.
- Smith, A./Voß, J.-P./Grin, J. (2010): Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. In: *Research Policy*, 39, 435 - 448.
- Teufel, B., Erdmann, L., Schirmeister, E., Daimer, S., Laredo, P., Schoen, A., Robinson, D., Loikkanen, T. (2013): VERA Deliverable 3.1: ERA Scenario Report, Karlsruhe / Paris / Helsinki.

Navigating towards responsible research and innovation: facilitating strategic reflection

Stefan Kuhlmann*(University of Twente), Jakob Edler(University of Manchester), Ralf Lindner(Fraunhofer Institute for Systems and Innovation Research), Gonzalo Ordóñez-Matamoros(University of Twente), Sally Randles(University of Manchester) and Bart Walhout(University of Twente)

* s.kuhlmann@utwente.nl

KEYWORDS: Responsible research and innovation, Governance of research and innovation, System transformation

1. Introduction and relevance of the paper

The quest for responsible research and innovation has seen a remarkable career in recent years. Starting with a rather confined academic debate calling for responsible innovation (e.g., Hellström 2003), the idea has entered the European Union's research and innovation policy, the Rome Declaration on Responsible Research and Innovation (RRI) received endorsement from the European Council in 2014, and initiatives promoting responsible (research and) innovation have taken root in several European countries.

This general thrust is aiming to redefine the roles and responsibilities at the science-society interfaces, and re-open the fundamental debate about how research and innovation could contribute to the desirable futures for societies. Such normativity is an inherent feature reflected in most definitions of and frameworks for RRI (cf. von Schomberg 2011; Stilgoe et al. 2013; Owen et al. 2013; Rip 2014).

In this context, our paper does not engage in contributing to the ongoing search for and foundation of normative directions. Instead, the question has not yet been adequately addressed yet of how to deal with inevitable tensions, conflicts and related power games that arise once a pluralistic actor landscape with diverging interests is confronted with norms and values that are intended to change their behaviour (Nowotny & Testa 2010; Randles et al. 2014: 25; van Oudheusden 2014):

- Our first assumption is that the application of normative positions will more often than not be contested. Consequently, acknowledging normative pluralism poses the challenge of identifying conditions and mechanisms able to address contestation and facilitate the capacities and capabilities of the actors to engage in constructive negotiations.
- Second, the quest for responsible research and innovation is not starting from scratch. The institutions, organisations, actors and procedures constituting research and innovation are subject to and influenced by a thick fabric of governance arrangements and practices, concurrently incorporating different types of governance (hierarchy, market-based mechanisms, networks), numerous instruments (hard/soft law, information, persuasion, participation) and levels (local/global).

2. Research aims and questions

The aim of this paper is to learn from the tensions, barriers and opportunities present in various situations, from large research programmes to sustainable production labels, together reflecting the richness of RRI goals and ambitions, in order to identify building bricks for an overarching governance framework for responsible research and innovation. This approach to learn from a rich collection of cases of 'RRI in the making' basically involves two questions:

1. How is 'RRI in the making' conditioned?
2. What are building components for an overarching governance framework?

3. Definitions and theoretical framework: an evaluative heuristic to explore and co-construct meta-governance

In this paper we are interested in those governance situations and practices in which the actors work towards legitimate normative objectives and outcomes. These normativities become institutionalized through various means and strategies, can stabilize into hard and soft regulatory instruments, but can also become 'unhinged' when political contexts shift. We conceptualize governance as "the dynamic interrelation of involved (mostly organized) actors within and between organisations, their resources, interests and power, fora for debate and arenas for negotiation between actors, rules of the game, and policy instruments applied helping to achieve legitimate agreements" (Kuhlmann 2001; Benz 2006).

For the study of efforts working towards goals and legitimate agreements, which have to do with ‘responsibility’ (though often not labelled as such) we apply a heuristic approach. Heuristics have proven to be useful to empirically and conceptually explore uncharted territory (e.g. ‘innovation journey’ heuristic, Van de Ven et al., 1999). A heuristic is used as a tentative research strategy combining a set of different perspectives, aiming to discover typical processes of establishing or changing social order (see Abbott 2004; Swedberg 2014). For our study of governance towards responsibility in research and innovation a descriptive heuristic appears most promising; descriptive heuristics “have to do with how we imagine social reality itself. Description is not an innocent process. Every description has assumptions built into it, an challenging those assumptions is an easy way to produce new ideas” (Abbott 2004, 138).

The first question is about analyzing the factors (or actors) which not only shape governance processes in general, but specifically ‘condition’ the qualities and outcomes of it, as perceived by the actors involved and observed in case studies. To bring about a logical order in our investigations, we distinguish between three dimensions:

- The governance arrangements and objectives around which actors mobilize resources and personnel in an attempt to realize responsibility in research and innovation
- The actor landscape involved
- de facto governance practices, i.e. the places and spaces in which governance arrangements are called upon, objectives negotiated and instruments implemented.

To facilitate cross-case analysis we used a limited set of ‘descriptors’, specifying the objects and features each case study had to cover for each of the three above dimensions. The descriptors are mapped into an evaluative frame set by two value-related dimensions (responsibilisation and contestation) on the one hand and how these are shaped in the interaction between ‘actors and factors’ on the other (constructive and productive).

Two analytical perspectives have been guiding in linking these inputs in a meaningful way. First, a lesson from literature on governance is that in complex and dynamic settings, every mode of governance will be sub-optimal or fail. Jessop (2002) argues that a self-reflexive self-organization of interdependent but formally independent actors is a mode of governance that is less prone to failure if it allows for “continuing dialogue and resource-sharing (...) to manage the contradictions and dilemmas inevitably involved in such situations”. Jessop’s take on ‘meta-governance’ as “organising the conditions for governance” (Jessop, 2002: 242) resembles the way we have looked at responsibilisation and contestation as a dual value-related dynamic and challenge.

Second, we aimed to construct a frame which can be used in a meaningful way by governance practitioners. So we have conceived the framework as a means of ‘strategic intelligence’, supporting actors in reflecting on their own position and abilities, as well as those of others, considering the dynamic interplay between governance arrangements, the way actors are (not) involved in sense and decision making and institutional processes and conditions.

4. Empirical material and methodology: co-constructive work

A programme of 26 in-depth case studies helped to reflect a broad variety of research and innovation situations and governance challenges, into which interpretations of responsibility play (Randles et al. 2016). We sought to learn lessons by scanning transversally and triangulating the recurring and / or differentiated findings revealed across body of cases. The analysis resulted in 13 major lessons, supporting the development of 10 principles of a responsibility-related governance frame. The full paper will present a selection of cases for illustrative purposes.

The lessons and draft principles of responsibility were developed further in a series of ‘co-constructive’ top-level stakeholder workshops, held with about 100 experts and representatives of organisations steering research and innovation-related decision-making towards more ‘responsibly’. The workshop methodology (Bryndum et al. 2016) provided an open space for reflection without normatively predefining what ‘responsibility’ is. Rather, it is designed to ‘walk the talk’, making it possible for stakeholders to gain first-hand experience on how to promote responsible research and innovation in their organisations.

5. Outcome: Responsibility Navigator with 10 principles

The prime target users for the proposed framework are meso-level organisations in research and innovation systems, i.e. stakeholders who aim a) to lead organizations and procedures towards more responsiveness and accountability; b) to set and define policies, design programmes and develop evaluation and assessment tools; c) to mediate between levels of the innovation system by bringing together different actors and interests; and d) to shape the practical implementation of governance instruments at the analytical, the strategic or the procedural level. Such decision makers typically work as ‘change agents’ at ministries and funding organizations, in universities, research institutes, companies, professional associations, or civil society organizations.

Such efforts can be facilitated by a set of guiding governance principles and requirements, that is, by applying an orientating framework to better ‘navigate’ towards institutional transformation. This is done with the help of a ‘thinking tool’ designed to enable related debate, negotiation, experimentation, and learning in a constructive and productive way. We call this the Responsibility Navigator. It aims at making existing and new governance instruments and arrangements effective, from bottom-up processes up to transformation at a systemic level.

Ten ‘Res-Agora principles’ and requirements have been identified to allow for responsibility-related governance. The Responsibility Navigator defines each principle and illustrates them with fictive cases depicting possible situations and governance challenges and dilemmas, and complemented by relevant questions which those actors interested in ‘navigating’ towards the intended cultural change will have to ask themselves in order to arrive at practices and directions that are widely accepted.

References:

- Abbott, A. (2004): *Methods of Discovery: Heuristics for the Social Sciences*, New York, London: Norton (Contemporary Societies).
- Benz, A. (2006): „Governance in connected arenas – political science analysis of coordination and control in complex control systems”, In Jansen, D. (ed.): *New Forms of Governance in Research Organizations. From Disciplinary Theories towards Interfaces and Integration*, Heidelberg/New York (Springer), pp. 3-22.
- Bryndum, N., Lang, A., Mandl, C., Velsing Nielsen, M., Bedsted, B. (2016): *The Res-AGorA Co-construction Method*. In: Lindner et al. (eds): *Navigating Towards Shared Responsibility in Research and Innovation. Approach, Process and Results of the Res-AGorA Project*. Karlsruhe: Fraunhofer ISI, 55pp.
- Hellström, T. (2003): Systemic innovation and risk: technology assessment and the challenge of responsible innovation. In: *Technology in Society* 25 (3), pp. 369–384.
- Jessop, B. (2002). *The Future of the Capitalist State*, Oxford: Blackwell.
- Kuhlmann, S. (2001): Governance of Innovation Policy in Europe – Three Scenarios. In: *Research Policy*, Special Issue „Innovation Policy in Europe and the US: New Policies in New Institutions”, edited by Hans K. Klein, Stefan Kuhlmann, and Philip Shapira, vol. 30, issue 6/2001, 953-976.
- Kuhlmann, S. et al. (1999). *Improving Distributed Intelligence in Complex Innovation Systems. Final report of the Advanced Science & Technology Policy Planning Network (ASTPP)*
- Lindner, R., Kuhlmann, S., Randles, S., Bedsted, B., Gorgoni, G., Griessler, E., Loconto, A., Mejlgaard, N. (eds.) (2016): *Navigating Towards Shared Responsibility in Research and Innovation. Approach, Process and Results of the Res-AGorA Project*. Karlsruhe: Fraunhofer ISI.
- Nowotny, H.; Testa, G. (2010): *Naked Genes. Reinventing the Human in the Molecular Age*, Cambridge/Mass (MIT Press).
- Owen, R.; Stilgoe, J.; Macnaghten, P.; Gorman, M.; Fisher, E.; Guston, D. (2013): *A Framework for Responsible Innovation*. In: Owen, R.; Heintz, M.; Bessant, J. (eds.): *Responsible Innovation. Managing the Responsible Emergence of Science and Innovation in Society*, London: p. 27–50
- Randles, S., Edler, J., Gee, S., Gough, C. (2016): *Res-AGorA case studies: drawing transversal lessons*. In: Lindner et al. (eds): *Navigating Towards Shared Responsibility in Research and Innovation. Approach, Process and Results of the Res-AGorA Project*. Karlsruhe: Fraunhofer ISI, 65pp.
- Randles, S.; Dorbeck-Jung, B.; Lindner, R.; Rip, A. (2014): *Where to Next for Responsible Innovation? Report of the Roundtable at S.NET Boston 2013*. In: Coenen, C.; Dijkstra, A.; Fautz, C.; Guivant, J.; Konrad, K.; Milburn, C.; van Lente, H. (eds.): *Innovation and Responsibility: Engaging with New and Emerging Technologies*, Berlin, p. 19-38
- Rip, A. (2014): *The Paste and the Future of RRI, Life Sciences, Society and Policy*, 10:17 (10.1186/s40504-014-0017-4)
- Stilgoe, J.; Owen, R.; Macnaghten, P. (2013). *Developing a framework for responsible innovation*. *Research Policy*, 42(9), 1568–1580
- Swedberg, R. (2014). *Art of Social Theory*, Princeton University Press.
- Van de Ven, A.H.; Polley, D.E.; Garud, R.; Venkataraman, S. (1999), *The Innovation Journey*, Oxford University Press.
- van Oudheusden, M. (2014) ‘Where are the Politics in Responsible Innovation? European Governance, Technology Assessments, and Beyond’, *Journal of Responsible Innovation* 1: 67-87
- von Schomberg, R. (2011) ‘Prospects for Technology Assessment in a Framework of Responsible Research and Innovation’, in *Technikfolgen abschätzen lehren: Bildungspotenziale transdisziplinärer Methoden*, Wiesbaden: p. 39-61.

9D. PUBLIC PROCUREMENT FOR INNOVATION (II)

Can public procurement aid the implementation of regional innovation strategies?

Jon Mikel Zabala-Iturriagoitia*(University of Deusto), Edurne Magro(University of Deusto), Elvira Uyarra(University of Manchester) and Kieron Flanagan(University of Manchester)

*jmzabala@deusto.es

KEYWORDS: Public Procurement for Innovation, Smart Specialization Strategies, Regional innovation policy, Catalytic procurement

One of the main purposes of demand side interventions is to increase the demand for innovations, to improve the conditions for the uptake of innovations and to improve the articulation of demand. Among these demand-side instruments we can highlight the use of regulation and standards, support of private demand, systemic policies such as cluster policies and public procurement. A new European-level interest has recently emerged regarding demand-side approaches to innovation policy in general, and more specifically, the use of public demand as an engine for the development and diffusion of innovations.

In this general context, public procurement for Innovation (PPI) has become a fashionable policy tool. PPI processes put the government as a “lead customer” for an innovative product or service. This leads to several benefits, such as the possibility of producing economies of scale due to substantial early purchases, reduction of costs in products and also improvements in quality due to production-related learning effects, as well as learning effects related to reduction in production costs, and improvements in product quality and performance (Edlear and Georghiou, 2007).

Furthermore, PPI has been associated with innovations directed at addressing societal challenges or needs, as well as with mission oriented policies (Edquist and Zabala-Iturriagoitia, 2012). As a result, the use of PPI has focused to a great extent on the national level, without many efforts being devoted to the potential offered by PPI in addressing local and regional needs. Despite it being a key feature in guidance documents on EU Smart Specialisation Strategies (S3, European Commission, 2012), the rationales of public procurement of innovation at the subnational level are relatively under-researched.

The subnational level is generally seen as lacking the scale, competences and resources to undertake public procurement. For instance, Dale Clough (2015) notes how local authorities are viewed as problematic implementation settings for PPI since their purchasing patterns lack the scale or sophistication to stimulate innovation, as well as the ability to implement complex procurement techniques and successfully manage supplier relationships.

This paper seeks to contribute to the literature by advancing our understanding of spatial aspects of public procurement of innovation and the extent to which public procurement can be used as a regional innovation policy tool.

There are several reasons for adopting a more careful spatial consideration when studying public procurement, however. Firstly, a considerable share of public procurement is undertaken at subnational levels. Secondly, local procurement tends to be of a different nature and mix, often more oriented towards services and closer or more adapted to end user needs in relation to transport, education or personal services. This different profile is likely to raise different questions and considerations about the nature of and potential for innovation. Thirdly, public procurement will always have a spatial impact regardless of whether is undertaken locally, nationally or internationally, given the localised nature of supply markets. Finally, cities and localities can become loci for developing novel solutions, as spaces of connection between lead users and innovators that can help address challenges of both local and even eventually global relevance (Dale-Clough, 2015). The local level can act as a catalyst, coordinator and technical resource for the benefit of end-users. In this vein, Lember et al (2015) suggest that local procurement may be used to “experiment with relatively small-scale policy initiatives (e.g. on regional level, in specific sectors that are more dependent in technological progress) and to learn from such experiments”.

The paper will provide a conceptual discussion on the relationship between PPI processes and regional innovation policies, with particular attention to the implications for smart specialisation strategies. In this regard, the experiences posed by S3 in most European region set a solid ground for experimentation. In fact, S3 processes rely to a great extent on the role of the public sector in defining the entrepreneurial discovery processes depending on the regional priorities and the diversification strategies set by regional stakeholders. The use of PPI for regional innovation and smart specialisation strategies is also associated to some key challenges. For instance, besides the challenges associated to the scale of operations, PPI requires certain organizational routines and government (managerial) capabilities, which are not always found out within regions.

In particular, the paper will put special emphasis on the challenges associated to the implementation of PPI processes in a case study at the sub-national level.

The case addresses a concrete urban transformational change in Malmö (Sweden). In particular, this case focuses on Malmö's local investment program for ecological development, which includes a number of other projects to accelerate the development of an environmentally sustainable Malmö. The case is interesting for multiple reasons. The main reason highlighting the relevance of the case study is the long trajectory of the city of Malmö in the promotion of the environment. This trajectory is explained by the industrial structure that dominated the city of Malmö in the previous century, which had strong environmental impacts (e.g. Kockums shipyards). This long term commitment proves that despite consensus and awareness building exercises require a long time to be established, they often also lead to significant outcomes in sustainable local economic development projects. Second, the Malmö case illustrates how public procurement has been rolled out as a policy instrument to achieve environmental sustainability goals. Last but not least, the involvement of multiple stakeholders, before, during and after the implementation of the initiative led to the definition of demanding requirements, which requested innovative efforts on the side of the firms. Finally, the urban planning project in Malmö has also generated positive spillovers, mainly through the intense support to entrepreneurial projects, in the regenerated neighbourhoods in Malmö. As a result, the city has turned into a reference not only in the achievement of sustainable goals but also in the promotion of a fertile business environment.

In recent years, public procurement has been advocated a powerful instrument toward the attainment of sustainability goals. In particular, catalytic procurement practices have been at the centre of the Malmö experience, since the City of Malmö acted as a catalyst, coordinator and technical resource for the benefit of end-users. This role also varies over time. During the first stages of the development of the Malmö urban planning project, the public sector played a central role, and in particular one of the majors of the city, who was the real proponent of the sustainability project in the city. In these initial stages, the public sector, in seeking for the sustainable local economic development of the city, went through the identification of relevant stakeholders (public and private), the establishment of objectives, evaluation criteria, and the institutionalization of the process. Once the project was defined and launched, the public sector adopted a secondary role, acting as a pivotal actor that kept relationships with various stakeholders both at the local level (i.e. the civil society in Malmö at large and its demands) and at the national level (i.e. construction firms). However, one of the key roles played by the City of Malmö, was as a regulator (during the initial stages of the project), defining standards that were beyond the sustainability levels required by Swedish regulations.

These formal regulations or institutions were also complemented with other informal mechanisms such as the promotion of a culture of entrepreneurship, which is one of the key determinants of the urban transformation that Malmö has experienced since the launch of the Malmö city of the future project. As a result, the city has managed to undergo a transition from being based in old (and polluting) shipyards to hosting innovative firms in industries such as clean-tech, life sciences, moving media, or computer games.

Trading Scale and Complexity: The Innovation Potential of Different Modes of Collaborative Public Procurement

Lisa Dale-Clough
(Manchester Institute of Innovation Research)
lisa.dale-clough@mbs.ac.uk

KEYWORDS: Emerging themes and topics, demand orientated innovation policies

Public organisations primarily buy goods and services to deliver effective and efficient public services. But for over a decade, scholars and policy-makers have argued that public procurement can be used to articulate requirements for innovation – addressing unmet needs and other failures in innovation systems (Edler and Georghiou, 2007). These policy arguments often use the large proportions of GDP represented by public procurement in European countries as justification for its use as an innovation policy instrument, and academics have argued effective public procurement of innovation (PPI) requires large scale demand (Dalpé, 1994; Edler and Georghiou, 2007; Porter, 1990; Edquist et al., 2000; Georghiou, 2007; Aschoff and Sofka, 2009). But public procurement is typically fragmented between discrete organisations, each of which has systemic and path-dependent qualities (Edquist et al., 2000; Dale-Clough, 2015), and is often focussed on small-scale and short term objectives.

Large scale demand can be achieved practically through centralised purchasing or coordinated purchases between multiple public authorities (Rothwell, 1984; Uyarra and Flanagan, 2010). A range of collaborative procurement methods have been identified in the procurement literature, including informal ad hoc collaboration; formal, virtual and third party forms (Bakker et al., 2008), ‘piggy backing’, ‘lead buying’, and procurement groups (Schotanus and Telgen, 2007; Uyarra, 2010). Pre-Commercial Procurement also requires international purchasing consortiums when funded by the European Commission, and category management techniques and environmental performance standards also collectively articulate buying preferences to supplier markets and could be considered forms of collaborative procurement. Therefore, there are a range of collaboration opportunities available to public authorities, at least some of which could be used to stimulate innovation.

However, whilst large demand generates clear incentives for firms, reduces market risk, and enables early economies of scale and learning conducive to competitive advantage (Edler and Georghiou, 2007), supplier research has emphasised the barriers to smaller innovative firms presented by large contracts and the technological lock-in induced once these purchasing collaborations are formed (Uyarra et al., 2014). Coordinated or collective purchasing is also thought to increase the complexity and subsequent cost of procurement (Dalpé, 1994; Hommen and Rolfstam, 2009). In pluralistic settings like those created by collaborative public procurement – the power to make decisions tends to be shared across multiple organising actors with potentially conflicting goals and knowledge-based processes (Denis et al., 2001; Jarabkowski and Fenton, 2006). Procurement governance emphasises competition and market testing, and creates a perpetual focus on cost and rationalisation (Pinch and Patterson, 2000: 273). Subsequently, the institutions and typical governance arrangements of public procurement create a structural pre-disposition towards discrete purchases that “make do” and on managing political-risks rather than innovation (Dalpé, 1994; Edquist et al., 2000; European Commission, 2010; House of Lords, 2011; Georghiou, 2007). Subsequently, there may be a requirement to create a consensus between the participating organisations about the need for innovation – something that is difficult even in individual public organisations (Bhatta, 2003; Luke et al., 2010; Potts 2010). Some argue that consensus can be fatal for innovation, but a lack of cooperation surrounding the emergence and diffusion of new technologies can lead to inaction and inability to change the status quo. Subsequently, collaborative PPI may not be attractive to suppliers, and further research is required to understand how to create competitive PPI programmes.

Collaboration in public procurement is therefore both a potentially positive force for innovation by aggregating interactions between supply and demand side actors, and a negative force that creates further barriers to user-producer interaction and innovative SMEs, and unattractive innovation

opportunities based on the lowest common denominator. There is currently a lack of evidence to judge the likelihood of either effect emerging, and a trade-off is inferred between the complexity involved in managing the delivery of PPI in practice and achieving the scale required to stimulate innovation. Public procurement is also a field of government activity particularly vulnerable to policy-implementation breakdown: it being 'entrepreneurial' activity that spans both social policy and economic regulation. This means activities contain inherent scope for conflicting interpretations of objectives (Hill, 1981) leading to inertia in adopting new practices and values. Analyses of the governance of PPI are therefore needed as possible pre-requisites to realising the full benefits of the existing policy and research in this field, and collaborative PPI offers an insightful empirical world to explore this in practice.

Evidence: This paper has emerged from the early stages of a two year research project that will examine collaborative PPI. Some case studies from the existing policy and research literature will be included to exemplify the issues raised.

Results: The paper will explore the assumption that different modes of collaborative public procurement will contain differing propensity for innovation based on differences in the level of integration, information exchange, collaboration timescale, and objectives embedded in each mode. The paper will define different collaborative procurement modes by addressing three primary issues: a) how collaboration (and incentives) is achieved using scale; b) the mode of collaboration (procurement process and relationships between partners) and c) the types of objectives(s) governing the procurement activity and their performance requirements. A matrix of collaborative procurement modes and their innovation potential will be developed and presented diagrammatically in the paper, along with a discussion of how we may characterise the mechanisms and innovation potential of different collaborative procurement modes.

Theoretical background: Increasingly refined accounts of the context of interactions in innovation systems are required to refine systems understandings of innovation generation and diffusion (Markand and Truffer, 2008) and underpin the building blocks of research that can influence policy and action (Lember et al., 2014). This paper will contribute to debate on the innovation interaction context by focussing on interactions between organisations in different sectors of innovation systems (demand and supply) to explain how procurement practices are selected that embed innovation rationales, including the incentives and the features of the resultant interactions. In line with the systems approach to innovation that this research is situated in, a broadly political-economic approach will be applied (Edquist, 1997) that emphasises interdependence, non-linearity and institutional explanations (Equist, 1997).

Contribution: The paper proposes that different types of collaborative procurement vary in their innovation potential and complexity according to how scale is created, the mode of procurement and the objectives governing the procurement.

References

- Aschoff, B., and Sofka, W. (2009) Innovation on Demand – Can Public Procurement Drive Market Success of Innovations? *Research Policy*, 38: 1235-1247.
- Bakker, E. and Walker, H. (2008) Collaborative Procurement in Local Government. Report for South East Centre of Excellence. Available at: <http://www.southeastiep.gov.uk/uploads/files/SECECollaborativeprocurementreport16June2008.pdf>
- Bhatta, G. (2003) Don't just do something, stand there! - Revisiting the Issue of Risks in Innovation in the Public Sector. *The Innovation Journal*, 8(2): 1-12
- Dale-Clough, L. (2015) Public Procurement of Innovation and Local Authority Procurement: Procurement Modes and Framework Conditions in Three European Cities. *Innovation: The European Journal of Social Science Research*, special edition: Public Procurement as a means to stimulate innovation for a better world, March 2015: 1-23.
- Dalpé, R. (1994) Effects of government procurement on industrial innovation. *Technology in Society*, 16(1): 65-83.
- Denis, J.L., Lamothe, L., and Langley, A. (2001) The Dynamics of Collective Leadership and Strategic Change in Pluralistic Organisations. *The Academy of Management Journal*, 44(4): 809-837.
- Edler, J. and Georgiou, L. (2007) Public Procurement and Innovation – Resurrecting the Demand Side. *Research Policy*, 36: 949 – 963.
- Edler, J., Rolfstam, M., Tsipouri, L., Uyarra, E. (2015): Risk management in the procurement of innovation: A Conceptualisation, in: Edquist, C.: Vonortas, N.; Zabala-Iturriagagoitia J.M.; Edler, J. (eds), *Public Procurement for Innovation*, ISBN: 978 1 78347 188 1.
- Edquist, C. (ed.) (1997) *Systems of Innovation Technologies, Institutions and Organizations*. London: Pinter.
- Edquist, C. (2009). *Public Procurement for Innovation (PPI) – a Pilot Study*. WP 2009/13. CIRCLE, Lund University. ISSN 1654-3149.
- Edquist, C., Hommen, L. and Tsipouri, L. (eds.) (2000). *Public Technology Procurement and Innovation*. Boston, MA and Dordrecht: Kluwer Academic Publishers.
- Erridge, A., and Greer J. (2002) Partnerships and public procurement: building social capital through supply relations. *Public Administration*, 80 (3): 503–522.
- European Commission (EC). (2010) Risk management in the procurement of innovation. Concepts and empirical evidence in the European Union. Report to the European Commission, Brussels EUR 24229. Luxembourg: Publications Office of the European Union. ISBN 978-92-79-14660-2.
- Georgiou, L. (2007) *Demanding Innovation Lead markets*, Public Procurement and Innovation. London: NESTA.
- Hommen, L., and Rolfstam M. (2009) Public Procurement and Innovation: Towards a Taxonomy. *Journal of Public Procurement*, 9(1): 17-56.
- House of Commons, Communities and Local Government Committee. (2014) Sixth Report of Session 2013-14. Local government procurement. London: Her Majesty's Stationary Office.
- House of Lords Science and Technology Committee. (2011) 1st Report of Session 2010–12: Public procurement as a tool to stimulate innovation, London: The

Stationery Office Limited.

Hill, M. (1981) *The Policy-Implementation Distinction*. In: Barrett, S., Fudge, C., (1981) *Policy and Action*. Methuen: London.

Jarabkowski, R., and Fenton, E. (2006) *Strategizing and Organizing in Pluralistic Contexts*. *Long Range Planning*, 39: 631-648.

Lember, V., Kattel, R., Kalvet, T. (eds) (2014) *Public Procurement Innovation and Policy: International Perspectives*. Heidelberg, N.Y. Dordrecht, London: Springer.

Luke, B.G., Kearins, K., and Verreyne, M-L. (2010) Innovative and entrepreneurial activity in the public sector: The changing face of public sector institutions. *Innovation: management, policy & practice*, 12: 138–153

Markand, J., and Truffer, B. (2008a) Technological innovations systems and the multi-level perspective: Towards an integrated framework. *Research Policy*, 37: 596-615.

Pinch, P.J., and Patterson, A. (2000) Public Sector Restructuring and Regional Development: The Impact of Compulsory Competitive Tendering in the UK. *Regional Studies*, 34(3): 265-275.

Porter, M.E. (1990) *The Competitive Advantage of Nations*. New York: Free Press.

Potts, J. (2010) Innovation by elimination: A proposal for negative policy experiments in the public sector. *Innovation: management, policy & practice*, 12: 238–248.

PricewaterHouse Coopers (PwC) (2012) *How to drive innovation and business growth: Leveraging emerging technology for sustainable growth*. PwC Advisory Oracle practice. PricewaterhouseCoopers LLP.

Schotanus, F. and Telgen, J. (2007) Developing a typology of organisational forms of cooperative purchasing. *Journal of Purchasing and Supply Management*, 13(1): 53-68.

Uyarra, E. (2010) 'Opportunities for innovation in local public procurement: case study of Greater Manchester'. London: NESTA (ISBN 978-1-84875-087-6).

Uyarra, E., Edler, J., Garcia-Estevéz, J., Georgiou, L. Yeow, J. (2014) Barriers to innovation through public procurement: A supplier perspective. *Technovation*, 34(10): 631–645.

Uyarra E, and Flanagan, K. (2010) *Understanding the Innovation Impacts of Public Procurement*.

Public procurement for innovation: lessons from the procurement of a navigable storm surge barrier

Joeri Wesseling* and Charles Edquist
(CIRCLE)

*Joeri.wesseling@circle.lu.se

KEYWORDS: Innovation policy, Demand-side policy, Large infrastructural project, Tender, Water construction sector.

1. Relevance

Public Procurement for Innovation (PPI) is a powerful, underutilized demand-side innovation policy instrument that can be used to stimulate innovation, meet sectoral policy goals and mitigate grand challenges (Edler and Boon, 2015; Edler and Georghiou, 2007; Edquist, 2015; Edquist and Zabala, 2012). PPI “takes place when a public agency or unit places an order for a product (good, service or system) to fulfil certain functions within a given time period, but which does not exist at the time of the order” (Edquist, 2015, p.7). It is the demand-pull for the commercial application of new solutions that makes PPI so powerful (Edler and Georghiou, 2007). The literature on PPI is however underdeveloped; empirical analyses of PPI are so far limited to case studies in various sectors and countries, but more systematic analyses are lacking (Edler 2009; Edler et al. 2005; Edquist & Zabala-Iturriagoitia 2012; Flanagan et al. 2011; Hommen & Rolfstam 2009; Uyarra & Flanagan 2010). More case studies need to be conducted with systematic methods of data collection to enable systematic comparisons.

2. Theoretical framework

The lessons for policy makers to organize PPI that result from the PPI literature remain tentative and further research is needed to enrich these lessons. They include the following:

1. Related to the plurality of policy goals behind PPI mentioned before, the identification of user needs and associated policy goals is key in the early phase of PPI. “One of the greatest challenges ... is to reconcile the expectations, needs and limitations of a large number of users” (Edler et al., 2006, p.9).
2. The specification of functional requirements of the innovation that is to be procured is crucial. These should not be too narrow to stimulate creativity and technological variety (Edler et al., 2006; Edquist and Zabala, 2012; Edquist, 2015; Uyarra et al., 2014).
3. It is important to develop expertise within procuring public agencies to manage/coordinate the PPI process and to make assessments of the solutions proposed by suppliers (Edler et al. 2005; Edquist 2015; Uyarra et al. 2014).
4. Finding a balance between cooperation and competition is key. Cooperation between buyers and suppliers stimulates learning by interacting but may reduce technological variety as well competition between suppliers (Edler et al., 2006; Homman and Rolfstam, 2009; Edquist and Zabala, 2012).
5. PPI takes time and may fail. Procurers should be aware of this and be able to take and manage the risks that are typical to the procuring of products that do not yet exist at the time of procurement (Edler et al., 2015; Edquist, 2015; Georghiou et al., 2014).

3. Research aim

Through this case study, we aim to further develop these lessons for policy makers to enable them to manage PPI processes in ways that make them successful in meeting their (plurality of) policy goals.

This paper analyzes in-depth a case of direct developmental PPI that is driven by multiple policy goals and where a long-term contract is rewarded through a multi-stage selection process. This case enables us to study how policy makers have directed a PPI process in ways that yield innovations that combine multiple policy goals. This approach enables a deeper understanding of the directionality in PPI driven by different types of policy rationales. We structure our analysis using the currently available tentative lessons on PPI summarized above in this section.

4. Case study description

The case study focuses on the public procurement of a navigable storm surge barrier (NSSB) in the New Waterway, the Netherlands (1987-1997). In 1987 the Dutch public agency responsible for water safety, ‘Rijkswaterstaat’, issued a tender for a radically new solution to protect the Netherlands from storm surges, but that did not hamper shipping through the New Waterway to sustain the competitiveness of the Rotterdam main

port. The functional requirements constituted an unprecedented advanced demand that made existing NSSB technologies technically insufficient (Arcadis, 2006; Environment Agency, 2009). Hence, we study a case of developmental PPI.

The PPI process involved a design-construct-maintain contract, which was awarded after a pre-qualification stage and three rounds of competition. Six consortia (comprising 33 firms) signed in for the tender, of which one was excluded during the pre-qualification stage.

This case study is unique because it was the first time the design for such an innovation was not developed by the public agency. This means that the agency had significant expertise in-house, while lack of public expertise is often itself identified as a bottleneck to PPI (Edler et al., 2006; Edquist, 2015). The PPI process was characterized by some organizational mistakes and successes that we can draw important lessons from. The water construction sector has, furthermore, not yet been studied from a PPI perspective and unique because the failure of an innovation may result in tremendous societal costs (e.g. with flooding) that cannot be carried by the private sector. Application to this sector may provide new lessons for PPI. Finally, the PPI can be considered a success, because the ensuing innovation enabled the public agency to effectively meet its policy goals.

5. Methods

In this case study, the development of the PPI process was captured through event history analysis, which allows for the identification of causal mechanisms in the innovation process. Event history analysis can also capture dynamic patterns of innovation activities and has been used to study innovation processes at both the micro and meso level (Hekkert et al., 2007; Van de Ven et al., 1999). These characteristics make case studies a very useful tool to study directionality in the PPI process and to identify policy recommendations.

Our database comprised the public agency's extensive documentation of the PPI process as well as complementary technical journals and reports. To triangulate these data and collect data on processes not captured by formal documents, interviews with eleven stakeholders were conducted. All relevant stakeholders were interviewed, including the project leaders and managers of the PPI project, throughout every stage of the PPI and from both the public (7) and private side (4).

6. Expected conclusions

We structure the conclusions and policy recommendations of this case study using the list of tentative lessons drawn from existing literature on PPI, critically reflecting on these lessons.

1. Dealing with multiple policy goals and user needs. To ensure valuable inputs to the selection process and to maintain support for such a multi-purpose PPI from all stakeholders, we find that it is important that a well-structured PPI organization is set up. This structure should be an outlet for both public and private stakeholders to voice their concerns and should communicate the PPI's progress.
2. Specifying functional requirements. It is important for policy makers to anticipate that during developmental, R&D-intensive PPI, not enough information may be available to select a winning design after one stage. Therefore, policy makers should, in such cases, use multiple selection stages that specify functional requirements over stages to exploit both creativity and competitive pressures.
3. Expertise within public agencies. Setting functional requirements, assessing solutions, demanding the right information and coordinating the PPI process requires both in-depth and broad technical expertise. We find that it is important for procuring organizations to develop such expertise in-house. Our case also illustrates that uninformed intervention by politicians in the PPI process can be damaging to its outcome. Technical decisions should therefore not be made by parliamentary vote or ministers, but by experts.
4. Balancing competition and cooperation. During a multi-stage PPI procedure, policy makers may strike a fruitful balance between competition during the early selection stages, which facilitates technological variety, and cooperation during the later stages which optimizes further development of the selected solution(s) through complementary expertise and learning by interacting.
5. Taking risks. We find that when private actors have different risk perceptions or cannot finance the excessive costs of a failing innovation, public actors should carry the risk of the innovation. This requires in-house risk-assessment expertise. When public agencies are responsible for sectoral policies that are characterized by such (concrete) risks, they should carry more of the risk of innovation than in innovation policy and mission-oriented policies when this is not the case.

We critically reflect on these conclusions and policy recommendations, discuss their interdependencies and provide recommendations for further research.

References

- Arcadis, 2006. Inner Harbor Navigation Canal Floodgates Conceptual Study.
- Edler, J., 2009. Demand policies for innovation in EU CEE countries.
- Edler, J., Boon, W., n.d. Call for papers special issue Science and Public Policy The next generation of innovation policy : Directionality and the role of demand-oriented instruments.
- Edler, J., Georghiou, L., 2007. Public procurement and innovation—Resurrecting the demand side. *Res. Policy* 36, 949–963. doi:10.1016/j.respol.2007.03.003
- Edler, J., Tshipouri, L., Hommen, L., Rigby, J., 2005. Innovation and Public Procurement . Review of Issues at Stake.
- Edquist, C., Edquist, C., 2015. Papers in Innovation Studies Innovation - related Public Procurement as a Demand - oriented Innovation Policy Instrument
- Innovation - related Public Procurement as a Demand - oriented Innovation Policy Instrument.
- Edquist, C., Zabala-Iturriagoitia, J.M., 2012. Public Procurement for Innovation as mission-oriented innovation policy. *Res. Policy* 41, 1757–1769. doi:10.1016/j.respol.2012.04.022
- Environment Agency, 2009. The Thames Barrier [WWW Document]. URL www.environment-agency.gov.uk (accessed 1.1.15).
- Flanagan, K., Uyarra, E., Laranja, M., 2011. Reconceptualising the “policy mix” for innovation. *Res. Policy* 40, 702–713. doi:10.1016/j.respol.2011.02.005
- Hekkert, M.P., Suurs, R. a a, Negro, S.O., Kuhlmann, S., Smits, R.E.H.M., 2007. Functions of innovation systems: A new approach for analysing technological change. *Technol. Forecast. Soc. Change* 74, 413–432. doi:10.1016/j.techfore.2006.03.002
- Hommen, L., Rolfstam, M., 2009. JOURML OF PUBLIC PROCUREMENT , VOLUME 9 , ISSUE 1 , 17-56 Copyright © 2009 by PrAcademics Press 9, 17–56.
- Uyarra, E., Edler, J., Garcia-Estevéz, J., Georghiou, L., Yeow, J., 2014. Barriers to innovation through public procurement: A supplier perspective. *Technovation* 34, 631–645. doi:10.1016/j.technovation.2014.04.003
- Uyarra, E., Flanagan, K., 2010. Understanding the Innovation Impacts of Public Procurement. *Manchester Bus. Sch.* 18, 123–143. doi:10.1080/09654310903343567
- Van de Ven, A.H., Polley, D.E., Garud, R., Venkataraman, S., 1999. *The Innovation Journey*. Oxford University Press.

9E. INSTITUTIONAL LOGICS AND UNIVERSITIES

Governing university employment: institutional logics and regional heterogeneity

Laura Cruz-Castro*, J. Alberto Benitez-Amado and Luis Sanz-Menéndez
(CSIC Institute of Public Goods and Policies)

*Laura.Cruz@csic.es

KEYWORDS: Universities, Employment models, Academic careers, Organisational practices, Institutional logics, Higher education policies, Regional governments, Diversity of responses, Dynamics comparison, Spain

Aim and relevance

The aim of this paper is to understand why university employment practices diverge over time and explore the influence of institutional pressures derived from regional policies. We link with the sub-theme of the Conference related to the relationship between governance and institutions in research policies.

It is traditionally assumed that organisational structures and practices within the same field tend to converge and much empirical research focuses on the development and diffusion of institutional logics. Approaches that take into account conflicting institutional logics and competition among actors to change the dominant logic are less common but growing in interest.

In the case of universities, in a research area dominated by the study of American universities, governance practices and institutional innovations have been traditionally linked to role of professions, corporations and the influence of the market, whereas the role of the state has been much less considered. Nevertheless, research policy analysis needs to understand the way in which organisations absorb policy and regulatory pressures through organisational practices and innovations. We address precisely this issue and link with broader debates around academic tenure and flexibility.

Spanish universities depend politically and financially on their regional governments, which, in recent years, have developed and implemented diverse policies leading to differentiation and diversification of the traditionally homogeneous Spanish University System. The analysis of the Spanish university system from a regional perspective provides us with an interesting methodological opportunity for comparative research.

Theoretical framework, key concepts and research question

Institutions are metaphorically conceptualized as “the rules of the game” (North 1990; Scott, 1995/2008). North (1990: 3) formally defines institutions as “the humanly devised constraints that structure human interaction”, which include formal rules (laws, regulations) and informal constraints (customs, norms, cultures).

Scott (1995:47; 2008:50) argues that institutions, at the most fundamental level, have three “pillars”: Regulatory, Normative and Cognitive. The first pillar, the regulative one, refers to the formal rule systems and enforcement mechanisms sanctioned by the state (North 1990). The second pillar, the normative one, defines legitimate means to pursue valued ends (Scott 1995/2008). Finally, the cognitive pillar refers to taken-for-granted beliefs and values that are internalised by social actors (DiMaggio and Powell 1983). These pillars of institutions provide three “related but distinguishable bases of legitimacy” (Scott 1995). In response, organisations respond to a variety of institutional pressures by making strategic choices going from compliance to defiance (Child 1972, Oliver 1991). Institutionalists have demonstrated that regulative, normative and cognitive forces shape how new organizational practice models emerge and diffuse throughout organizations (Scott 1995/2008).

However, we still have a limited understanding of why organisational responses to institutional pressures differ. In the last years, based on Friedland & Alford (1991) original insight of the diversity of institutional logics in societies, much research has been done (Thornton & Ocasio 2008; Greenwood et al 2011 for recent reviews); the concept of “logic” generally refers to broader cultural beliefs and rules that structure cognition and guide decision making in an organizational field. At the organizational level, logics can help to focus the attention of key decision makers on a delimited set of issues and solutions (Ocasio 1997), leading to decisions consistent with the logic or order that reinforce existing organizational identities and strategies (Thornton 2002).

Although this analytical emphasis on stability is challenged by the emergence of organisational innovations in the form of new practices, little is known about the institutional sources of organisational practices variation (Lounsbury 2001). We are precisely interested in understanding how heterogeneity in university organisational practices is institutionally shaped through policies (Dobbin & Dowd 1997). In this paper we analyse variety in the employment practices (hiring and promotion) of public universities in the context of a single national

regulatory environment implemented differently by the regional governments.

More specifically we address the question of how a set of Spanish universities have hired and promoted their academic employees after the introduction of national policy reforms in 2001 affecting the regulatory pillar of academic employment (allowing for contract-based positions out of the civil servant tenure model). We argue that the spread of new employment practices in universities is shaped by different regional policies and by competing logics that generate variation in organisational adoption and behaviour that help drive university transformation.

Methodology and empirical material

To empirically address our question we have examined the diffusion of “labor contracting” of permanent academics in universities, as new organizational practice in the context of competing institutional logics, and have compared how different institutional pressures from the state (regional Governments’ policies) have shaped the organizational practices and the overall institutional logics in two regions.

Methodologically, we have tried a quasi-experimental approach, with the dynamic comparison (Gerring & Dermott 2007) of 16 public universities in two regions; we adopt a most similar cases design, in which we select regional university systems that were mostly similar (size, regulative environment and policy) in t0 but one of which has been characterised by change-oriented research and HE policy while the other is not. We expect to find different employment practices over time (comparing t0 y t1) and signs of different institutional logics in universities in the two regions, and to be able to make plausible associations between policy and its effects. The expectation is that we would find heterogeneity across universities in different regions and similarity among universities in the same region.

We have used triangulation methods and techniques, combining quantitative and qualitative (text and interviews) information and a variety of data sources to empirically approach our variables of interest:

Firstly, to address the organisational practice dimension, we have performed a quantitative analysis of the aggregated data on the evolution of the academic employment, by different types, by the 16 selected universities between 1998 and 2009. From this data we have constructed a macro indicator of the evolution of the employment structure. The 2001 Law provided Regional Governments with very strong powers regarding the use of non-civil servant categories, so the share of “civil servant” “contracted permanent” and “fix-term contracted” over time are good indicators of the dominant model of employment in universities and their trends and evolution. We have looked at some conglomerates of universities by region and also by age.

Secondly, to approach the cognitive dimension of institutional logics we have used 2015 survey data on the perceptions, beliefs and preferences of the Spanish university employees regarding academic employment practices, evaluation criteria and performance rewards. The sample for this analysis in the two regions of interest represents 15% of all university employees, with 1.200 questionnaires.

Thirdly, in order to address the policy dimension, we have made archival and document analysis of university reports and regional legislation that has allowed us to characterise our two regional cases along two different policy models, one of which is clearly change oriented while the other is not. We have complemented this secondary information with qualitative data coming from more than 20 interviews in universities (mainly with academic authorities), in Regional Governments and with some union representatives.

Preliminary findings and expected results

Our findings show a significant change in the employment structure trends in the universities located in one of the regions moving away from the civil servant model over time and in comparison with the other.

We also find that the opinions and preferences of academics in those universities reflect elements of an institutional logic coherent with such trends. We have made a plausible connection between the change oriented policy implemented in one of the regions and its effects on the behaviour of universities through the establishment of incentives and the provision of resources.

With this paper, we expect to contribute to the literature with original empirical evidence supporting the idea that policy matters and influences university employment practices and research careers. In this sense, state logics could drive university transformation.

We also expect to link with the less studied cognitive dimension of institutional logics and explore the connection between policy-driven change in organisational practices with the expectations, beliefs and values of individual academics and researchers about careers, which, ultimately, could provide support for the transformational effects.

We will draw some policy conclusions about how regulations, resources and frameworks (sticks, carrots and sermons) could gradually change the orientation of universities.

References

- Aagaard, K. (2011) Kampen om basismidlerne."Ph.D- afhandling, Dansk Center for Forskningsanalyse, Aarhus Universitet
- Berman, E. P. (2012). Explaining the move toward the market in US academic science: how institutional logics can change without institutional entrepreneurs. *Theory and society*, 41(3), 261-299.
- Crow, M. M. & Bozeman, B. (1998) Limited by design. R&D laboratories in the U.S. national innovation system. New York, NY: Columbia University Press
- Friedland, R., & Alford, R. R. (1991). Bringing society back in: Symbols, practices and institutional contradictions.
- Gulbrandsen, M. (2011) Research institutes as hybrid organizations : central challenges to their legitimacy. *Policy Science* 44: 215-230
- Nigam, A., & Ocasio, W. (2010). Event attention, environmental sensemaking, and change in institutional logics: An inductive analysis of the effects of public attention to Clinton's health care reform initiative. *Organization Science*, 21(4), 823-841.
- Smets, M., Jarzabkowski, P., Burke, G. T., & Spee, P. (2015). Reinsurance trading in Lloyd's of London: Balancing conflicting-yet-complementary logics in practice. *Academy of Management Journal*, 58(3), 932-970.
- Swan, J., Bresnen, M., Robertson, M., Newell, S., & Dopson, S. (2010). When policy meets practice: colliding logics and the challenges of 'Mode 2' initiatives in the translation of academic knowledge. *Organization Studies*, 31(9-10), 1311-1340.
- Thornton, P. H. (2004). Markets from culture: Institutional logics and organizational decisions in higher education publishing. Stanford University Press.
- Thornton, P. H., & Ocasio, W. (2008). Institutional logics. *The Sage handbook of organizational institutionalism*, 840, 99-128.
- Thornton, P. H., Ocasio, W., & Lounsbury, M. (2012). The institutional logics perspective: A new approach to culture, structure, and process. Oxford University Press.

Scientific diaspora: Challenges and opportunities for public policy

Inga Ulnicane(University of Vienna) and **Anete Vitola***(University of Latvia)

*anete_vitola@yahoo.com

KEYWORDS: Scientific diaspora, International research collaboration, Scientific mobility, Public policy

RELEVANCE: As global research collaboration (Wagner CS, Park HW, & Leydesdorff L, 2015) and talent mobility is intensifying, the topic of scientific diaspora receives an increasing academic and policy attention. In particular, countries experiencing brain drain (such as many countries in Southern and Eastern Europe) can use academic and social capital of their scientific diaspora as one of opportunities to benefit from global flows of researchers and knowledge. Moreover, today opportunities for interaction between home country and expatriate scientists are increasing due to advancement of information and communication technologies. Increasing academic and policy relevance of scientific diaspora topic is demonstrated by recent scientific publications (e.g., Gaillard, Gaillard, & Krishna, 2015; Jöns, Mavroudi, & Heffernan, 2015; Larner, 2015; Leung, 2015) and policy discussions (e.g. the NODES (Networks of Diasporas in Engineering and Science) forum at the American Association for the Advancement of Science AAAS meeting in February 2016).

RESEARCH AIMS AND QUESTIONS: This paper aims to explore the roles played by scientific diaspora as well as public policies aiming to engage diaspora researchers for the benefit of their countries of origin. Research questions addressed in the paper are: what is scientific diaspora and how is it changing; what roles does scientific diaspora play in its home and host countries; what are the policy options to engage scientific diaspora; how policy on scientific diaspora is emerging and what is policy discourse on scientific diaspora in a small catching-up European country Latvia*. Additionally, the paper aims to develop policy recommendations on the ways scientific diaspora can be utilized as a source to improve research performance, in particular, international collaboration and transformation of research system.

DEFINITIONS: Scientific diaspora is a complex concept. Gaillard et al (2015, p. 276) points out that this concept is based on an ‘internal contradiction: the universality of science versus the expatriate scientists feeling of allegiance. Studies show that the more “scientific” researchers feel, the more they tend to prefer contacts with professional peers, rather than with colleagues who are fellow citizens’. Jöns et al (2015) emphasize pivotal role that choice plays in one’s decision to participate in the creation of diasporic linkages; they suggest a concept of ‘elective diaspora’ defining it as ‘the elective diaspora of knowledge workers as a practice based, flexible association of highly diverse professionals and other talent who might not be in contact with each other, but who have formed emotional ties with a particular place or culture and chosen to participate in the construction of diasporic knowledge networks’.

RESEARCH METHODS AND EMPIRICAL MATERIAL: To study scientific diaspora, the paper combines extensive literature review of studies on scientific diaspora undertaken so far with an exploratory case study of public policy to engage scientific diaspora in Latvia.

The literature review to identify potential roles of and public policies for scientific diaspora covers a broad range of academic and policy studies on scientific diaspora undertaken within a number of scientific disciplines and research fields (e.g., research and innovation policy studies, geography, STS, migration studies). Existing studies demonstrate that diaspora can play diverse roles including being knowledge brokers of collaborative networks between their home and host countries and institutions (Jöns et al., 2015; Larner, 2015), supporting reforms and capacity building in their countries of origin (Leung, 2015; Tejada, Varzari, & Porcescu, 2013), and organizing knowledge diaspora networks (Saxenian, 2007).

Several countries (e.g., Colombia, South Africa, China, New Zealand) have launched specific policies for scientific diaspora focusing of building scientific diaspora networks (Davenport, 2004; Gaillard et al., 2015), facilitating short term research visits of expatriate scientists to their home countries as well as providing incentives to consider return option (Leung, 2015). While policies have emphasized potential benefits of engaging scientific diaspora, they have also encountered some challenges (e.g., some well-known scientific diaspora networks have stopped their activities and evidence of impact of policy instruments aimed at scientific diaspora often is missing).

In policy, two options regarding scientific diaspora are considered – return option and diaspora option: return option foresees return of expatriates to the country of origin, while diaspora option foresees remote mobilization

and association of diaspora to the development of home country (Meyer & Brown, 1999). Studies of scientific diaspora so far have mostly focused on countries of South America, Africa and Asia Pacific. Despite increasing concerns about unidirectional flow of scientific talent from South/East to North/West of Europe, less is known about scientific diaspora in Europe.

This paper undertakes an exploratory case study of Latvia drawing on diverse methods and data. In particular, a close analysis of documents on diaspora policies and research and innovation policies (2004-2014) is undertaken. During the last hundred years, Latvia has experienced two main waves of emigration: one after the occupation of Latvia by the Soviet Union in 1940 and the second after opening up of borders in 2004 when Latvia joined the European Union. Since the 1990s, Latvia has undergone major reforms of research system (Adamsone-Fiskovica, Kristapsons, Tjunina, & Ulnicane-Ozolina, 2009, 2011). The public R&D funding in Latvia is dominated by the EU Structural Funds. According to a recent evaluation of research system of Latvia, the country needs to strengthen international research collaboration links and inward mobility.

Against this background, policies to engage scientific diaspora can provide an opportunity for strengthening international linkages. The paper maps diverse actors involved in diaspora policy and their respective roles and analyses 14 policy documents on diaspora policies, science policies and strategies of the main universities to establish if and how scientific diaspora is seen as a resource for developing scientific capacities in Latvia. Interestingly, so far more attention towards scientific diaspora can be found in diaspora policy documents prepared by the Ministry of Foreign Affairs rather than within science and innovation policy documents which are responsibility of the Ministry of Education and Science. In future, it is planned to combine document analysis with other research methods and sources of evidence such interviews with policy-makers and stakeholders, surveys of scientific diaspora, and analysis of co-authorships.

EXPECTED OUTCOMES: Preliminary results indicate that diaspora policy discourse in Latvia has evolved over time. Since 2004 understanding of potential contribution of diaspora has broadened from its initial focus on culture and identity to a more recent shift to include education, science and economics as well. The role of scientific diaspora is acknowledged, but policy fails to address the issue with specific measures. Other topics - such as identity, culture, language - dominate the diaspora policy discourse and assigned funding. The paper suggests that policies to mobilize scientific diaspora can provide new opportunities to facilitate international research collaboration and transformation of national research system In Latvia (and also in other catching-up as well as in developed countries). The policy recommendations developed in the paper focus on tailor-made and context-specific initiatives to mobilize and engage scientific diaspora that can be developed by international organizations, national governments and universities. At the same time, awareness about the role of scientific diaspora among universities, other research institutions and policy makers needs to be increased. Additionally, reflexive tools to evaluate initiatives aimed at scientific diaspora have to be developed.

REFERENCES:

- Adamsone-Fiskovica, A., Kristapsons, J., Tjunina, E., & Ulnicane-Ozolina, I. (2009). Moving beyond teaching and research: economic and social tasks of universities in Latvia. *Science and Public Policy*, 36(2), 133-137. doi: 10.3152/030234209x406836
- Adamsone-Fiskovica, A., Kristapsons, J., Tjunina, E., & Ulnicane-Ozolina, I. (2011). Latvia: Repositioning of Academic Institutions in a Catching-Up Country. In B. Göransson & C. Brundenius (Eds.), *Universities in Transition: The Changing Role and Challenges for Academic Institutions* (pp. 219-245). New York, NY: Springer New York.
- Davenport, S. (2004). Panic and panacea: brain drain and science and technology human capital policy. *Research Policy*, 33(4), 617-630. doi: <http://dx.doi.org/10.1016/j.respol.2004.01.006>
- Gaillard, J., Gaillard, A.-M., & Krishna, V. V. (2015). Return from Migration and Circulation of Highly Educated People: The Never-ending Brain Drain. *Science Technology & Society*, 20(3), 269-278. doi: 10.1177/0971721815597168
- Jöns, H., Mavroudi, E., & Heffernan, M. (2015). Mobilising the elective diaspora: US-German academic exchanges since 1945. *Transactions of the Institute of British Geographers*, 40(1), 113-127. doi: 10.1111/tran.12062
- Larner, W. (2015). Globalising knowledge networks: Universities, diaspora strategies, and academic intermediaries. *Geoforum*, 59, 197-205. doi: <http://dx.doi.org/10.1016/j.geoforum.2014.10.006>
- Leung, M. W. H. (2015). Engaging a temporal-spatial stretch: An inquiry into the role of the state in cultivating and claiming the Chinese knowledge diaspora. *Geoforum*, 59, 187-196. doi: <http://dx.doi.org/10.1016/j.geoforum.2014.06.008>
- Meyer, J.-B., & Brown, M. (1999). *Scientific diasporas: A new approach to the brain drain.*: Unesco Discussion Paper No.41.
- Saxenian, A. (2007). *The new argonauts: Regional advantage in a global economy*: Harvard University Press.
- Tejada, G., Varzari, V., & Porcescu, S. (2013). Scientific diasporas, transnationalism and home-country development: evidence from a study of skilled Moldovans abroad. *Southeast European and Black Sea Studies*, 13(2), 157-173. doi: 10.1080/14683857.2013.789674
- Wagner CS, Park HW, & Leydesdorff, L. (2015). The Continuing Growth of Global Cooperation Networks in Research: A Conundrum for National Governments. *PLoS ONE*, 10(7). doi: 10.1371/journal.pone.0131816

*Initial idea to study scientific diaspora of Latvia belongs to Julia Melkers. We gratefully acknowledge her role in initiating this paper.

- Child, J. 1972. Organizational structures, environment and performance: The role of strategic choice. *Sociology* 6 (1): 1-22.
- DiMaggio, P.J., Powell, W.W., 1983. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review* 48 (2): 147-160.
- Dobbin, F., Dowd, T.J. 1997. How policy shapes competition: Early railroad foundings in Massachusetts. *Administrative Science Quarterly* 42 (3): 501-29.
- Friedland, R., Alford, R.R., 1991. Bringing society back in: Symbols, practices, and institutional contradictions. In: W.W. Powell, P.J. DiMaggio eds. (1991). *The new institutionalism in organizational analysis* (pp. 232-266). Chicago: University of Chicago Press.
- Gerring J., McDermott . R. 2007. An Experimental Template for Case Study Research. *American Journal of Political Science* 51 (3): 688–701
- Greenwood, R., M. Raynard, F. Kodeih, E.R. Micelotta, M. Lounsbury. 2011. Institutional complexity and organizational responses. *Academy of Management Annals* 5 (1): 317-71
- Lounsbury, M. 2001. Institutional sources of practice variation: Staffing college and university recycling programs. *Administrative Science Quarterly* 46 (1): 29-56;
- North, D.O. 1990. *Institutions, Institutional changes and economic performance*. Cambridge: Cambridge University Press.
- Ocasio, W. 1997. Towards an attention-based view of the firm. *Strategic Management Journal*, 18 (special issue): 187-206
- Oliver, C. 1991. Strategic responses to institutional processes. *Academy of Management Review* 16 (1): 145-179.
- Scott, W.R. 2008 *Institutions and organizations. Ideas and Interest*, 3rd ed., Newbury Park, CA: Sage.
- Thornton, P.H., 2002. The rise of the corporation in a craft industry: Conflict and conformity in institutional logics. *Academy of Management Journal*, 45 (1): 81-101.
- Thornton, P.H., and W Ocasio. 2008. Institutional logics. In: R. Greenwood, C. Oliver, K. Sahlin, and R. Suddaby eds. (2008). *The SAGE Handbook of Organizational Institutionalism*. (pp-99-129). London: Sage.

Converging institutional logics and blurring boundaries: how national policies influence roles and relationships between research institutes and universities

Siri Borlaug(NIFU Nordic Institute of Studies in Innovation, Research and Education), **Siri Aanstad***(NIFU Nordic Institute of Studies in Innovation, Research and Education) and Taran Thune(TIK- Centre for technology, innovation and culture, University of Oslo)
*siri.aanstad@nifu.no

KEYWORDS: Research policy, Research organisations, Institutional logics

Research aims and objectives

In the national knowledge, research and innovation system, higher education institutions and research institutes/laboratories have played different but often complementary roles (Aagaard, 2011; Crow and Bozeman, 1998; Gulbrandsen, 2011). Broadly speaking, universities are often more academically oriented while research institutes are mission- and industry-oriented. Developments in research policy over the two last decades have, however, put pressure on the functional role division between these two types of research organisations.

This paper aims to understand how changes in the external and internal conditions of research organisations, influence their behaviour, roles and profiles. More specifically, the aim is to investigate how policy changes affect the relationships between different kinds of research organisations that are part of the same knowledge, research and innovation system. We will argue that the impact of research policy must not only be understood in terms of the direct effects they have on the behaviour of the organisations they target. There may be important indirect effects on the division of roles and relationships between organisations in the national and/or regional systems.

To investigate these developments, we will look at the relationship between two large research organisations that have been perceived as “institutional twins” in the research landscape in Norway – the public university NTNU (the Norwegian University of Science and Technology) and the non-profit research institute SINTEF. SINTEF was established by NTNU in 1950 as the “applied arm” of the public university, responsible for applied and industry specific work, whereas NTNU was responsible for blue sky research as well as education of engineers. From the start, the two organisations, which are located in the same city, have had a close relationship with a high degree of collaboration and a strong awareness of the differences and complementarity in their institutional roles and profiles.

However, in the last decade, the relationship has increasingly been put under pressure, partly as a result of a range of national policy initiatives that have sought to strengthen the commercial role of public universities through focus on commercialisation of university research, entrepreneurship and university-industry collaboration. This means that the universities have moved into what used to be the turf of the applied research institutes. The applied research institutes on their side received signals through policy and funding systems to become more like universities. What we observe, is a converging trend in the roles of previously distinct organisations that we interpret as changes in their institutional logics, brought about by field-level institutional changes reflected in research policies.

Theory and definitions

The aim of this paper is to provide a theoretically-based discussion of changing institutional roles and practices, inter-institutional relationships and the wider impacts of this on the public research system. We use the conceptual framework of institutional logics (Thornton et al., 2012) to interpret empirical findings in our case study. Institutional logics is a perspective developed within organisational theory to better the understanding of institutionally complex organisations. The basic premise in this line of research has been that many organisations have multiple and often conflicting frames of reference that condition actors’ behaviours, understandings and views on rationality. Institutional logics have been broadly defined as a social domain’s “organising principles” (Friedland & Alford, 1991: 248) or “rules of the game” (Thornton & Ocasio, 2008: 112). A widely held assumption is that these logics are relatively consistent institutional orders that change incrementally and from the bottom-up, and that attempts to change them from the outside are met with resistance from organisational actors. The issue of how institutional logics change and how new logics emerge, have started to receive more

attention in the literature (Berman, 2012), although it is recognised as an under-investigated area (Nigam & Ocasio, 2010).

Several contributions focus on conflicting institutional logics in meetings between for instance policy and practice (e.g. seen in attempts to implement health care reforms), where failure of new initiatives is explained by reference to lack of match with the prevailing institutional logic. In particular, several contributions have focused on conflicts between prevailing institutional logics (e.g. in medical care, science, quality journalism, community interests etc.) and the market or management logic (e.g. Thornton, 2004; Swan et al., 2010). There is also an increased interest in when and how institutional logics coexist, and in the fact that many organisations and organisational fields are characterised by multiple, sometimes opposing institutional logics and expectations (Smets et al., 2015) but are still able to cope and succeed. Most often, these studies focus on one organisation or similar kinds of organisations (hospitals, universities, museums, investment banks, etc.) that operate in the same organisational field. In our study, we will extend this perspective by looking at organisations that populate different but closely related organisational fields, and the process of convergence towards similar institutional logics in different kinds of organisations. We identify four key institutional logics that prevail in both universities and research institutes, but to varying degrees. These are basic research, innovation, project management and education.

Methods and empirical material

To shed light on the questions of interest, we have performed a case study of the relationship between NTNU and SINTEF. The case study is based on both historical data that has been used to map key developments in the joint history of the two research performing organisations, and qualitative data on the interaction between them today. To acquire in-depth insight into the current situation, we have carried out ten case studies of collaborative projects within three different scientific fields, and conducted 42 interviews with researchers and management in both organisations.

Expected outcomes

We can, broadly speaking, distinguish between three historical phases in the relationship between NTNU and SINTEF. In the first phase, the relationship was based on a clear division of roles and responsibilities, as well as close personal and informal inter-linkages. For instance, professors from NTNU had leadership positions at SINTEF. This changed in the second phase, from the 1970s. SINTEF experienced strong growth, both organically and through mergers with other research institutes, and gradually developed into a more independent organisation that appointed its own scientific leaders. NTNU on their part merged with several other local higher education institutions into the new comprehensive university in 1996. Thus, by the end of the 1990s, both SINTEF and NTNU had become large organisations with great organisational complexity.

The historical changes in the relationship between NTNU and SINTEF have been a cause for internal concern, and since the mid-2000s, the two institutions have made a series of joint efforts to strengthen the strategic basis for cooperation. These efforts have led to a formalisation of the relationship over the past decade, a development that has been reinforced by increased political emphasis on clear regulatory guidelines and market-based transactions in the public research sector.

Furthermore, our study shows that developments in national research policies have contributed to a convergence in the practices and roles, and thereby put pressure on the traditional division of labour between NTNU and SINTEF. The mandate of the two organisations have become more similar, one driver being the amendment of the third mission to the university. The performance-based incentive structures have also become similar and in fact, universities are now rewarded for the same activities as the institutes. This has led to increased tensions between researchers and between the management in the two organisations. They compete over the same funding and have developed and strengthening practices previously seen as the domain of the others. As such institutional logics within both organisations have expanded, increasing NTNU and SINTEF's institutional complexity.

References

