



EU-SPRI HELSINKI 2015



The Book of Abstracts for The 2015 Annual Conference of the EU-SPRI Forum

Innovation policies for economic and social transitions: Developing strategies for knowledge, practices and organizations



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Innovation policies for economic and
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for knowledge, practices and
organizations

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Innovation policies for economic and social transitions: Developing strategies for knowledge, practice and institutions” – the subject of this conference. A good understanding and a critical analysis of related public policies is of high importance for present and future societies. The 2015 Eu-SPRI Forum Conference in Helsinki offers the community of scholars and experts a unique opportunity to review the state of our understanding in this field of policy studies and to identify issues for future analysis.

The Helsinki Conference is the fifth annual conference of the “European Forum for Studies of Policies for Research and Innovation” (Eu-SPRI Forum), after Enschede/NL (2010), Karlsruhe (2012), Madrid (2013) and Manchester (2014). The Eu-SPRI Forum was founded in Paris in June 2010 and has presently 16 member institutions. The Forum aims to strengthen the vibrant but dispersed interdisciplinary community of researchers focusing on interdisciplinary dimensions related to policy and governance in the field of knowledge creation and innovation – a growing research field since the 1960s, evolving at the encounter of economics, political science, sociology, Science and Technology Studies (STS), business administration, geography and history.

The Eu-SPRI Forum has three key missions: (1) Next generation – Eu-SPRI Forum supports the intellectual and career development of early career SPRI researchers (doctoral candidates; PostDocs), most notably through doctoral programs, conferences, summer schools and mobility between the partner groups; (2) exploratory initiatives – Eu-SPRI Forum aspires to anticipate new SPRI themes, concepts and methods. The exploration of new interdisciplinary analytical horizons is facilitated through co-funding of working groups; (3) structuring the field – Eu-SPRI Forum holds annual European Conferences like the 2015 Helsinki event, featuring both presently relevant and incoming new themes. The Conferences offer an informal space for exchange for the European and international SPRI community as well as for innovative stakeholders and policy-makers in the field.

Welcome to Helsinki!



Professor Stefan Kuhlmann
President of the Eu-SPRI Forum

The theme of the conference “Innovation policies for economic and social transitions: Developing strategies for knowledge, practice and institutions” addresses the role of innovation policies in supporting broader economic and societal change. The theme is timely in the European context but also allows us to integrate other world regions, such as emerging economies and developing countries struggling to solve economic modernization and pressing social challenges.

We have been fortunate to have various sessions in which top researchers address these burning questions including such themes like innovation and transformation of manufacturing industries, innovation collaboration to tackle societal challenges and innovation policy for sustainability. In the spirit of our community the conference has been also open for submissions from any perspectives and schools of thought in the field of research and innovation policies. This has resulted number of highly interesting tracks and contributions addressing such themes like patenting, emerging innovation ecosystems, and innovation system as a theoretical framework.

The contributions in this book of abstracts reflect the rich variety of perspectives and innovativeness of our vivid research community. We hope that that everybody attending the conference and reading these contributions enjoy them.



Hannes Toivanen



Mika Nieminen



Torsti Loikkanen

Co-chairs of local organizing committee

Already exchanging multiple emails with most of the accepted authors, I would like to take this opportunity to welcome you to the conference and with a few details to describe the content of this year's EU-SPRI conference.

The call for papers for the conference was finalized late 2014, setting the local organisers for what we expected to be a long wait for the first submission. Somewhat unexpected, the first submission arrived quickly on the 16th of January, while the majority of scholars followed a more deadline oriented approach. The majority of extended abstract were submitted on the deadline date or rather just after it. Actually, roughly 1/3 of the papers were submitted on the extended deadline date and

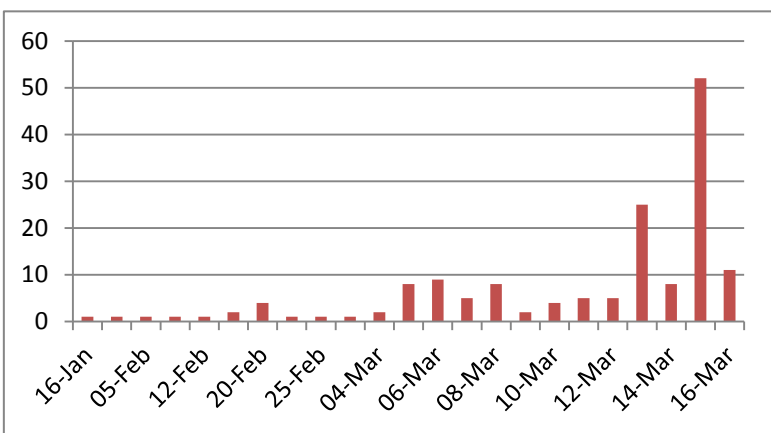


Figure 1 Count of submission on a given date to the EU-SPRI 2015 conference.

11 on the early morning hours of the next day. We received in total 162 extended abstracts. During the submission process, authors were given the opportunity to submit their papers to a special track or session or to the general track. 78 submission were assigned to the general track, 16 to “The missing links – Demand based policy making and instruments in the context of mission orientation”, 12 to “Innovation collaboration to tackle societal challenges and promote development”, 12 to “Social innovation futures: beyond policy panacea and conceptual ambiguity” and others were divide near equally to the remaining special sessions. The sessions and tracks selected for the conference were an important tool in creating a cohesive conference and I would like to thank the volunteer efforts of session and track organizers.

The conference has slots for roughly 110 papers and it was obvious that a significant number of the submission had to be rejected. The local organizing committee relied on the expertise of the scientific committee and session/track organizers to review the extended abstracts. Final decisions on acceptance were made by the local organizing committee. Discussing on the reviews, the local organizing committee first looked at the scores for scientific quality and finally on topical fit to the conference to narrow down on the abstracts that would be accepted. It should be noted that a number of submission with a high score on scientific quality were rejected emphasising topical fit. Finally the organizing



Figure 2 Wordcloud created from the accepted extended abstracts.

committee decided on 113 accepted papers, 45 rejections, and the rest were withdrawn by authors, thus 69,8 percent of submission were accepted.

The 113 accepted papers were used to create a, hopefully, interesting and thematically cohesive program. The wordcloud in Figure 2 summarizes, with some pre-processing, the content of the whole 113 extended abstracts, hopefully giving a starting point for fruitful discussion during the conference.

During the conference, I hope that the delegates that are active in Twitter would use the hashtag #EUSPRI2015 to share their comments.

Welcome to the conference!



Arho Suominen
“Man behind the emails”
Scientific Committee member

The Local Organizing Committee values the efforts of the Scientific Committee for the 2015 Annual Conference of the EU-SPRI Forum

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Mr. Torsti Loikkanen	VTT Technical Research Centre of Finland

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EXTENDED ABSTRACTS

THE ROLE OF RELATIONAL CAPITAL IN FORMATION OF MACROCULTURE AND ADAPTIVE CAPABILITY FOR INDUSTRY RENEWAL

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Keywords: Relational Capital; Macrocultures; Adaptive capability; Industry renewal

EXTENDED ABSTRACT

This paper is intended for the General Submission Track of EU-SPRI 2015 Conference. Topic of the paper relates to the general theme of the conference as it concerns the role of intangible factors in renewal and transformation of industries.

A major challenge for business sectors today is how to continue to renew and adapt to radically new competitors, innovations, and opportunities emerging from across the globe. Building up strong collaborative networks and creating durable capabilities tends also gradually lead to strategic similarity, and unfortunately, technological traditionalism over time. Sectors of inter-related companies with shared strategic beliefs run a risk of losing the ability to adapt in the long run – in other words their adaptive capability. This phenomenon is related closely to industry life cycle. As a sector or industry matures it does not only affect to number of companies or nature of innovative activities but gives rise to emergence of typical behaviour patterns among inter-related companies. Besides of endogenous forces pertaining to industry life cycle, there are also other factors which may contribute to and strengthen shared beliefs and perceptions within a field. For instance, many innovation policy instruments are explicitly geared towards encouraging networking and knowledge sharing among actors, mechanisms which are seen as having positive effects on firms' innovation performance. Paradoxically the very same instruments may potentially be detrimental for building industry's capability to renew.

We base our argument above to the concept of 'interorganisational macroculture' (Abrahamson & Fombrun, 1994; Hodgkinson & Healey, 2011), which captures the observed phenomenon that managers across organizations within a broader field, such as an industry or sector, share relatively similar industry related beliefs, perceptions and practices. From this perspective strategic decisions are not made inside a vacuum within the organization: shared beliefs and perceptions are both generated by and mirror the value-added networks that configure companies into such collective networks. Furthermore, there is the tendency of macrocultures to become more the same (homogenise) over time, which according to Abrahamson and Fombrun (ibid.) accounts for the frequent failure of entire industries to adapt to radically new competitors and innovations, clinging instead to outmoded practices and competitive positioning strategies. Macroculures can remain stagnant for extended periods of time if no external stimuli are introduced,

resulting in a detrimental influence to organizational performance in face of sudden or sharp changes in operating environment. The notion of interorganisational macrocultures may provide an explanation for why we sometimes observe stagnation, industry decline and inadequate levels of innovativeness in industries and innovation systems that appear well-developed.

Theoretically, the socio-cognitive macroculture perspective is part of neo-institutional theory, based on the premise that action follows mimetic and normative forces in organizational fields (DiMaggio & Powell, 1983). In addition, the definition of the term macroculture is closely aligned with the term ‘institutional logic’ (Thornton & Occasio, 2008). Integrating the institutional perspective in the innovation systems literature is only a very recent development (Gustafsson, 2010).

Our objective is to shed light on understudied effects of relational capital on industrial macroculture and adaptive capabilities. Our paper specifically asks: what role relational capital has to the formation of macroculture and adaptive capability?

Data and methods

In this paper we explore the role of relational capital in formation of macroculture and adaptive capabilities in two case industry contexts, game industry and forest-based bioenergy sector in Finland. Selection of the case fields is guided by the assumption that the interorganisational macrocultures differ between industries in different maturity stage of their life cycle. The Finnish digital game industry presents a vibrant sector characterised by rapid increase of number of firms, employees and turnover during the recent past. In comparison, forest-based bioenergy provides an interesting case to study the role of relational capital and macroculture for adaptive capability in the context of a mature industry – exemplified here by the Finnish forest industry, which has been looking for new sources of competitiveness and innovation since the early 2000s.

The primary data used in the analysis consists of board member data of Finnish companies in game and forest-based bioenergy industries. The game industry data covers majority, if not all, of the companies which are active in game development. The forest-based bioenergy industry dataset contains board member data of the member firms of three industry associations, namely Finnish Forest Industries Federation, Finnish Sawmills Association, and the Bioenergy Association of Finland. The company board member data is used to study formal linkages among companies within the two industries in Finland. The data allows us also to examine the formal cross-sector linkages on the board level, i.e. the linkages facilitated by individual board members across industry boundaries.

In addition to the board member data, we have survey data covering upper management representatives of game and forest-based bioenergy firms. The survey data is collected by using computer aided phone interview method in early 2015. Results of the survey are used to shed light on relational capital, adaptive capability and strategic issues perceived by firms in the case industries. We also utilise semi-structured interview material from face-to-face interviews to add qualitative information and insights about role of formal and informal (intra-industry) linkages for development of adaptive capabilities at firm, industry and also innovation system level. Altogether 20 interviews have been carried out with

representatives of innovation system level (including policy, education, associations), intermediaries (including incubators, accelerators), and private companies' respondents.

Preliminary results

The work is currently in progress. The board member data is analysed with the help of network analysis techniques. We have used the person to company linkages to create a network dataset for the both case areas. In creating the network, companies have been assigned as nodes and the co-occurrence of an individual person in managerial positions (as a board member) in two companies creates an edge between two nodes. Very preliminary results from the network analysis suggest, against initial intuition, that the formal networks at the company board level are sparse in both case industries. However, as the network analysis is not yet completed, these first results have to be regarded cautiously. In the final paper, the findings of network analysis are contrasted and compared with results of the survey (available in April, 2015) and insights from the interview material.

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RELATIONAL CAPITAL AND COMPANY PERFORMANCE: CASE YIC IN FINLAND

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Keywords: relational capital, company performance, ecosystem, innovation system

EXTENDED ABSTRACT

Research problem

The importance of relationships between multiple stakeholders in this networked world has been seen fundamental for value creation (Vargo and Lusch 2004). Innovation performance is the result of interactions involving a large number of actors (Laundy et al. 2002), promoting theories on the impact of social (relational) capital (Dasgupta & Serageldin 2001), social network theory of innovation (Lengrand & Chatric 1999) and (knowledge) ecosystem (Iansiti & Levien 2004). One way to understand and measure these interactions stems from the intellectual capital (IC) approach, especially with a concept of relational capital, which has been complemented with human capital and structural capital (Sveiby 1997, Edvinsson and Malone 1997) as well as with social capital—an asset that is attained through involvement in a community (Feltman and Zoller 2012). Previous research has established that networks have a role for value creation and that the scale and extent of networks have a positive impact on innovative performance (Marrocu, Paci, Usai, 2011). Furthermore, strong entrepreneurial and investor networks are associated with successful entrepreneurial economies (Feltman and Zoller 2012); success and networks effects are about more than just the size of company's clientele (Afuah 2013). But does relational capital have any exploratory power for the success of companies?

This research about the relational capital and company performance takes place in the context of the Finnish innovation ecosystem, concentrating on young innovative technology based/service companies. Toward this, a financing and development instrument called Young Innovative Companies (YIC) by Tekes (Finnish Funding Agency for Innovation) was used as it provides funding for comprehensive development of their business activities, and has been supporting over 150 Finnish growth companies since 2008.

Research methodology and data

The research is conducted with statistical analysis methods integrating company performance data and network data creating a comparative research setting analysing two groups: YIC and comparable non-YIC companies. For company performance, metrics of average annual growth rate of personnel and sales turnover are used. For company network properties, metrics of in-degree (degree), eccentricity, closeness centrality and betweenness centrality were used.

First, the two company groups were identified. Public information on the companies included in the YIC program was gathered and relevant company performance data was retrieved for the YIC companies from Statistics Finland. Thereafter, the comparative group, with similar high growth innovative enterprises that are less than five years old, was created by combining the (1) high growth enterprises search from Statistics Finland 2008-2012, with (2) several company level datasets¹.

To measure relational capital, person level labour flow data was drawn from the Finnish Longitudinal Employer Employee Data (FLEED). This study concentrated on annual labour flows from all Finnish companies to the target companies (YIC and non-YIC companies) over the period of 2001-2011. Data on average annual growth rate was successfully retrieved for the period of 2008-2012 on 65 YIC companies and 74 non-YIC companies.

The statistical analysis of the dataset relies on a descriptive analysis of the performance data and network data, basic network statistics and correlation analysis of network and performance data. Finally Ordinary Least Squares (OLS) regression and treatment effect method was used to test if labour flow network explains employment growth.

Research results

The analysis reveals that the size of companies, measured by the average number of employees, is approximately 2.4 times larger in the group of non-YICs compared to YICs. The average annual growth rate of personnel of YICs was 46.9% and for non-YICs it was 42.1%. Based on Student's t-test, the difference between the groups is not statistically significant. However, based on the non-parametric Mann-Whitney test, YICs grow as a group faster than non-YICs with the 10% significance level. At maximum, YICs have quadrupled and non-YICs tripled their personnel in four years. In the same time period, the average annual growth rate of turnover in non-YICs is 91.2% and in YICs 117.9%. On the average, YICs have doubled their turnover in four years; the best performing YIC has decupled its turnover. The difference between non-YICs and YIC is, however, not statistically significant.

The group level results of YIC and non-YIC companies reveal that the average degree of non-YICs is 3.2 and that of YICs is 1.3. This lower degree of YIC can at least partly be due to the bigger size of non-YIC companies. The average in-degrees of non-YICs are clearly higher than those of YICs. There are no significant differences in out-degrees between these groups as there is limited variation in out-degrees in general, explained by the sample companies' growth that understandable increases in-flow and limits out-flow of employees. By using weighted values, more variation is visible in the weighted degrees and weighted in-degrees. The eccentricity, closeness centrality and in betweenness centrality exhibit limited variation unfruitful for further analysis.

Using Pearson correlation, the companies' average annual employment growth rate (log) *ge* correlates slightly with their degree, in-degree, weighted degree and weighted in-degree the correlations being 0.17-0.26. The variables weighted out-degree, eccentricity, closeness centrality and betweenness centrality are highly correlated. Multicollinearity limits combining the variables in further regression analysis. There is no

¹ Such as all R&D surveys; all Community Innovation surveys from 2000 onwards; Database on domestic, EPO and USA patents; Database on Business Subsidies including loans and grants provided by Tekes; and Sfinno Database on Finnish Innovations.

corresponding correlation between average annual sales revenue growth rate (log) gt and degree, in-degree, weighted degree and weighted in-degree.

Linear least squares regression was used to fit the companies' annual average employment growth rates (in logarithms) over the period 2009-2012 with common explanatory variables like R&D persistency, domestic and US patent activity, export orientation, the degree, in-degree and out-degree network statistics and six sectors.

OLS regression indicates that the size of the company has a negative effect on the growth rates: small companies grow faster than large ones. The persistency of R&D activities also has a negative impact on the growth rates: this effect is associated with the lower growth rates of large R&D persistent companies. Domestic patenting activity has a positive impact on the growth rates. Finally, the higher the in-degree, i.e. the closer the firm is to the network centre, the higher its growth rate. This effect is highly significant.

Then the YICs and non-YIC companies were divided into two subgroups: companies with less or equal to the median weighted degree (WD) and companies with more than the median WD. An equal number of firms were picked, using propensity score matching, from these two groups so that they are pairwise as similar as possible in terms of their sector, size, R&D persistency, patenting activity and export orientation. The data allowed picking up 72 companies with low WD (≤ 5) and 72 companies with high WD (> 5). Value WD=5 is the median.

The results of OLS regression after matching indicate that when comparing companies with high weighted degrees with those of low weighted degrees, the degree and domestic patenting have a highly significant effect. In addition, US patenting and export orientation have a significant effect on average growth rates, but the effect of US patenting is negative.

After matching, the average growth rates of companies close to network centre are 10 percentage units higher than those of companies far from the centre. This result is statistically highly significant.

Discussion

Relational capital is seen as the driver for innovation (Vargo and Lusch 2004), which has a positive impact on innovative performance (Marrocu, Paci, Usai, 2011). Our empirical results support prior findings.

The research setting is limited by several factors. First, the correlation of degree and performance is problematic as in the dataset degree is near equal to in-degree. The relationship of increased need for human resources and high employment growth performance is a chicken-and-egg problem. The increase in relational capital can't be attributed as the sole factor of increased performance. Second, the properties of the non-established companies are challenging. Many of the measures we are accustomed to us in analysing company performance can be of limited value if the company has been recently established.

Even with the limitations, the flow of relational capital seems to have an impact to company performance. By analysing labour movements we are able to quantify latent patterns and informal relationships and use these as explanatory variables for performance. Further explanations can be gained by understanding the nature of inbound and outbound flows – what are the characteristics of companies with significant outflow and what are the characteristics of companies with inflow.

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Does It Matter Who Leads? Women in U.S. Science and Technology Policy

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EXTENDED ABSTRACT

For decades, U.S. research policy has given priority to diversifying the science and engineering workforce, including raising the percentage of women. Many studies have addressed the factors that affect successful recruitment of women into the STEM fields (science, technology, engineering, and mathematics) and whether their careers advance. But there has been scant attention paid to their roles in decision making about the STEM enterprise (with Cozzens 2008 as the rare exception). We know very little systematically about women's participation within the bodies that: (1) make critical decisions about what constitutes science; (2) prioritize and allocate scarce financial and natural resources; and (3) oversee and govern our science and technology processes and products.

The purpose of this study is to examine the presence and influence of women in science and technology policy in the U.S. at the federal level. The main proposition explored is that *who* makes decisions about science and technology policy matters. The study examines the experience of women and men in leadership positions in six science-intensive agencies under two Presidential administrations, those of William Clinton and George Bush, both of whom appointed significant numbers of women to leadership positions in their administrations. Through several different empirical approaches, we address three questions: (1) *Does the presence and proportion of women in science and technology policymaking roles vary by type of organization, discipline, and appointment structure?* (2) *To what extent, and under what circumstances, do women in science and technology policy-making positions change the agenda, moving it toward a wider range of issues or toward different styles of policy production?* (3) *How does the (a) number and (b) proportion of women in the agency or on the decision-making body affect the influence women actors have on outcomes and processes? Are the effects different in science and technology policy leadership from those observed in other organizations? If so, why?*

The study began with a dataset provided by the U.S. Office of Personnel Management for all government employees. Our analysis has focused on the 2.6 million records of individuals in eight science-intensive agencies, including both research-supporting and regulatory organizations. The records include information not only on pay and occupation, but also on individual and educational characteristics.

Quantitative analysis in our team (Smith-Doerr et al. 2014) has focused on occupational segregation and pay gaps for women, controlling for individual characteristics and grouping the agencies as “masculine” or “gender neutral” and “multidisciplinary” or not. The team hypothesized that masculine based science agencies (those with higher concentrations of physical scientists) would have larger pay gaps overall, but that women there would have to be exceptional to succeed and therefore might achieve pay equity (the “Marie Curie” hypothesis). Supporting both hypotheses, the results show that the gap was largest for women in female dominated occupations at masculine based science agencies and for women in male dominated occupations at gender neutral science agencies. Organizational context does matter.

The paper for the conference will report on qualitative data collected for the project. For this analysis, we began with a population of 1661 individuals identified in the Plum Book¹ as holding politically appointed positions at senior levels² in the agencies and administrations of interest (1202 men and 459 women). Preliminary observations from three focus groups held in Washington, D.C., contributed to the development of an interview protocol. The protocol was designed for use with both men and women and asks about their experience in the agencies of interest, with particular attention to roles, agendas, decision making structures, and organizational cultures. The goal is to interview three men and three women from each of six agencies in each of the two administrations. Finding contact information and securing participation has been both time-consuming and challenging, and snowball sampling has been used to supplement the Plum Book search. Women have been much more likely to agree to an interview than men. At the time we are preparing this abstract, we have conducted 24 interviews, including five with men. Not many of those interviewed were agency heads themselves, but many worked for women who headed agencies.

Very preliminary observations suggest that the women at this top level of leadership were highly effective, as seen by those around them. With a few exceptions, they did not pursue women’s issues in particular but rather focused the attention of their agencies on increasing effectiveness with regard to the goals of the administration they were in. The women we talked to considered themselves effective as change-makers as well, although they did not see all women in government that way. They valued teamwork and often saw themselves and the women they worked for as particularly effective at building relationships. Many in the Clinton administration made broadening participation an important objective. So far, we have not found anyone who thought women systematically pursued different kinds of agendas from men; instead, their experiences were shaped more by the political visibility of these appointed jobs and complex relationships with a wide variety of external groups.

We look forward to presenting a more sophisticated, NVivo-based analysis of a larger range of the interview material at the conference.

¹ Published by the Senate Committee on Homeland Security and Governmental Affairs and House Committee on Government Reform alternately after each Presidential election, the Plum Book lists over 7,000 Federal civil service leadership and support positions in the legislative and executive branches of the Federal Government that may be subject to noncompetitive appointment, nationwide.

² EX, ES, SL and AD

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GENDER DYNAMICS AND WOMEN'S CAREERS IN INNOVATION ECOSYSTEMS AND KNOWLEDGE PRACTICES

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EXTENDED ABSTRACT

Economies, which display a trend towards greater dependence on knowledge, information and high-level skills, compete on the basis of their research and innovation capacity and effectiveness. The underlying economic dynamics can be modelled using the concept of innovation ecosystem, which captures the relationships between the knowledge economy (i.e. people and organisations producing and applying science knowledge), the commercial economy (i.e. people and organisations who create markets for science knowledge), and the mechanisms enabling translation of knowledge into potential product solution (Jackson, 2011).

We report on the results of a new study of women's career patterns and analyse available evidence of women's contribution to knowledge and commercial economies to show how gender dynamics and women's careers can act as determinants of: 1) new directions for innovation that draw on scientific understanding of the significance of sex and gender differences; 2) intellectual and creative capacity of the human capital engaged in knowledge and commercial economies; and 3) ability of innovation processes and practices to facilitate effective transformation of ideas into products. These interactions are shown in Figure 1.

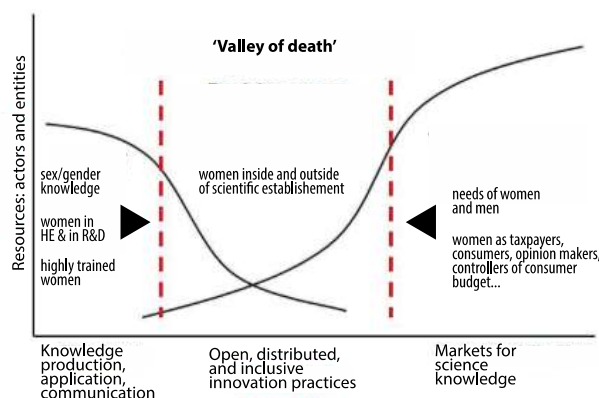


Figure 1. Gender dynamics and women's place in innovation ecosystem (adapted from Jackson, 2011).

Furthermore, in response to the aspirations of the European policy makers, namely to create sustainable economies and societal wellbeing through research and innovation, we discuss how the relationship between gender and innovation fits into the current EU policy frameworks and informs future innovation policies. Of particular interest are EU 2020, Horizon 2020, Innovation Union, and the Equal Treatment in Access to Products and Services Directive (EU, 2014).

Mapping the gender dynamics

We have analysed the career pathways of women in STEM fields using 1200 CVs of “excellent” women scientists listed on the Academia Net (www.academia-net.org). To be eligible for inclusion in this database, each woman has to be nominated by a leading science institution according to strict selection criteria. Our analysis confirms the conclusions of others (Vinkeburg, 2014) that there are many paths to excellence but it is the traditional model (reflecting the pattern of men’s careers) of early success and steady advancement (LERU, 2009) that is most rewarded. Significantly, the examined CVs show great diversity in the career pathways of women scientists and engineers. One particular feature of this diversity is cross-sector mobility, which can be a source of experience that is very much needed in innovation.

More generally, women’s growing participation in higher education means that today women gain 59% of graduate degrees and 46% of PhDs (EU, 2013). The potential benefit of engaging this pool of talent in innovation has still to be realised. Although the capacity of junior scientists to commercialise their knowledge is not as strong at the beginning of their careers as of their male colleagues, mentoring and the presence of institutional support can change this (Murray & Graham, 2007). Currently, only 8% of the patent applications submitted to the European Patents Office come from women (Frietsch et al, 2008). This represents a serious waste of available creative and intellectual resources and lost opportunity for fully benefiting from innovation opportunities. Research shows that women are able to patent as well as men (Hunt et al, 2012), and can be as eager as men to embrace entrepreneurship (Graham, 2014). One important benefit of creating more gender balanced knowledge practices is that it contributes positively to collective intelligence and problem solving performance of teams (Bear, 2011).

In the commercial economy, the last ten years saw women’s participation in the labour markets increasing at a higher rate than that of men, and in all countries the share of women in knowledge-intensive activities exceeds that of men (EU, 2013). These trends have led economists to coin the term ‘womenomics’ (Economist, 2007), which captures the fact that women now control \$20 trillion of annual consumer budgets, globally (Silverstein, 2009). An important issue for future innovation policies is the influence of globalisation on Europe’s scientific and technological capacity. Increasingly, European R&D industry is attracted to the readily available (and often cheaper) pools of trained scientists and engineers, and to consumer markets outside the EU - spurred on by the various economic incentives offered by countries/regions such as Singapore, China and India.

One way for Europe to maintain its competitive advantage is to create niche innovation ecosystems that focus on innovation needs of the local populations, and can thrive in the European conditions. We examine opportunities to achieve this through four, so far overlooked, gender-related drivers of innovation:

- Increased participation of women as actors in the knowledge economy, and the growing opportunities for academic scientists to commercialise their knowledge
- Increased role of women as actors in the commercial economy, and consumers of innovation
- Emergence of new, more open and inclusive innovation practices
- Accumulation of scientific understanding of the significances of sex/gender differences.

Translating ideas into market opportunities

Introducing gender focus into an innovation ecosystem offers several benefits. Firstly, it ensures that there is no gender bias in translating scientific discoveries into products. This has not been the case so far, largely because science knowledge has more evidence for men than it has for women and scientific thinking is dominated by the view that what works for men will work for women (Buitendijk, 2011). For example, male and female voice frequencies are different but the early voice recognition software products failed to account for this and consequently did not work well for women: they were designed and tested in acoustic labs populated with men, so were tested on men, and failed to work for women. Cars are tested on male crash test dummies (only) but women have 47% higher risk of injury in a car crash (Bose, 2011).

Secondly, it ensures that significant biological, physical and social differences between women and men are exploited as a source of innovation. For example the metabolic profiles of women and men are significantly different, so much so that researchers advised that to ensure quality and efficacy of outcomes, two kinds of biomarkers are needed for diagnostic and therapeutic purposes in diseases linked to metabolic processes such as diabetes and Alzheimer's, one for women and the other for men (Mittlestrass et al, 2010). Such improvements in innovation quality will have positive impacts on health economics.

Thirdly, it makes a strong case for more systematic deployment of available talent pool of highly educated women across the spectrum of creative endeavours, from making science knowledge to making markets for science knowledge. Some opportunities relevant to knowledge and commercial economies are described above but they also apply when crossing the 'valley of death'. For example, at the Fraunhofer Centre for Responsible Research and Innovation, Martina Schraudner developed the Discover Market method (Schraudner, 2013). This approach synchronises two important conditions of successful innovation: the product answers a concrete need and it works well for all targets. This is achieved by using a participatory method for idea creation, in which 'non-traditional' actors, including women from outside formal scientific institutions, jointly decide what is needed. Then, the technical feasibility of the proposed ideas is analysed by Fraunhofer engineers to establish if a technical solution is possible. Another example of more open and inclusive knowledge transfer practice is the crowd sourcing approach used by www.innocentive.com. There, gender analysis of successful solutions submitted by women and men showed

that female solvers – known to be in the “outer circle” of the scientific establishment - performed significantly better than men (Jeppesen, 2010).

Relevance to EU policies

In theory, innovation ecosystems can be structured around almost any subject matter. In relation to gender there are important and timely topics. They include safety (e.g. cars, radio-diagnostic devices, biomarkers, nano-technology products), performance (e.g. active aging and mobility devices), sustainability (e.g. energy appliances and food products), and societal challenges (e.g. pollution control products).

Whilst the role of women has greatly expanded in both the knowledge and the commercial economy, women continue to be seen as “anti-innovation” and “hostile to innovation” (EU, 2005). Innovation ecosystems that incorporate gender can therefore have an important potential to be transformative, socially responsive, responsible and sustainable, which is highly relevant to the economic and societal aspirations of a number of policy frameworks, including EU 2020, Horizon 2020, ERA, and Innovation Union.

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UNDERSTANDING SOCIAL INNOVATION: FROM INNOVATION SYSTEMS TO INNOVATION FUNCTIONS¹

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Keywords: Social innovation; Social Innovation Systems; Social Innovation Functions

EXTENDED ABSTRACT

The concept of ‘social innovation’ faces as many opportunities as risks. It has the chance to get established as a valid approach of strategic action in challenge-driven policies or to remain a ‘buzzword’ or ‘catchword’ in the policy discourse when attention needs to be placed in non-technological innovation. It can become a recognised type of innovation or remain the ‘other’ category following more ‘mainstream’ types of innovation. It can offer a new way of understanding and broadening the concept of innovation to better acknowledge the social reality or remain a fuzzy or unclear type of innovation. It can bridge different policy and academic communities or it can stay a contested concept with some communities defending the ‘social’ part and others the ‘innovation’ part of the concept.

The EU-SPRI Exploratory study on Social Innovation Futures aspires to bridge the increasing distance between the ways social innovation is understood within policy and scholarly communities, and the mainstream of science, technology and innovation studies, as well as to examine the different ways in which the notion has been used in practice and isolate the underlying innovation processes involved (Benneworth et al., 2015). The different types of fuzziness surrounding the concept of social innovation can form four main groups: a) fuzziness between normative-policy goals and objective-scholarly understanding, b) fuzziness in the actual ontological foundations of the way social innovation is used between different disciplinary communities, c) fuzziness in the extent to which these concepts are concerned with innovation *strictu sensu*, and d) fuzziness inherent in different innovation studies traditions that themselves use the term ‘social’. (ibid.)

In response to this fuzziness the literature review² aims to shed some light in better understanding social innovation as a coherent innovation concept analysing it through the lenses of a classic innovation studies, starting from that of innovation systems. In the first instance it seems that the technological innovation system (Carlsson and Stankiewicz, 1991; 1995) might be the most relevant approach to social innovation with the term ‘technology’ encompassing a knowledge field, or a product or artefact, or a set of related products and artefacts aiming to satisfy a particular function, such as health care or transport.

¹ Submission intended for the Special Track ‘Social innovation futures: Beyond Policy Panacea and Conceptual Ambiguity’. The submission is directly relevant to the Special Track selected as it is part of the EU-SPRI Exploratory study on Social Innovation Futures where the Special Track is based on.

² Conducted as part of the EU-SPRI Exploratory study on Social Innovation Futures

A preliminary analysis of how the assumptions and propositions that characterise technological innovation systems fit with the features of social innovations revealed some interesting results in relation to the structural components in the system, i.e. actors, interactions/networks and institutions. For instance, depending on the type of social innovations examined, societal actors and social networks are becoming key players in the innovation system their behaviour being characterised by values such as social and environmental responsibilities. The role of networks is particularly interesting, especially more fluid ones, where social change may be activated as a result of human interaction and the dynamics created by the exchange of knowledge and ideas rather than through ready-made service packages and closed institutions. Although the role of the individual social entrepreneur is equally acknowledged, the networks become the base of systemic change based on the relations established between individuals and/or existing structures. (Ilie and During, 2012)

Notwithstanding the value of such an analysis, the innovation systems approach provides a rather static perspective in analysing social innovation, failing to capture the processes by which social innovation is implemented and the consequent dynamics of social innovation. These aspects are better examined through the lens of the innovation functions approach. (Bergek et al. 2008)

Such an analysis reveals interesting features in relation to social innovation functions. In the case of ‘knowledge diffusion’ for instance, in technological innovation systems different types of knowledge are distinguished (e.g. scientific, technological, production, market, logistics and design knowledge) as well as different sources of knowledge development (Bergek et al., 2008). In social innovations however other types of knowledge become important such as traditional or craftsmen knowledge while knowledge is diffused through social and collective learning.³

Another example of a special feature of social innovation relates to the function “influence in the direction of search” which addresses the fact that for a certain need many technological solutions may be possible and that the dominance of one over the others is influenced by internal and external factors such as regulations and incentives supporting a particular solution or the estimated price of the possible technologies, and how many organisations support a particular technology over another. In social innovations this competition has a multiplication effect rather than leads to one solution dominating over others. Similar social initiatives act in favour of a given type of social innovation rather than against it. For instance, taking the various time-banks or alternative exchange networks operating in a country, although these ventures are strongly linked with the needs of local people, there is no reason for somebody not to become a member of several such networks at the same time. In fact, it is usually the same core group of people that usually initiate similar ventures⁴ although social innovations have still to assert themselves against other social practices in competition with other existing approaches which may lead to their modification’. (Franz 2010, cited in Hochgerner 2011)

³ See for instance the Goldfinger Factory, <http://www.goldfingerfactory.com/> or Nea Guinea in Greece, www.neaguinea.org.

⁴ The same core group of people in Greece established PRO.S.K.AL.O. (Cooperation Initiative for Social and Solidarity Economy), Bioscoop (a consumers’ food cooperative), Initiative 136 (a citizens’ initiative for the management of water resources, <http://www.136.gr/article/citizens-bid-control-thessalonikis-water>), as well as the People’s University of Social Solidarity Economy, <http://www.univsse.gr/p/univsse-in-english.html>

The “legitimation” function is also particularly interesting for social innovation. This function refers both to social acceptance as well as compliance with existing institutions. Whereas social acceptance may be granted due to the key role played by society in social innovation in the first place, social innovations may be objected by existing institutions because they clash with the mainstream as happened with the ‘markets without intermediaries’ in Greece.

Continuing this research, the literature review will examine social innovation through the lens of innovation functions highlighting differences as well as similarities between social innovations and other types such as business innovations. A combined approach will be applied in understanding social innovation across innovation systems and functions in the sense that there is an interplay between a set of system components whose capacity to achieve innovation is based on the established interactions and institutions, but whose nature evolves on the basis of the kinds of innovation functions that are prosecuted. The paper will conclude with reflections about the dynamics of social innovation, and the underlying processes, and how these may aggregate to systemic properties in a social innovation system.

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SOCIAL INNOVATION AS RADICAL INNOVATION – A REVIEW AND AGENDA

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Keywords: social innovation; radical innovation

EXTENDED ABSTRACT

This paper discusses “radical innovation” and its relevance for social innovation. The underlying idea is that there is a need to bring existing knowledge from innovation studies into discussions and policy interventions aiming to support social innovation, which has increasingly been promoted as a means to solve the grand challenges of modern societies. Radical innovation is a type or category of innovation which can be understood intuitively as a phenomenon that represents something significantly new with great impacts on many aspects of society such as industrial structure and patterns of competitiveness and social interaction. It is a fundamental concept in innovation studies (Henderson & Clark 1990:9).

There is a clear dual nature to radical innovation. On the one hand, many of the global challenges related to health, the environment, the financial crisis and more seem to call for drastically new solutions. Radical innovation is in this perspective something to be strived for and promoted to get a desired system change with huge perceived benefits. On the other hand, radical innovation is also tied to the notion of “creative destruction”: massive and often unpredictable shifts that may make whole industries disappear and destabilise existing structures (Abernathy & Clark 1985). One may perhaps say that the financial crisis partly was caused by radical financial innovations, yet solutions to the crisis may also lie with other and equally transforming innovations. It is therefore important to understand this phenomenon better.

Categories and typologies are central in the field of innovation studies and date back to Schumpeter’s fundamental texts on innovation from the 1930s. Here and in later writings radical innovation is often defined as part of a dichotomy or scale, i.e. it is defined relative to incremental innovation as its opposite or at the opposite end of a scale of newness or significance.

Radical innovations are often very visible and much studied. A common message in much of the innovation literature is nevertheless a warning *against* an overemphasis on radical innovation (Fagerberg et al. 2004; Tidd & Bessant 2013). Many famous historical examples of the impacts of incremental innovation are listed in the innovation literature (Marquis 1986; Abernathy & Clark 1985; Abernathy & Utterback 1978). Huge innovation impacts are not necessarily tied to radical innovation but to the cumulative effect of small changes.

Radical innovations are often defined as something that contains a different “core technology” or principle (Chandy & Tellis 2000:2) or as something that in various ways makes existing competences

obsolete (Abernathy & Clark 1985). Radical innovation is a heterogeneous category and there are many warnings against too general uses of the term (e.g. Henderson & Clark 1990).

Abernathy & Clark (1985) claim that industrial innovations typically encompass two dimensions: one related to markets and another related to technology. Innovations can be radical in both dimensions or only in one of them, and radical in this sense is defined as whether the innovation conserves existing market linkages and/or technological competences or disrupts the existing competences/linkages and creates new ones. This leads to three different ideal types of radical innovations. *Niche creating innovations* happen when firms use existing technological expertise to create a product for a new market. *Revolutionary innovations* represent technologically new products to existing markets, and the smartphone may be a good contemporary example. Finally, *architectural innovations* are products that are new in both the technological and market dimensions. Often they create a “dominant design” (cf. Abernathy & Utterback 1978; also Dosi 1988; Arthur 1989), a standard or paradigm that will shape the field for a very long time.

Henderson & Clark (1990) use the term architectural innovation in a slightly different sense. To these authors, there is a fundamental distinction between a radical innovation where a product or one of its components changes fundamentally (such as introducing a digital rather than analogue component in a technology), and an innovation where the components or core design concepts remain untouched but where the way these concepts work together is altered. This latter phenomenon is called “architectural innovation”, and the authors show how large and established firms struggle particularly when faced with this type because it requires a different type of knowledge than what they normally possess.

This can be related to a third type of radical innovation which we may term complex system innovations or platform innovations (Marquis 1986; Kwan et al. 2013, Lusch and Nambisan 2012, Shapiro 2007). Many of these are related to large-scale publicly funded project such as GPS, the internet and WWW. They need long-term planning and the combined efforts of many different actors (Marquis 1986).

The traditional view in much of the innovation literature is that large organisations are good at incremental improvements but bad at radical change, which often comes from the outside from small, new and entrepreneurial challengers or from the state (Mazzucato 2013). In this sense there is a distribution of labour in the innovation system.

Large firms are described as “unable”, “unwilling” or even “incompetent” when faced with radical innovation (Rosenbloom & Christensen 1994; Henderson 1993), which has been referred to as the “incumbent’s curse” (Chandy & Tellis 1990). Many are not even able to adopt externally developed technologies even when they are close to the basic competences in the organisation. Substantial case evidence supports these claims, e.g. that every major change in standards and configuration in the computer disk drive industry was initiated by new entrants and led to the downfall of the dominant firm (Christensen 1993).

This happens to well-run firms with good innovation track records, sophisticated management systems and high R&D expenditures, and Western Union/Nokia/Kodak etc are used as cases of lack of imagination and limited perception, “of what can happen to a dominant company whose view of its technology has become so committed to a certain path of development that it cannot imagine the alternatives that lie within

its technological purview and control” (Smith 1982:96). More systematically (Chandy & Tellis 1990), it has been shown that large organisations often lack the incentives to do radical innovations, they have cognitive filters that screen out information not directly relevant to what they are doing at the moment (Hannan & Freeman 1977), and they develop routines that become institutionalised into an incremental improvement and efficiency paradigm (Nelson & Winter 1982). In Christensen’s terminology (disruptive innovation, the innovator’s dilemma) organisations become too focused on serving existing clients, which opens up for challengers that start out in different markets and with different service or business models. This is not just a particular challenge in social and public sectors (Christensen et al. 2006).

However, Chandy & Tellis (1990) show how a fair number of large firms survive and even initiate radical innovation. Their data indicate a stronger ability of Japanese and European large firms when it comes to handling radical innovation. Other forms of entrepreneurial culture, traditions for decentralised decision-making to powerful and capable sub-organisations, and different employment institutions (such as lifelong employment in one organisation) may matter. In other words there seem to be country-specific factors that shape how radical innovations originate and diffuse in society.

Several points for reflection and discussion concerning social innovation emerge from this brief review. The first is whether “radical” is a relevant term for social innovation – what are the historical and present examples? A second question is whether we can distinguish between different types of radical social innovations. Will they be distinguishable by the nature of the competence disruption, the “architecture” of the new idea or perhaps by the relevant societal sector? Thirdly, what are the life cycles or evolutionary patterns of (radical) social innovations? Questions of diffusion and the nature of incremental improvements are essential here. Finally, because social innovations are often perceived as related to areas like health, the environment, education and training, which in most countries are largely public service sectors, will the public organisations delivering these services be as conservative as the large firms facing radical technological innovation? Will there be differences between countries in this respect in whether potentially radical social innovations can influence and transform public services?

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SOCIAL INNOVATION AS INSTITUTIONAL INNOVATION

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Keywords: Social Innovation; Institutional innovation; Institutions; Organisations; Social Practices; Social Action; Agency

EXTENDED ABSTRACT

Common understanding of Social Innovation (SI) as an essential component in policy discourses to solve the so-called Grand Challenges of the 21st Century confronts the need to answer the remaining ‘desperate quest for a definition’ (Djellal & Gallouj, 2012: p. 121). SI has become ‘overdetermined’ that is, associated with a variety of meanings and interpretations rooted in a diversity of disciplines and faces the risk of having its validity challenged (Laclau & Mouffe, 1985).

From the theoretical perspectives of science, technology and innovation studies, the EU-SPRI Exploratory study on Social Innovation Futures aspires to open academic debate to overcome current concerns surrounding ‘policy and chaotic’ views on the SI concept. Being the ‘innovation problem’ to understanding what affects innovation processes and how that shapes the change trajectories, the project aims to the nuclear question: How can SI be understood and interpreted as *innovation process*? (Benneworth et al., 2015).

SI processes take parts of an emergent paradigm that needs to explicitly address the issue of purpose and direction of change where the social and technological components of innovation should not be seen as contradictory, but as inherently connected (Howaldt et al., 2014). This paradigm shift claims for a theory of socio-technological innovation and new answers on the nature and purposes of innovation in society (Edwards-Schachter et al., 2012; Benneworth & Cuhna, 2014). It is also intrinsic to policy orientations to deal with global ‘intractable problems’ or ‘global challenges’ which dates back several decades ago, like in the references in the Club of Rome report *Limits to Growth* (1972), which likewise explicitly names *social innovation, in parallel to technical change*, to change political processes and structures to favour a sustainable development.

In this framework, this paper reviews the burgeoning literature that has developed in recent years a diversity of approaches on the role of institutions and institutional dynamic in innovation processes and explores their possible contributions and research avenues to SI¹. The critical review attempts to examine important aspects and characteristics, which have so far remained rather latent, like institutional changes and legitimisation of SIs.

Despite the reference to institutions and institutional dynamic is to be found in both innovation field and SI literatures (cf. Edquist, 1997), many uncertainties remain as to the real contents of the concept of institution. The question of the relationships between organisations and institutions and the conceptual vagueness in their uses implies some clarification to clearly identify the role of institutions in innovation dynamics. For this reason, a first step was to explain and establish a set of notions such as ‘actor’, ‘agent’, ‘stakeholder’, ‘organisation’², ‘institution’ and ‘institutional field’. The analysis followed the general notion of institutions provided by Edquist & Johnson (1997) as ‘sets of common habits, norms, routines, established practices, rules or laws that regulate the relations and interactions between individuals, groups and organizations’. These definitions discriminate between the ‘rules of the game’ and the players in the game (North, 1990). According to Scott (2008, p. 41) institutions constitute symbolic systems that are ‘experienced as possessing a reality of their own, a reality that confronts the individual as an external and coercive fact’ and comprise ‘regulative, normative and cultural-cognitive elements that, together with associated activities and resources, provide stability and meaning to social life’. Other useful concepts that guided our review was the distinction between formal and informal institutions (North, 1990) and differences stated by Crawford & Ostrom (1995) between ‘soft institutions’ (social norms and values such as trust, reliability, exchange and cooperative interactions) and ‘hard’ institutions (rules, norms and strategies; e.g. formal written laws and regulations) that can enable or hinder innovation. From these theoretical scopes, the paper discussed possibilities and limitation to various research avenues related to:

- **the role of institutions and institutionalisation in shaping and framing patterns of behaviour and cooperation from a SI systemic perspective.** Institutions constitute a central element in National Innovation System (NIS) and Regional Innovation System (RIS). Both concepts, as policymaking tools, could provide useful insights to investigate a current problem of up-scaling of SIs (Coriat & Weinstein, 2002; Hekkert & Koch, 2013). Braczyk et al. (1998) identified the role of regional institutions (including formal institutions, rule systems, explicitly and implicitly shared norms and values) for enhancing the effectiveness of RIS and innovation performance. The role of institutions and institutionalisation processes can be analysed by the building of innovation networks using the triple-helix models which produce knowledge infrastructures in terms of overlapping institutional spheres, enabling the emergence of hybrid organisations. More appropriate to analyse SI from an institutional perspective is the broaden model proposed by Carayannis strengthening the participation of civil society as the fourth helix together the engagement and empowerment of users and communities in innovation processes (Carayannis & Campbell, 2012).
- **the emergence of new organisational and institutional intermediaries in SI processes** (including, e.g., the generation of proto-institutions, Lawrence, Hardy & Phillips, 2002). One

² According to Edquist & Johnson (1997) organizations include : firms, political bodies (e.g. national councils); bureaucratic bodies (e.g. public agencies and offices implementing innovation policy); regulatory bodies (e.g. for standards, norms and certification); ‘social’ bodies (e.g. academies and professional associations); educational bodies (e.g. universities and schools); ‘knowledge-oriented bodies without economic goals’ (e.g. government defense and health laboratories); bridging bodies like innovation centers and industrial liaison units of universities). Organizations also include Non-Government organizations, philanthropic associations and social firms.

key issue for SI studies is in having processes to explain recurrent action at a distance and path-dependency, in terms of the development of new social institutions which support that SI. How multiple actors/stakeholders do, learn and construct collaboratively social practices, with active participation of communities and users, are intrinsic to the notion of SI processes. In this respect SI encompasses the emergence of new organizations and social institutions with multi-stakeholder participation which *potentially* can stimulate a stunning change in institutional forms of governance and transform spatial relations. An example is the recurrent worldwide phenomenon of small-scale activities and micro societal experiments where different actors from public, private and civil sector mobilize their knowledge and resources and construct ‘collaborative repertoires’ of social practices (Cels, de Jong & Nauta, 2012). To date, the analysis of such phenomenon has limited to the description of case studies as entrepreneurial spaces catching sight of the emergence and functioning of multi-stakeholder platforms, Living Labs, rural labs, change labs and other micro-societal experiments. They can be investigated complementing macro-level perspectives on systemic intermediaries (Smits & Kuhlmann, 2004) and network-oriented notions of innovation intermediaries, such as innovation brokers. Vermeulen et al. (2007) highlight the role of these intermediary-level institutions as providing spaces of resistance by established interests to these novel innovations, a key issue for SIs in challenging social injustice where incumbents enjoyed privileged positions.

- **the role of institutions in building governance relations in SI processes.** Recent contributions from Borrás & Edler (2015) propose three pillars to understand governance of change in socio-technical and innovation system. The notion of governance brings forward the understanding that collective action entails complex forms of public-private interactions and such interactions are typically conceptualized as ‘governance instruments’ with the explicit intention to shape social action in specific ways. ‘The governance of change in a socio-technical system is essentially the governance of institutional frameworks (which define the opportunity structures for agents) and the subsequent transformation of the agents’ behaviour’ (p. 41).

Part of the attractiveness of SI process is that it seemingly offers the capacity to change power relationships and change local political economies by collective mobilisations and transformations of less powerful actors. SI entails institutional change produced by the *hibridization* of collaborative repertoires of practices developed by different actors (individuals and organisations), often involving negotiations of settled institutions among diverse actors with conflicting logics. Lastly, the paper examined the possibilities and limitation in institutional theories framed on innovation studies to explain institutionalisation of such collaborative social practices and collective agency from power perspectives.

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THE MISSING LINKS – DEMAND BASED POLICY MAKING AND INSTRUMENTS IN THE CONTEXT OF MISSION ORIENTATION: CONCEPTS, IMPACTS, GOVERNANCE CHALLENGES

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EXTENDED ABSTRACT

In this paper we seek to develop a novel, holistic understanding of demand oriented policy. As a starting point we take the increasing prominence of demand oriented or demand side innovation policies across the OECD world, at least as they are more and more expressed in political announcements.

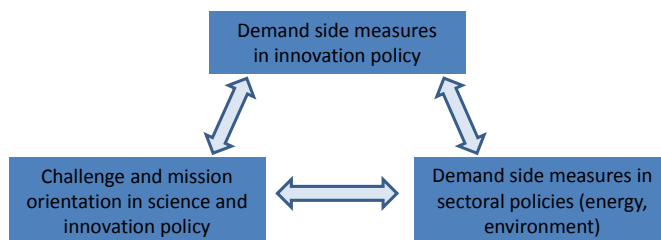
To develop such holistic understanding of what demand side policy actually means and how it can be further developed we propose to bring together three strands of current thinking in innovation policy practice and studies. The first strand concerns *mission orientation and grand challenges*. No doubt, the trend to tackle grand challenges and develop mission-oriented science and innovation policy is intensifying. More recently, this thinking is extending the notion of challenges to mobilise innovation policy to support system's transition. However, the policies discussed in those broader challenge-oriented debates so far have largely ignored the demand side. There seems to be an implicit assumption that policy orientation towards societal challenges will be sufficiently in line with demand and demand conditions; demand articulation remains implicit (Boon et al, 2011), leaving conflicting demands unexplored.

The second line of literature, revolving around the debate on *demand-based innovation policy*, however, has shown us that it is not necessarily the case that meeting societal challenges is in line with (public) demand. Demand conditions can constitute market and system failures even if preferences are known. In innovation policy research, attention for improving and increasing demand has gained momentum over the last decade (Edler & Georghiou, 2007; OECD, 2011; Izsak and Edler, 2011). This academic interest goes hand in hand with a growing importance of demand-side measures as innovation tools. A recent Trendchart Survey found that 75% of all EU countries have demand-side policies on their public innovation agenda (Izsak and Griniece, 2012). Demand-side policy instruments include price-based measures, such as tax incentives and subsidies to support private demand, training and awareness measures as well as policies to mobilise public procurement for innovation. These instruments answer to market and systemic failures on the demand side of the innovation system, including information asymmetries, inefficient user-producer interactions, and difficulties in defining needs (Edler et al, 2013; Boon et al, 2011). Setting up and managing

these programs involves cognitive and organisational challenges. In fact, the strategic intelligence needs for the design, implementation and evaluation of demand-side measures are manifold. Operationally, the question is: what is the failure, what are the demand conditions that might need support? What are the conditions of articulation, or limited articulation, of demand? What are the corresponding needs on the supply side? What is the right timing for demand-side measures in the interplay of supply and demand? How can we measure the immediate demand effects and indirect supply effects of demand-based policies? In addressing the market and systemic failures, we can also learn from user innovation literature in which there is ample attention paid to studying factors influencing information asymmetries between users and manufacturers and the organization of user-producer interactions (Von Hippel, 2005).

A third important discussion, less prominent in innovation policy communities, is the roles *science and innovation play to support policy goals in domain ministry*, such as transport, health, energy etc. In fact, most demand-based innovation policy instruments are applied in the area of energy and environmental policy (Edler, 2013). In these sectors, challenges are less straightforward and more ‘wicked’ in the sense that they involve a wide set of disciplines, problem definitions and solution routes (Nelson, 2011). In some cases, public agencies are not explicitly aware of these characteristics of problems and the need for detailed reflection on developing and using policy instruments.

Figure 1: the demand side policy triangle



In our paper, we bring together these different perspectives. For each of the three pillars we discuss the intervention rationales, issues of policy design, governance, implementation and the use of strategic intelligence. This shall help us to support learning between those pillars but also, more

importantly, think about the consequences for governance and coordination of policy.

The current state of affairs as regards the role of demand side in innovation policy is ironic. Policy practice marches on, designs and implements more and more measures, but the underpinning learning and reflection, based on a deeper conceptualisation of demand-side intervention logics, improved analytical concepts and, above all, an active exchange between the three pillars, is limited. This paper conceptualises demand-side intervention logics, using the triangle shown in Figure 1. Empirically, the three pillars and the interactions between these pillars will be supported by illustrative case material from the authors’ previous work on demand-side innovation policy.

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ARTICULATIONS OF ‘THE AGEING SOCIETY’ IN NANOTECHNOLOGY

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Keywords: Ageing Society, Articulations, Nanotechnology, Grand Societal Challenges

EXTENDED ABSTRACT

Introduction

The ageing of the population is a problem that is increasingly on the agenda of governments of mostly European countries. The problem of the ‘ageing society’ is actually a multitude of demographic, economic and (health) care problems that are tied together under one caller. (Peine, et al., 2015)

Science policies and agendas are full of ‘grand societal challenges’ as the new science funding framework of the European Union, Horizon2020, calls them. The ageing society is included in the challenges and is increasingly mobilized as a problem that science could solve. (European Commission, 2011)

In this paper, we start from the notion that the ageing society is a ‘big word’: “an encompassing concept that is uncontested itself, but that allows for multiple interpretations and specifications.” (Bos et al. 2014, p. 151) Because of the ambiguity of big words, their translation from science policy to the actual researchers that have to work under these themes is not straightforward. And because big words are normative, it is seen as good if your research can link up with one of these goals. Researchers are faced with the pressure to do relevant research and, as a consequence, constantly try to position their research by using one or more big words. (Bos et al., 2014)

In this paper we look at the different strategies (‘articulations’) to position research to the encompassing goal of the aging society in a large Dutch nanotechnology project and present the first results. Nanotechnology is especially interesting because new technologies often come with large expectations about how they may contribute to societal goals. We studied both how ‘the ageing society’ was used in policy documents and we interviewed researchers and research policy makers about how they thought it linked with the research that was conducted in the nanotechnology program.

Theory: Articulations of big words

Even though societal challenges like the ageing society provide noble goals, this does not mean that they provide clear guidance for research. It is actually the combination of normativity – it is seen as good to find solutions for the problems an ageing society might bring – and the very broadness and ambiguity of

these big words which leads to unexpected dynamics. Big words provide legitimacy, while they are at the same time constantly specified to be able to actually use them. (Van Lente & Van Til, 2008)

The specifications of big words happen in funnels: step-wise specifications from the broad overarching goal to a specific technology, situation or research object. Sustainability can for example be connected to climate change, which is caused by CO₂-emissions. These emissions can be avoided by using renewable energy sources, such as solar panels. Something as specific as research on SI-quantum-dot based spectrum converters can then be seen as sustainable because it contributes to making solar panels more efficient. The link between solar energy and sustainability has been made many times, making it possible to skip all of the intermittent steps and still have a legitimate explanation: saying a solar panel is sustainable is usually accepted without further explanation. This is what has been called a ‘fixed funnel’: “a line of reasoning, of connecting to sustainability, which is well established and consistently used for a particular technology.” (Bos et al., 2013, p. 238) In this paper we will investigate these funnels of articulations for the ageing society and we will refine the concept further.

The ageing society is an umbrella-term under which several societal, political and economic concerns are brought together. Predictions are that a larger percentage of elderly people this will bring large strain on care and health care systems, pensions schemes will become unsustainable and economic growth will decline because a smaller percentage of the people will be actively working. (Peine et al., 2015)

While these challenges are not necessarily scientific or technological, increasingly the ageing society is advanced as a problem to be addressed by scientific and technological research. Over the last decade or so, the EU has funded research projects on “ICT and Ageing Well” with more than 800 million EUR.¹ It is advocated that using these technological fixes will lead to a triple-win: society wins because problems are solved, companies can profit from a whole new market of users and elderly users get to ‘age well’. (Neven, 2011) However, in this triple-win scenario, the views of the technology developers of ‘ageing well’ do not always match the opinions of the elderly themselves. (Neven, 2014)

This mismatch shows the importance of studying the different articulations of normative and ambiguous umbrella-words. Peine and Herrmann stress this by setting an agenda to make sense of societal challenges and their articulations. (Peine & Herrmann, 2012) We will follow these articulations within the Dutch nanotechnology program NanoNextNL.

Case and methods

NanoNextNL was founded in 2011 with 250 million euros and includes all Dutch universities, more than 100 companies and several Dutch knowledge institutes. To establish this program, a Strategic Research Agenda (SRA) was made in 2008 to show where the nanotechnology field in the Netherlands was going. (Netherlands Nano Initiative, 2008) The research in NanoNextNL was to be carried out in ten themes.² In this SRA the ageing society is mentioned as something to which nanotechnology can contribute. (NanoNextNL.nl, 2015)

¹ See http://cordis.europa.eu/fp7/ict/programme/challenge5_en.html and <http://goo.gl/M9H21m>.

² The ten themes were: Risk Analysis and Technology Assessment; Energy; Nanomedicine; Clean water; Food; Beyond Moore; Nano materials; Bio-nano; Nano fabrication; Sensors and Actuators

We analyzed the articulations of the ageing society in the SRA and interviewed contributors to the SRA to understand how they envisioned the role of nanotechnology in providing solutions for an ageing society. Here we interviewed thirteen people who were concerned with either writing this SRA or setting up NanoNextNL.

From these interviews and from the analysis of the SRA, two themes of the NanoNextNL program were selected where the connection with the ageing society was most prominent: the Nanomedicine and the Food theme. (NanoNextNL.nl, 2015) Seven researchers were then interviewed in the Food theme and eight in the Nanomedicine theme. The interviewees for both themes ranged from theme coordinators, principal investigators of projects (mostly university professors), PhDs working on projects and industry collaborators.

A total number of 28 people were interviewed. All these interviews were transcribed by us. Also research papers of the interviewees were collected as well as other background information (for example university press releases about scientific work or newspaper interviews). All these documents were coded and analyzed by us to look for the different articulations of the ageing society.

First results

Within the Nanomedicine theme, most researchers link their research to the ageing society. For example, one researcher connects his research on single cell encapsulation in droplets is connected to the ageing society. By claiming that his research is good for healthcare and taking into account the fact that elderly people have more illnesses, he is able to make this specification. His research aim is to combine plasma-based cells with myelomas, which could create an ‘anti-body factory’. Antibodies are currently mostly used as markers for blood tests in hospitals. In this way antibodies could be produced cheaper and easier. Figure 1 shows the funnel of articulation of this example.

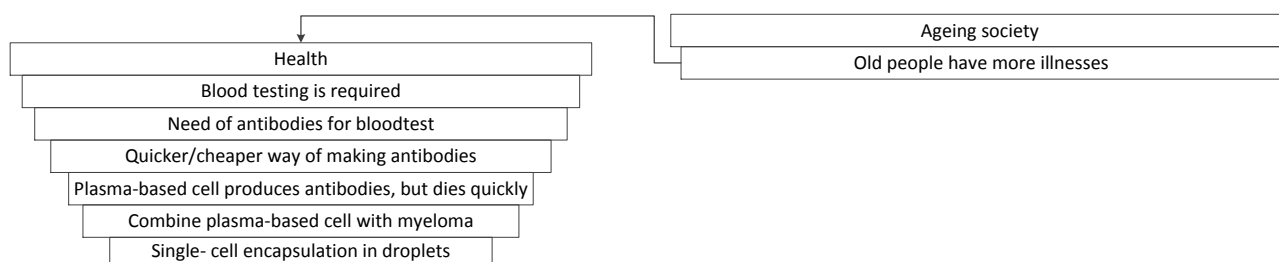


Figure 1 Funnel connecting the ageing society through health (curing illness) with research on single-cell encapsulation in droplets

Most researchers in the Nanomedicine use similar funnels connecting to ‘health’ which then all connect to the ageing society in the same way: by referring to the fact that elderly people have more illnesses. The funnel connecting their work to ‘health’ already exists and in this way can easily extend it to also fit with ‘the ageing society’. Health is here always portrayed as curing illnesses.

In the Food theme, researchers make fewer connections to the ageing society. Most researchers either do not really make a connection or acknowledge that the connection is somewhat farfetched. The links that

are made to the ageing society actually also use a connection with ‘health’. (Figure 2) Here the connection that is made to health is more based on lifestyle or on preventing that people get sick.

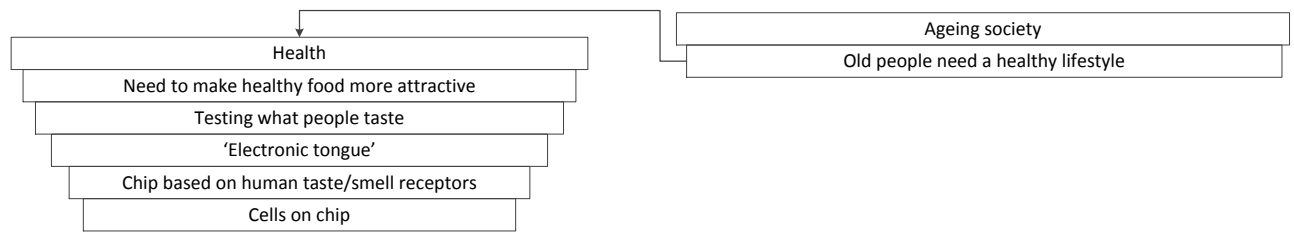


Figure 2 Funnel connecting the ageing society through health (lifestyle) with research on cells on chips

These examples show how many steps of specification sometimes are needed to connect research to a big word like the ageing society. It also shows how already fixed funnels connecting to ‘health’ are mobilized to fit under the ageing society. This paper will investigate further how researchers use the concept of the ageing society as a legitimation – to get funding for example – and how choices in the research are influenced by linking up with a big word like the ageing society.

In this way we unravel how steering research towards ‘the aging society’ actually works. We conclude that while governments are trying to urge researchers to become more societally relevant by using the ageing society as a goal, the mechanisms by which researchers articulate and specify these goals differ greatly. How large societal problems are currently being filled in by researchers, can provide insights on how to organize more demand-based agenda-setting of mission-oriented science.

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A SYSTEMIC AND CO-EVOLUTIONARY APPROACH TO TRANSFORMATIVE CHANGE IN HEALTH CARE – THE CASE OF AMBIENT ASSISTED LIVING TECHNOLOGIES AND ACTIVE AGEING IN NORWAY

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EXTENDED ABSTRACT

Throughout the last decade there has been growing attention within research and innovation towards how society meets and finds solutions to grand challenges (European Commission 2011; Head and Alford 2013; Benneworth et al. 2014). There is also increasing recognition that the public sector often takes an active role in addressing societal challenges in terms of supply side funding, engaging in and guiding the direction of developmental work (Mazzucato 2011) or through demand side and mission-oriented innovative public procurement policies (Edler and Georghiou 2007).

Complex societal challenges are often perceived as ill-defined and require specialized knowledge and innovative solutions that can only be found through collaboration in broader constellations across public, private and voluntary sector (Rittel and Webber 1973). There also seems to be increasing recognition that organizational, institutional and socio-cultural challenges associated with implementation of new technologies constitute considerable challenges alongside that of developing the technology in itself (Geels 2002, 2005).

One of the societal challenges that currently require attention is demographic ageing (OECD 2009). The increase in life expectancy is a result of an improvement of public health, new medical treatments and improved diagnostic tools. Together the increased life expectancy will strengthen the share of chronic and life-style diseases and which increasingly replace acute diseases (OECD 2010, 2011). The expected demographic ageing in the decades to come will put increasing financial pressures on public welfare services. Therefore, in order to ensure high quality welfare services in the future, there is a need for innovation and to re-think how health care services are organized and delivered (OECD 2010; European Commission 2011).

From re-active to pro-active health care services

The projected demographic changes actualize and legitimize a shift from a re-active to a pro-active health care system. Whereas a re-active health care system is based on providing passive care and curing treatment a system based on pro-active care is based on preventive and often home-based services enabling its users to manage their own lives as long as possible, often supported by ambient assisted living technologies (NOU 2011:11; Meld. St. nr. 29 (2012-2013)).

The notion of ‘ambient assisted living technologies’ is broadly defined and comprises a) technologies that increase safety and enables living at home longer, as well as stimulate social participation and thereby counteract solitude; and b) technologies that enable people to manage their own (chronic) health conditions, and often in closer contact with family members and next-of-kin.

The emergence of new welfare technologies such as GPS tracking and sensors represents great possibilities for innovation in health care. However, today’s welfare system still largely reflects an ideology and organizational design based on re-active and institutionalized care. In this system provision of universal and standardized health care services to a homogenous user population often stifles innovation through outdated processes and principles.

The Norwegian case study is thus focusing on the innovative efforts to address demographic ageing by exploring the possibilities associated with ambient assisted living technologies. The data collection will be structured around the National program for welfare technologies¹. Launched by the Norwegian Directorate of Health in 2013 the aim of the National program for welfare technologies is to ensure that such technologies shall be an integrated part of public health care services by 2020. The main tasks for the program is to test and develop AAL (ambient assisted living) technologies in the municipalities, to generate and diffuse knowledge on AAL, to develop good models for the introduction and use of AAL technologies, as well as to develop standards and IT architecture on AAL technologies. The national program has funded 10 pilot projects involving 32 municipalities, and the program is planned upscaled to involve 320 municipalities by 2019.

A systemic and co-evolutionary approach to the current transformation in health care

In order to improve our understanding of how this societal transformation process is being addressed and unfolds, the paper aims to apply an analytical framework based on a combination of innovation systems and transition theory (Weber and Rohracher 2012; Markard and Truffer 2008). This framework seeks to combine the systemic strengths of the innovation systems approach with the co-evolutionary dimensions of the multi-level perspective.

One of the strengths of the innovation system approach is its ability to understand how innovations emerge through the interplay across a diverse set of actors and how their behaviour is conditioned by institutions surrounding these actors, such as regulations, norms and expectations, and which is often seen as ‘the rules of the game’. The innovation system approach includes depicting a) system boundaries, b) the

¹<http://helsedirektoratet.no/helse-og-omsorgstjenester/omsorgstjenester/velferdsteknologi/nasjonalt-velferdsteknologiprogram-nvp/Sider/default.aspx>

actors involved within the system boundaries, and c) the relations between the actors (Edquist 2005). Moreover, the innovation system perspective includes production and innovation subsystems perceived as being part of a mutual interplay. Whereas the production subsystem refers to the continuous improvement of the production processes within established product lines, the innovation subsystem encompasses generating radical innovations leading to a significant transformation of existing production systems.

The innovation system perspective is nonetheless weaker in terms of depicting the relationship between the transformational and the structural determinants of the system (Markard and Truffer 2008). What does it take for new and radical innovations to alter the existing production regime? Here the multi-level perspective represents a complementary and appropriate approach (Ibid). Distinguishing between niches, regimes and landscapes, this approach comprises an analytical framework that allows studying how radical innovations diffuse beyond the niche-level and which conditioned by the surrounding landscape may eventually replace the existing production regime.

Together the multi-actor and systemic perspective of the innovation system approach and the evolutionary and multi-level perspective of transition theory seem to constitute an appropriate analytical framework for studying the co-evolution of a pro-active healthcare system based on AAL technologies.

The paper in this sense seeks to interpret the ongoing transformation processes in health care through the lens of a systemic and a co-evolutionary approach. The study aims to understand a) how the search for innovative solutions and services based on welfare technologies takes place across public and private actors; and across national, regional and local governance levels, b) how the move from a re-active to a pro-active health care system can be perceived as a regime shift, and c) how the experiences, knowledge and solutions based on AAL technologies can be seen as a niche technology contributing to such a shift.

Through this analysis, the paper seeks to test and apply this analytical framework onto the ongoing transformation changes of the healthcare system. This exercise is expected to contribute to an improved understanding of the current processes of transformative change of health care, and also to test empirically and further refine the conceptual framework applied.

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CONCEPTUALIZING THE ACTIVE ROLE OF USERS IN SHAPING TRANSITIONS

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Keywords: user roles, strategic niche management, multi-level perspective, grassroots innovations, practice theories

EXTENDED ABSTRACT

How to move away from unsustainable patterns of consumption is a key issue in sustainability transitions. Fundamental shifts are necessary in how people move, eat, live communicate and use energy. It would be difficult to realize these shifts without an active role of end-users. This paper focuses on the various active roles users can play in sustainability transitions.

In transition studies user habits and patterns are often seen as barriers for change. Users are not ready to adopt new solutions because these often do not fit their requirements and needs. Unsustainable behaviour is a routine part of everyday life, preconfigured not only by infrastructures, and system of provision, but also embodied in values, norms, dreams, fantasies, cultural perspectives and bodily experiences. All of this makes it very difficult for individuals to change behaviour since they are carriers of practices not autonomous agents (Shove et al., 2012). The MLP, another popular model in transition studies, conceptualizes prevailing user preferences as constitutive parts of socio-technical energy, mobility, food and housing regimes which together generate landscape trends of individualisation, mass-consumption, mass production of waste, and global warming (Rip and Kemp, 1998; Geels, 2005).

Practice theoretical approaches, MLP and transition studies more generally adopt a co-evolutionary perspective which assumes, however, that our current unsustainable user needs and habits are not fixed and can be redefined through a socio-technical change process. Generally it is also acknowledged that this process should include an active role for users. However, these theories have yet to develop a more comprehensive view on how this redefinition process could work and what role users will play in this process. Moreover, while the role of users in early experimentations with technology is well acknowledged (Hoogma et al., 2002; Seyfang and Smith, 2007) less is known about the extent to which users can contribute to accelerating transitions and defining their course. These are the gaps in literature we seek to address.

We begin from two research questions:

RQ1: What kind of roles are attributed to users in transitions literature?

RQ2: How are different user roles implicated in the process of starting up, accelerating and stabilizing socio-technical transitions?

We conduct an interpretive expert review focusing mainly on transitions literature but combining it with insights from other innovation literature (Von Hippel, 1998; Oudshoorn and Pinch, 2003, and many

others). By searching for the active role of users in literature on Strategic Niche Management (Kemp et al., 1998), Multi-level Perspective (Geels, 2005), Grassroots Innovations (Seyfang and Smith, 2007) and Practice Theories (Shove et al., 2012) we propose a following typology:

1. **User-producers** invent, experiment and tinker with radical technologies, creating new technical and organizational solutions. They may also be involved with developing efficient diffusion mechanisms as well as with maintenance and repair work;
2. **User-consumers** assess available technological options, discover new uses, articulate preferences, disseminate information about new solutions and define their lifestyle through a variety of consumption practices. The early active role of 'lead users', however, is eventually eclipsed by the emergence of a large number of more passive 'lay consumers' with explicit and more fixed preferences;
3. **User-intermediaries** are involved with coordinating niche cumulation: they enrol new actors and broker contacts between them, they help to create a space for producers, users and regulators to meet and attempt to achieve the alignment of technologies, actors and rules. In other words, user-intermediaries attempt to stabilize the emergent niche and turn it into a regime;
4. **User-citizens** engage in politics of regime shift lobbying for a particular niche and against the regime (or other competing niches);
5. **User-legitimizers** shape the values and worldview of niche actors giving meaning, purpose and rationale for their activities. They provide a cultural 'glue' which helps to ensure a sense of belonging, identity and social cohesion. In so doing they draw on both local (e.g. communal values) and global cultural resources (e.g. anti-consumerism).

Co-evolutionary approach to transitions offers a theoretical context for this typology (see figure 1 on the next page). Early variation is created through user experimentation on both levels, technical (e.g. artefacts, repair and maintenance, diffusion mechanisms) and symbolic (e.g. legitimating values, attributed cultural meanings and associated lifestyles). As experiments accumulate and a niche starts to increase in size a need for coordination emerges to ensure mutual learning and to align the visions and preferences of various stakeholders. Through citizen activism pressure is put on an incumbent regime while alternative solutions are being advocated. Once a certain threshold of stability has been achieved and user preferences have become relatively well articulated 'lay consumers' shift to new practices in great numbers thereby completing the transition. A former niche has become a regime and vice versa.

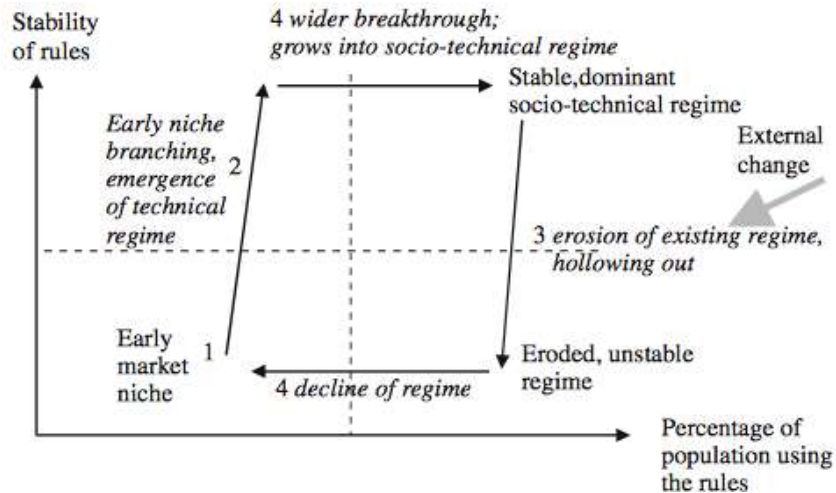


Figure 1. Emergence and breakthrough of niches (Schot and Geels, 2007: 614)

Following from this we propose two hypotheses on the salience of different user roles and the degree of user organization during different phases of transitions:

H1: The role of user-producers and user-legitimizers will be most dominant in emerging niches, followed by user-mediators and user-citizens in more mature niches, and finally user-consumers in the new dominant regime.

H2: The degree of user organization relative to the size of the niche is lowest in the emergent niche, highest in the acceleration phase of transitions and intermediate in stabilized regimes.

We attempt to corroborate the typology and the hypotheses with a case study on the transition to car-based mobility regime.

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SHIFTING PARADIGMS FOR EUROPEAN INNOVATION POLICY: FROM FOSTERING TRANS-NATIONAL COOPERATION PROJECTS IN R&D TO BUILDING PAN- EUROPEAN ENTREPRENEURIAL ECO-SYSTEMS

A PROPOSAL FOR A RESEARCH PROGRAMME

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Keywords: Entrepreneurial Eco-systems; Knowledge Triangle Integration; Pan-European

EXTENDED ABSTRACT

Introduction

This thought piece is inspired by the experimentation and learnings with the way the ‘European Institute of Innovation and Technology’ (EIT) has conceptualised its first ‘Knowledge and Innovation Communities’ (KIC). Interestingly, first ideas to build a ‘European Institute of Technology’ date back to the 80’s (Pease, 1983) and very similar ‘Knowledge Integration Communities’ (KICs) were experimented by the pilot Cambridge-MIT Institute (Acworth, 2008). We argue the need for a new paradigm for the European Innovation policy with the shift from long established trans-national collaboration in R&D projects to long-term partnerships for enabling Pan-European ecosystems. We suggest intensified research collaboration to examine and define new forms of innovation policy in Europe. Such efforts could be formalised, for instance, within the framework of EU-SPRI as a research programme consisting of interrelated research streams.

Background

Europe lacks still today a true EU-level Innovation Policy beyond traditional rhetoric of knowledge transfer. Recently, authorised voices stress it is high time to ‘*take innovation out of the ghetto of a too narrow focus on science and technology*’ (Mazzucato, 2013). Indeed, ‘*many policies are still based on an old supply driven innovation model which takes support for R&D as the main entry point for policy making without thinking more creatively about the broader suite of innovation policies available*’ (Schot, 2014). Surprisingly, technological innovation and the linear model are more pervasive in governmental policies than business practice. It is therefore time for a new narrative and a new generation of innovation policy instruments (Borras and Edquist, 2013).

In Europe most of the public R&D is still managed at national level while the policies that EU institutions support today were largely conceptualised in the 80's in fostering (trans-national) collaboration in R&D projects involving academic and business partners. Out of the three vertex of the so-called Knowledge Triangle (Figure 1), an innovation policy for Europe is very far away from being realised, among other things because the choice of innovation strategy and policy instruments is still being researched (OCDE, 2010; Flanagan et al. 2011). Comprehensive scholarly' works on European innovation policy are scarce (Peterson and Sharp, 1998; Borrás, 2003) coupled with well-intentioned declarations of intend on broad-based innovation for Europe (EC, 2006). More recently, (Granieri and Renda, 2012) question whether there is any such Policy at all today, beyond widespread and linear support for R&D in general and collaboration in particular, stressing that a much clearer division of labour in the multi-level governance system that characterises Europe is needed. Lack of focus on Europe is somehow surprising taking into account growing interest in a new agenda for innovation studies (Fagerberg, Martin and Andersen, 2013; Cox and Rigdy, 2013).



Figure 1. The Knowledge Triangle as seen by the 'European Institute of Innovation and Technology' (EIT), emphasises the partnership side in building up its knowledge triangle operations (so called 'Knowledge and Innovation Communities' or KICs) thereby referring to business instead of innovation (Source: www.eit.europa.eu).

While there are some exceptions like ERC and SME Instrument within Horizon 2020 focusing on individual talent and ideas, the most of the new EU instruments are still characterised by emphasis on cooperative R&D projects bringing together science and business partners institutionally to promote, facilitate and accelerate technological innovation.

Hence the current paradigm in European innovation policy (Muldur et al. 2006) can be characterised by: Member states principally responsible for capacity building (including Structural Funds); EU and inter-governmental cooperation fostering connections across borders; Increasing emphasis on large firms and easing access for SMEs firms; Collaboration principally framed by disciplines and business sectors. A new paradigm emerges with a shift from project collaboration to long term partnerships for enabling ecosystems meaning: Capitalising on existing capabilities and alignment of public support available in Europe; Bottom-up community-driven partnerships for co-creation and multilevel synergies; Focus on emergence and growth of young dynamic firms ('yollies'); Acceleration, the exploitation of tacit knowledge and addressing societal challenges.

Why a research programme?

E&Y and CEPS (2011) report "Next Generation Innovation Policy: the future of the EU innovation policy to support market growth" was very critical about former EU approaches to innovation, forecasting that "without a radical change [...] Europe in 2020 will be only slightly different, in terms of goals achieved, from Europe in 2011, but it will cost more." One can ask like Granieri and Renda (2012) cited by Susana Borrás "whether an innovation policy can aspire to be really disruptive without disrupting its own organizational framework". In that connection, EIT can be seen as an 'innovation policy lab' to help transform European policy (Schot, 2014).

Actively capturing lessons learned and good practices emerging from the KICs dynamics is key if the EIT wants to establish itself as a knowledge pool and pioneer example of an intelligent form of organisation capable of shaping new, co-created, more effective, efficient and adaptable innovation models. More generally, 'disruptive collaborative spaces' (WEF) and 'strategic public private partnerships' (OCDE) are exciting new research domains where innovation can be fostered in a wider sense, not just financing R&D inputs, but including also often neglected issues such as regulation, standardisation, intellectual capital, etc. As a starting point to delineate such spaces, one could target good practice from institutions and agencies in the US (e.g. DARPA and ARPA-E) and Europe (Tekes, NIH, TSB, FFG, etc) as well as new policy experiments (like EIT KICs) fostering not just start ups through entrepreneurial ecosystems and enabling frameworks within, across and beyond national innovation systems and borders. A research program would allow capturing salient elements for future 'intelligent innovation institutions' and 'learning innovation agencies'.

Possible content and work streams for the research programme

We suggest intensified research collaboration to examine and define new forms of innovation policy in Europe. Such efforts could be formalised, for instance, within the framework of **EU-SPRI** as a research programme. The programme could answer what European innovation policy should

mean. Indeed, paradoxes and myths about the roles of public and private stakeholders coupled with the emergence of new players (China in particular) makes as imperative as urgent for Europe to tackle both its innovation ‘gap’ and ‘fragmented’ landscape. Figure 2 illustrates interrelations among work streams of a research programme while the underlying logic is as follows:

Policies aimed at involving ESTABLISHED BUSINESS in COLLABORATIVE R&D acknowledges that firms can carry out research considering the double role of R&D i.e. to increase absorptive capacity and competitive advantage. But also, that taking into account the new geography of knowledge, business themselves should do R&D in increasingly open environments involving other actors in the innovation system. Furthermore, the EU has mainly encouraged collaboration involving business through projects, namely, time-limited consortia associating established firms. It is no surprise that within this paradigm, further efforts have been made to engage SMEs, because of their number and importance for current employment in Europe. Hence the focus on EXISTING FIRMS and how to modulate European policies to associate SMEs.

Increasingly, systems of innovation theory has stressed the iterative nature of innovation to the extent that COLLABORATION of actors within ECOSYSTEMS occur through a variety of channels, not only through formal projects but also through informal interaction. This is particularly important for what concerns novel forms of innovation fostering new business creation. The importance of NEW FIRMS is well known not only as net job creators but also as potential disruptors. Hence, a second Workstream focus on a subset of SMEs, namely, new business and inquire whether and how the EIT governance, management and content represent a new EU model.

Finally, though new businesses may comprise potential disruptive high growth new firms they are difficult targets for policy. Herein, how ECOSYSTEMS engage EXISTING BUSINESS is determinant for the sectoral renewal and growth: alliances between established firms and new ones can be a way to scale up the start-ups (World Economic Forum, 2014). A third Workstream could then focus on ICT - a sector Europe cannot simply miss –regarding REMOVING BARRIERS through more ‘intelligent innovation institutions’ and ‘learning innovation agencies’.

Work stream I : Business R&D (EXISTING FIRMS)

Work stream II: EIT & KICs(NEW FIRMS)

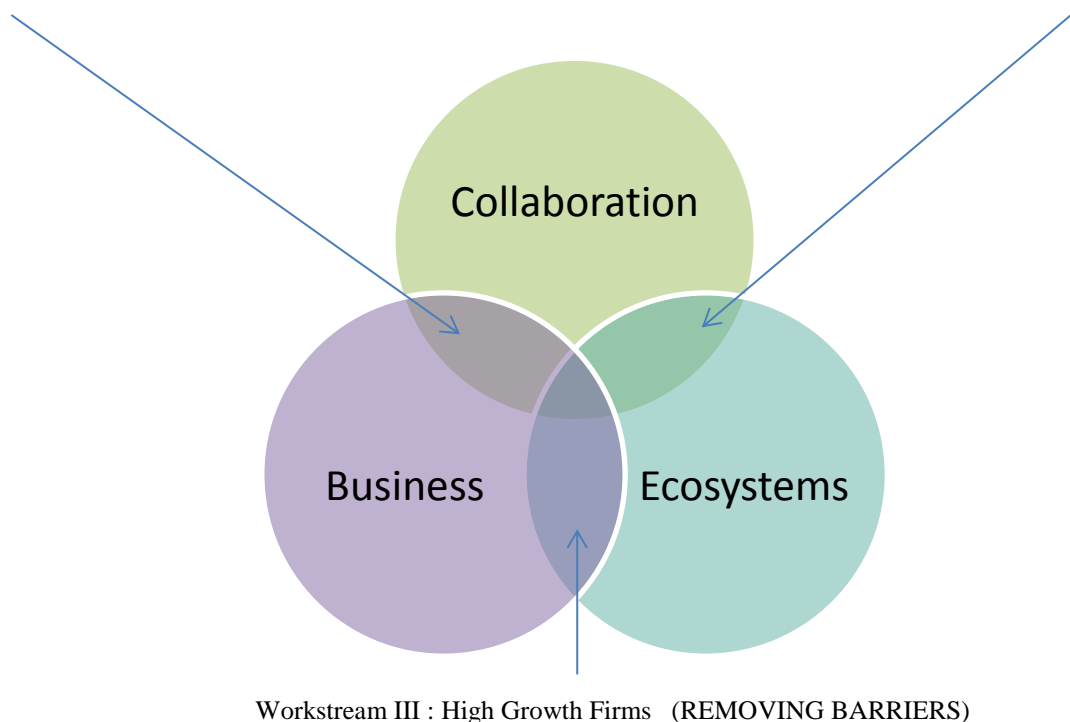


Figure 2. The cognitive trajectory and interrelations among the work streams.

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THE TRIPLE CHALLENGE: THE ECONOMY, CLIMATE CHANGE AND GOVERNANCE

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Keywords: Europe; Economic stagnation, Climate change, Governance, Innovation policy

EXTENDED ABSTRACT

This paper argues that Europe – as other parts of the world - is confronted by fundamental changes in its external environment as well as internally, giving rise to several daunting policy challenges, the solution of which requires a completely new policy stance.

First, there is the economic challenge manifest in slow growth or even stagnation in many developed countries. This is related to a number of factors. One is the globalization of the world economy and the rise of new economic powers in Asia and elsewhere, posing a threat to the competitiveness of many national industries throughout the developed world while at the same time opening up new markets and opportunities. A second is the extensive and long-lasting impact of the 2007-8 financial crisis and the measures taken to counter its effects. In recent years, economic stagnation has been especially pronounced in Europe, where it has led amongst other things to increased differences between rich and poor countries and to very high levels of unemployment (especially among the young) in large parts of the continent. Thirdly, there are underlying and persistent structural problems in certain countries that need to be urgently addressed. Austerity programmes currently underway in a number of European countries are unlikely to provide a satisfactory solution to these problems. Rather, as we shall argue in this paper, what is required is a continuous upgrading of skills, technologies and industrial structures in the countries concerned, and long-term policies – backed up with substantial investment – to make all this possible.

Second, there is the challenge posed by the climate crisis, the solution of which requires nothing less than a fundamental transformation from carbon-based growth to a new, sustainable economy. This may be technologically feasible but is nevertheless extraordinarily difficult to bring about as it challenges fundamental beliefs regarding the economy and society and our very notion of ‘progress’. Yet without a successful transformation to a sustainable economy, future generations will be in dire straits. Like the economic challenge, the climate challenge points to the need for long-term policies supporting the development of skills, innovation and structural change in Europe.

The third challenge concerns the governance crisis now facing Europe and the difficulties this poses for policy making and implementation. These difficulties were already becoming apparent before 2008, but the financial crisis has made them much more severe. A European Union that is struggling with dwindling popular support for its institutions is finding it difficult to rally its citizens behind adequate responses to such long-term problems. That task has been made all the more difficult by the hegemonic influence of neo-liberal ideology over the last two decades, with its blind faith in the supremacy of ‘market solutions’ and its constant belittling of any efforts by ‘the state’.

The paper argues that a completely new policy stance is required, one that simultaneously addresses the challenges brought about by economic stagnation, by climate change, and by the governance crisis, as these are indeed closely inter-related. Without growth, greenhouse gas emissions may continue to decline, although almost certainly not at the pace necessary for their elimination by the end of the present century. But employment would undoubtedly continue to suffer. A return to the type of growth that prevailed before the 2007-08 financial crisis, on the other hand, might be good for employment but certainly not for the climate, as emissions would continue at unsustainably high levels. Is there a way out of this dilemma? It is argued that challenges, while often daunting, are also opportunities for doing things differently, and may call forth - and indeed even require – innovation and entrepreneurship at various levels of society, not only in private enterprises but also in the public sector and among policy-makers, for their successful resolution. What is required is a reconceptualization of what is intended by ‘economic development’ and a fundamental transformation of the economy to a new ‘green’ trajectory based on rapidly diminishing emission of greenhouse gases. This entails a much greater emphasis on innovation in all its forms (not just technological). Innovation policy must be placed at the very heart of industrial policy and indeed of economic policy more broadly. While this may well entail certain costs in the short term, it will undoubtedly bring considerable benefits in the longer term in the form of strengthened industrial competitiveness, enhanced exports and new jobs. It may also encourage countries in other parts of the world to follow suit, thereby ensuring that climate change is kept within manageable bounds.

A PLACE-BASED APPROACH TO THE GOVERNANCE OF TRANSFORMATIVE INNOVATION POLICY

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Keywords: Transformative Innovation Policy; Piloting Culture; Strategic Alignment; Tentative Governance

EXTENDED ABSTRACT

There is an increasing acknowledgement that the current rationales for innovation policy and public intervention are no longer capable of providing fit-for-purpose policy tools and measures for a transformative innovation policy which seeks to respond to long-term challenges such as climate change, resource depletion or an ageing population (see e.g. Webera & Rohracherb, 2012; Steward, 2012). This policy goes far beyond the confines of science and technology policy and innovation support for industry. This new challenge-driven and demand-oriented innovation policy requires a fundamental reframing of innovation policy and its tools.

In an era of transformative innovation policy there is a need for the cognitive and politico-strategic alignment of actors in terms of problem perception; of 'making sense together', identifying wicked problems and designing policy tools and instruments that are capable of renewal, as well as designing and implementing coordinated action. One of the axes upon which such a sense-making and transformation (Borras & Seabrook, 2015) could take place is between the *local, central and transnational government levels*, in a process of bringing together a consortia or community of interests where the understanding of our current social problems and the potential means of solving them could be realised. In this context, governance can be understood as a process of interpreting and defining problems in such a way that coordination and cooperation are simulated in a desired manner (Stegmaier, et al., 2014).

The transnational government level in its formal and legal structures, such as the European Union, and informal and non-legal structures, such as the Earth Summit, functions as an arena for worldwide policy models. These transnational structures are used to justify and legitimise national policies, and they serve to negotiate, mutate and domesticate policy frameworks (Niinikoski & Kuhlmann, 2015; Alasuutari, 2010).

The central government level needs to recognise and be sensitive to local realities and perceptions, as it is on the local level that the majority of policy problems, as well as innovation processes engaging local communities, take place. The local level can, at best, act as a catalyst for change and policy transformation by carrying out concrete pilots and experiments, while the central and transnational government levels

enable local level processes of innovation to take place through various policy frameworks and instruments (regulative, normative, resource or strategic steering).

In a recent country review of territorial governance in Finland and Estonia, the need for a more strategic approach was identified, with implications for the roles, functions and also (more significantly) for the *rationale of the public sector as a whole*. Issues such as the setting of strategic goals, which necessitate new processes of policy renewal, invigorating innovation through the promotion of a piloting culture and fully taking advantage of the potential that lies in digitalisation were also raised. The OECD country review outlined five governance phases of reform. These phases are indicative of the processes ongoing in innovation policy: 1) streamlining strategy; 2) silo-busting for better policy integration; 3) setting clear reform paths; 4) adopting “Just do it” pragmatism, and 5) knowledge-sharing that breaks down borders. Our paper investigates the *processes through which sense-making, agenda-setting and problematisation, as well as strategic alignment and implementation could be developed as an embryo of transformation*.

In this paper we elaborate a place-based approach to tackle the issues raised by the multi-level governance of transformative innovation policy. Drawing on the socio-technical approach (see e.g. Fox 1995) we understand that transformative innovation policy requires the effective blending of the technical and social systems in order to respond long-term challenges. These two aspects must however be considered interdependently, because arrangements that are optimal for one may not be optimal for the other and trade-offs are often required. Thus, for policy design to enable system-wide changes, i.e. transitions, to occur, there is a need for a dual focus. Based on concrete empirical examples in the Helsinki Metropolitan area, as well as emerging new initiatives within the central government designed to foster a more challenge-driven strategic approach to innovation and to the locally driven initiatives, we seek to understand the patterns of system-wide changes, how these patterns enable challenge-driven socio-technical innovation to occur and what kind of support could and should be provided by the central government, if emergent transformative innovation policy was to be developed as a part of a more general agenda for change within the context of the ‘government as an enabler’ approach. We understand socio-technical innovation to include multiple types of technological, organisational, behavioural and business model innovation.

We use a case study method to focus on three of the initiatives currently being rolled out in the Helsinki region in order to analyse the notion of innovative experimentation and the tentative governance of specific socio-technical innovation processes. These initiatives differ from each other in various ways but they all aim to promote transformative change in the region. The first empirical case concerns the Mobility as a Service (MaaS) approach. This is primarily initiated by the city of Helsinki; the concept focuses on the task of figuring out how to get from point A to point B and then taking this out of users’ hands. The basic idea behind the concept is that there is a transportation operator that takes care of arranging transport for passengers. The MaaS initiative, as such, has a variety of policy aims, enhancing new business opportunities, reducing traffic congestion and carbon emissions and improving travel comfort and convenience.

The second initiative was introduced by company leaders and large Finnish corporations in the region. The aim of this initiative is to make the whole region one big reference market for smart and clean

technologies, once again focusing on technical, business and behavioural innovations to enhance businesses and at the same time reduce carbon emissions and create environmentally friendly solutions for urban cities. The third initiative, entitled *Health Capital Helsinki* is based primarily on the national governmental strategy to better utilise its proven expertise in the health sector in order to enhance the growth and competitiveness of the sector. Based on national policy aims the city of Helsinki and the University of Helsinki commissioned an analysis of how to improve growth in the health sector in the Helsinki region focusing on the key players, such as the various universities, the university hospital, incubators and accelerators, as well as the private sector.

In order to analyse the various transformative and experimental large scale cases an analysis framework is built to compare governance mechanisms and practices between the cases, explaining how they create or hinder transformative change. The cases will be compared using the grounded theory approach, specifically, iterative constant comparative analysis. The aim here is to identify and conceptualise the latent social patterns and structures of governance mechanisms and patterns of transformative innovation policy. Based on our preliminary findings the usage of an organising concept to align strategies and the identification of key initiators and actors at various governance levels, as well as the creation of mechanisms to improve competencies and the integration of new actors and new knowledge practices to enable experiments seem to have had a significant role in the governance of transformative change.

The analysis provided seeks to generate a framework for analysis for transformative innovation policy, with a particular emphasis on finding the best ways to identify a constructive role for both the local level and central government as enablers or transformational nodes. The framework could also be used as a means of better understanding and steering the processes by which innovation policy is transformed to meet the challenges of increasingly complex policy challenges and increasingly under pressure European economies and societies.

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IT'S NOT AGE—IT'S EXPERIENCE: HOW HISTORICAL ENVIRONMENTAL DYNAMICS INFLUENCE FIRMS' ABILITY TO SURVIVE TRANSITIONS

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Keywords: Environmental change; transition policy; firm survival; age dependence; adaptation

EXTENDED ABSTRACT

Sustainability transitions pose firms with persistent environmental shifts due to the regulatory reforms, technological discontinuities, competitive changes, and economic shocks that accompany them. These shifts change the level of resources available in the environment and redefine attractive market positions. This can render existing firm strategies ineffective, which means that firms either have to change their activities or prevent the shifts to survive.

How firms do so continuously draws the attention of policy makers that wish to identify effective policy interventions to influence this process, but it is also an enduring research theme in evolutionary economics, management, and organization science. The dominant scholarly view is that adapting to environmental change is particularly hard for old firms. As firms age, they develop routines and “mechanistic” structures that allow them to cope quickly and effectively with their environment (Burns & Stalker, 1961; Nelson & Winter, 1982). This can give them a competitive advantage. However, in the process firms' decision makers become anchored in past experiences and their innovations become increasingly incremental and focused on well-established domains. This makes old firms inert and adaptation difficult in the absence of supporting policy interventions.

Contrary to this view, however, some old firms systematically adapt to dramatic environmental changes, even in the absence of beneficial interventions. The National Cash Register Company, for example, has remained a market leader from 1884 until today, despite facing several waves of discontinuous technological and competitive shifts. In some empirical domains, studies even report that old firms are better able to cope with changing environments than young firms. Although contemporary models account for this by suggesting that different functional variations of age dependence prevail under different conditions (e.g. Le Mens et al. 2014; Le Mens et al. 2011), they suffer from two notable shortcomings. First, they typically start from the assumption that firms become more inert over time—despite empirical evidence that this is not universally the case—and second, they do not consider the evolutionary implications of historical environmental dynamics.

Until now, these issues remain unexplored. In this paper, we consider firms not just as subject to future environmental dynamics, but also as the product of evolutionary processes driven by historical environmental dynamics. We hypothesize that, because different historical dynamics lead to the survival of different firms that have adapted to different environments (e.g. in terms of innovativeness, structure, propensity to change, and degree of specialization), the relationships between inertia, age, and survival differ between patterns of historical environmental dynamics. Increasingly dynamic global environments make these issues particularly pertinent.

To advance our hypothesis, we introduce an agent-based simulation approach that is widely used in biology and management research, but that is quite new to transition studies and even more so to policy studies. In particular, we introduce a novel evolutionary variant of Kauffman's (1993) NK-model wherein hypothetical populations of firms continually adapt to systematically varying patterns of environmental demands. To do so, firms make incremental changes to the routines that determine their fitness. We then introduce a dramatic and persistent shift in environmental demands to capture the effect of a major policy initiative, technological discontinuity, competitive change, economic shock, or regulatory reforms. We systematically identify the types of firms that successfully cope with this shift and explore how this varies across experimental settings.

Our preliminary results capture well-known empirical phenomena and further show that different patterns of historical dynamics lead to differences in the relationship between age and the hazard of failure. Our model thus explains why and when some firms—even old ones—are able to change their core features to keep up with changing environments, even in the absence of beneficial interventions. Furthermore, our results show that the historical dynamics of the various contexts in which transitions unfold are an important factor in explaining the speed and outcome of the transition processes themselves.

Most importantly, however, our results indicate that the outcomes of policy interventions that aim to affect the behavior of firms will differ depending on the historical dynamics of the affected firms' environments. We discuss the implications of this for transitions affecting industries in various stages of maturity and complexity. We use this discussion to inform policy makers that aim to influence transitions about the complex trade-offs that are involved in designing effective policy interventions when considering the targeted system's historical dynamics.

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MODELLING THE DIFFUSION AND EFFECT OF BEHAVIOUR CHANGING FEEDBACK DEVICES

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Keywords: diffusion; agent-based model; habits; demand-side; feedback device

EXTENDED ABSTRACT

Introduction

In western societies, behavioural change of demand side actors such as households is required to achieve a sustainable level of resource use (Tukker et al. 2010). Frequently and routinely performed activities, such as heating, commuting, and lighting involve the consumption of considerable amounts of energy, water and material resources. Changing such behaviours is however difficult as they often are embedded in daily routines and performed habitually. Habits therefore constitute barriers for sustainability transitions if they inhibit deliberation and the adoption of more sustainable modes of behaviour.

One way to tackle ‘undesired’ habits is to use so-called behaviour changing feedback devices (BCFDs), which are innovative technical products that give actors feedback on their behaviour and support them in acting more sustainably. The e-aquarium, for instance, measures room temperature, visualises the result in a quality of life in an imaginary aquarium, and, with it, it gives consumers feedback on the temperature in the room (Keyson et al. 2014). The functionality of BCFDs can be: 1) to provide information about environmental consequences of behaviour (Wood & Newborough 2003), 2) to relate the behaviour to a normative objective in a playful way (Keyson et al. 2014), 3) to create peer pressure (Peschiera et al. 2010), or 4) to break habits by intervening at the moment of performing an action (Laschke et al. 2011). Existing research show that these devices can lead to typical energy savings of 10%, but that results vary widely (Darby 2006, Karlin et al. 2014).

Implementing BCFDs can be seen as an innovative measure to support sustainability transitions. We have argued the need to assess the potential of these devices for inducing behavioural change, and that such an assessment includes the challenge to understand the combined effects of the diffusion of the BCFDs themselves and the diffusion of behavioural changes induced by the devices (Jensen et al., 2015). The two diffusion processes are distinct but interdependent: adopters of BCFDs may well change their behaviour. The altered behaviour may propagate through social networks and, as a consequence, peers could adopt more sustainable behaviour even without having a BCFD. In this paper, we present an agent-based model to study the dynamics of the diffusion of BCFDs and the associated effects on behavioural change.

The Model

The diffusion of technological innovations and behaviour are both processes of the diffusion of innovations in the broad sense (Rogers 1995) and therefore share some commonalities. Most importantly, both are processes which happen (mostly) through social contacts and their understanding requires to analyse actors' motivation to (not) adopt and actors' relations in social networks. However, they are not identical. Technology adoption involves one-time decisions of product purchase or installation whereas behaviour adoption requires sustained changes. The one-time action of technology adoption can be assumed being a deliberate act, while changing behaviour requires to break existing habits and to establish different (new) ones. The two types of dynamics have been studied in mostly distinct strands of research and distinct theoretical, mathematical and computational models have been developed (Jensen and Chappin 2014).

For developing our model we adopt and link two existing models: one model of the diffusion of techno-logical innovations (Schwarz and Ernst 2009) and one model of the diffusion of behaviour (Anderson et al. 2014). The models have been selected based on a review of the literature on diffusion modelling (Jensen and Chappin 2014). These two sub-models are linked via the effect of the BCFD on the adopters, which is modelled as asymptotic change of current behaviour towards a normative behaviour defined by the BCFD.

A complete description of the model using the ODD protocol (Grimm et al. 2010; Grimm et al. 2006) is provided at <https://www.openabm.org/model/4549>, and additional details are given by Jensen et al. (2015). Main features of the model are that adopters are assumed to be households and heating behaviour is taken as an example to specify the model. Households are differentiated into five different life-styles: Postmaterialists, Social leaders, Mainstream, Traditionalists and Hedonistic which differ in their adoption behaviour. The households are linked via a social network that is based theoretically on literature (Watts & Strogatz, 1998) and empirically on ego-networks derived from interviews (Baedeker, 2014) as well as social and spatial proximity of households within a generic city (see Holzhauser et al. 2012). The households decide on the adoption of BCFD based on their preferences, which are defined based on milieus, and social influence. Agents' behaviour develops in each time steps towards the behaviour incentivized by a BCFD (if adopted), but also towards the average behaviour of peers, weighted by the strengths of social ties.

Results

Simulations with this model show the results to be expected: BCFDs unfold their effect on adopters, and this effect is propagated by behavioural diffusion throughout the network until eventually all agents approach the normative goal set by the BCFD. The model gives additional insights into the speed and pathways by which this limit point is reached, which differ considerably. In particular, our analysis has revealed two mechanisms by which behaviour diffusion contributes to and alters significantly the overall effect of BCFDs. First, behaviour diffusion aligns the behaviours of adopters and non-adopters of BCFDs, thus decreasing heterogeneity of these two groups' behaviour throughout the process. Second, behaviour diffusion speeds up over-all change caused by BCFDs. The convergence of behaviour of adopters and non-adopters slows down adopters at reaching the normative behaviour incentivized by BCFDs. This prolongs

the effect of BCFDs on the adopters, and the additional effect is propagated again to non-adopters through behaviour diffusion.

Discussion and outlook

The presented model is intentionally limited to studying the demand side of transitions, but captures aspects which are core to transitions thinking: the endogenous generation of dynamics, co-evolution of various dimensions (technology and behaviour), the heterogeneity of actors, and the relevance of social networks. The mechanisms emerging from co-diffusion which have been identified through the simulation experiments (see section 3) were not obvious beforehand. This supports the repeatedly made claim that simulation models are useful tools to understand transition dynamics (Chappin 2011; Holtz 2011; Squazzoni 2008; Papachristos 2014). The next step is to develop an empirical specification and calibration of the model to the case of ventilation behaviour in Germany. We expect this advanced model facilitates to make a thorough comparison between the prospects of different feedback devices, and to assess the contributions of specific devices to energy conservation.

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THE POTENTIAL OF EXPONENTIAL RANDOM GRAPH MODELS AND STOCHASTIC ACTORS ORIENTED MODELS FOR TRANSITION STUDIES

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Keywords: Transitions; Social networks; ERGM; SOAM

EXTENDED ABSTRACT

In order to achieve a successful transition, niche actors must engage in a number of different activities such as self-organisation and niche building, generating and spreading information, exchanging resources, influence decision makers, and collaborate (or compete) with other niche actors. All these activities are essentially relational in nature: they require the creation and maintenance of a connection between one or more actors. Given this relational nature of niche activities, network theory offers a potentially powerful framework to study and model different aspects of transitions with (Hermans et al., 2013).

In recent years the field of social network analysis has seen an explosion in new and innovative methods to model the creation, maintenance and termination of networks. Some of these new modelling approaches have been successfully applied in the field of governance and policy theory to quantitatively test the validity of some of the qualitative hypotheses that were developed in the broader literature on network governance and management (Lubell et al., 2012). In my contribution to the special session of the EU-SPRI conference on the modelling of sustainability transitions, I would like to explore what these statistical network models have to offer for the study of transitions. As such my contribution is to be regarded as a scoping study focussing more on the underlying modelling principles and possible applications (formulation of testable hypotheses) of such models and less as a practical example of modelling.

Application of network theories on niche processes

Stochastic Actor¹ Oriented Models (SOAMs) and Exponential Random Graph Models (ERGMs) both belong to the class of statistical inference models and are among the most popular and theoretically well-developed class of network models currently in use (Snijders, 2011). They can be regarded as regular agent-based simulation models and they only deviate from other agent-based models in the sense that the model is to be used for statistical inference: testing hypotheses about the social processes that led to the creation and development of a specific empirically found network. If a researcher would do another measurement he or she would observe a slightly different network, but because the same basic social processes are assumed to

¹ *Snijders (2011) explains that the word 'actor' instead of 'agent' is preferred in line with the terminology in use in sociological theory and to underline that actors are not regarded as sub-servient to others' interests.*

be responsible for the creation of the network, the new network would possess the same statistical parameters.

The statistics in these models are based on the occurrence of certain micro-level mechanisms of tie formation (and termination) into local network patterns called configurations. These configurations form the basic building blocks of network models. Examples of such micro-level configurations are reciprocated dyads, two-paths, transitive triads and cyclical triads. The relative occurrence of such patterns says something about the underlying social processes that are responsible for the dynamic process of network formation. Networks are therefore thought of as the meso level between micro-level behaviour and macro-level social phenomena such as institutions and social capital (Boshuizen, 2009, Lubell et al., 2012).

In their book on communication networks Monge and Contractor (2003) have translated a number of popular social network theories into these configurations. In Table 1 a number of these theories have been translated into some of the often mentioned mechanisms driving transitions. In the last column some hypotheses regarding the occurrence of certain network configurations are formulated that could be used to test whether an empirical network shows any indication that such a mechanism might be responsible for its creation or evolution.

Table 1: Application of different network theories on transition theory

	Relevance for transition theory	Possible hypotheses / research questions?
Theories of self-interest		
Structural holes: <i>Actors can benefit from exploiting the structural holes in their personal network</i>	Niches need innovators that are capable of connecting different types of organizations	Graph realizations where there is a greater likelihood of high actor centrality have a higher probability of occurring.
Mutual self-interest and collective action		
Public good theory: <i>How to induce contribution to public good and avoid free riders?</i>	An actor is more likely to contribute to the public good in networks with a high centralization	Successful niches will have a higher probability of centralization at the network level.
Critical mass theory: <i>Number of people with resources and interest has to reach a certain number for innovation to take off.</i>	How do competing niches induce membership of their own niche and discourage membership of other niches?	Niche networks grow based on “popularity” (indegree) of potential members.

Table 2 (continued)

	Relevance for transition theory	Possible hypotheses / research questions?
Cognitive theories		
Cognitive social structures	Actors in niches have to create shared interpretations / expertise	The effects of transitivity and cyclicity are expected to be more likely to occur in such networks: “friend of friends will become friends”.
Semantic/knowledge networks	Contributions of knowledge and niche experiences to the ‘Global Niche Level’	Ties between actors in the social network are more likely to occur if they share a tie to similar set of concepts in the adjoining semantic network.
Exchange and dependency theories		
Exchange theory: <i>Resources and information are distributed over different members of the network. Actors thus seek out each other to gain access to these resources.</i>	Transitions require the involvement of different actors with access different kinds of resources and knowledge sources in interdisciplinary teams.	The driving force of tie formation is mutuality: we expect to see a lot of reciprocated ties in the case of equality of exchanges.

Based on: Contractor and Monge (2003) & Contractor et al. (2006)

Considerations for research design

The formulation of testable hypotheses is influenced by the type of model that is intended to be used and this in turn sets specific requirements to data collection. For instance the actors in SOAMs are assumed to be able to control their outgoing ties in ways that maximizes their utility from the network structure (Snijders, 2010). As a result most SAOMs are used for the modelling of networks with directed ties only and this favours hypotheses that assume processes of reciprocity and transitivity as building blocks. SOAMs are especially suitable to investigate the longitudinal development of a social network over time. Current SOAMs software packages (SIENA and RSIENA specifically) thus require panel data (multiple measurements of time = t to time = t+1) of a stable set of nodes. For modelling long-term innovation processes like transitions, this requirement provides a limitation since it is unlikely that the same actors will be involved from the beginning to the end of the transition. However, within a more limited time frame, e.g. a project network, stability can be assumed. Application of a SOAM on such a network would provide opportunities to investigate the strategic behavior of actors at the micro level, of which there is a need in transition studies (Alkemade et al., 2011).

ERGMs in contrast are not actor-based, but ‘tie-based’ models of social networks. These ties are formed through a stochastic process with the probability function of a tie being formed is drawn from one of the exponential family of distributions (normal, chi-squared, exponential for instance). ERGMs can be used for both directed and undirected networks, but not (yet) for valued networks. ERGMs are mostly used to investigate cross-sectional network data (several different networks measured at a single time). This type of

research set up would favour the study of different niches over the different development stages (embryonic, proto-niche and full niche) that Lopolito et al. (2011) have described.

All in all ERGMS and SOAMs show a lot of promise for the study of transitions as they apply statistical computer modelling based on empirically observed social networks. They form an interesting hybrid between the quantitative world of computer modelling and the purely qualitative research that dominates most transition studies by using empirically observed social networks to validate and calibrate them.

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WHO IS THE POLICY-MAKER? AGENCY IN REGIONAL INNOVATION POLICY IN GREATER MANCHESTER AND THE BASQUE COUNTRY

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Keywords: innovation policy; policy dynamics; policy-maker; agency

EXTENDED ABSTRACT

There is widespread consensus that the policy landscape around the promotion of innovation-driven economic development is becoming increasingly complex, especially in a regional context. Regions can be seen as ‘policy spaces’ – stages on which the impacts of policy actions and decisions taken at different levels are played out (Uyarra and Flanagan, 2010). Innovation policies have also “broadened” and “deepened” as more – and more complicated – policies are combined from different domains (Borrás, 2009), making up complex, interacting and multi-level “policy mixes” (Flanagan et al., 2011). Finally, there has been a blurring of boundaries between public and private, political and administrative, and traditional and non-traditional actors in policy design and implementation processes, so that it is no longer clear who the ‘policy-maker’ is.

Accepting that a wide range of actors may have agency not only in innovation system processes but as active members of policy networks or even policy entrepreneurs, shaping public policies and their implementation (Flanagan et al., 2011), this paper explores multi-actor policy dynamics in two different contexts, namely the Greater Manchester conurbation in the North West of England, and the Basque Country region in Spain.

English city-regions are characterised by low levels of fiscal and administrative devolution and fragmented governance, London excepted. The competences (and instruments) relevant to innovation policy are largely held by central government. However, Greater Manchester is in the vanguard of developments to pool municipal sovereignty and in doing so win greater powers and fiscal autonomy. Central to Manchester’s economic development activities have been not only the expected government and municipal actors, universities and R&D-intensive firms - coming together in traditional but also novel and surprising constellations - but also highly influential property development companies. The Greater Manchester case is characterised by dense and overlapping governance networks in which mutual co-ordination, active collaboration but also significant tensions between these public and private actors play an increasingly important role.

This density and these tensions are also present in the Basque region, widely recognised as one of few European regions with almost complete competences in innovation policy. There is a complex combination of governmental institutions (administrations and their agencies) at different levels (regional government, provincial councils, counties, local municipalities). The region's three very different universities, key knowledge actors such as technology centres and cooperative research centres, and private companies also all play important roles in regional innovation policy making, which in addition has to deal with coordination with the central government.

By exploring these two very different but equally dynamic cases, the paper will generate reflections on the important question of who has agency in innovation policy and how this is evolving.

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ARE FINNISH REGIONAL INNOVATION CLUSTERS FRUITFUL FOR FOREIGN SUBSIDIARY INNOVATION?

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Keywords: Foreign subsidiary innovation; Embeddedness; Regional innovation clusters

EXTENDED ABSTRACT

This research will examine the importance of multinational enterprise (MNE) subsidiary embeddedness within external (i.e. suppliers, customers, research institutions, consultants) and corporate (other units of the MNE) networks when developing innovations. We study 125 innovations created by foreign MNE subsidiaries located in Finland between 1985 and 2013. The innovations were first identified through industry magazines. Second, the innovators answered to a Finnish Innovation (SFINNO) survey regarding the innovation process of the particular innovation. Innovators were being asked to evaluate the importance of their external and corporate network partners in Finland and worldwide on developing the innovation. Third, the findings are compared to the patent citation data provided by the Finnish Patent and Registration Office. Fourth, a selected number of innovators are interviewed in order to deepen our understanding of the importance of collaboration on innovation and the reasons for discrepancies of the information retrieved from these two databases. This paper aims to contribute to the theoretical and empirical understanding of the extent to which foreign MNE subsidiaries value the input of the local network partners compared to that of their own corporate networks. This should be especially interesting to policy makers in Finland, who need to understand how fruitful the local regional innovation clusters are for foreign subsidiary innovation.

Finland

Finland experienced a structural shift in the 1990s from specialisation in metal, engineering and paper manufacturing industries to include ICT and high technology products (Pentikäinen and Luukkainen, 2000). Forestry, ICT, metal and chemical industries became prominent clusters (Steinbock, 2006) and they have been accompanied more recently with new industries such as mobile games, cleantech and bioscience, all of which are driven by research and development (R&D) and innovation. In fact, R&D expenditure (% of GDP) in Finland is well above average (3.5% in 2012) compared to the other countries of the EU (mean 2.1%) (The World Bank). Largely due to its highly competent professionals and accessible innovation funding for Finnish small and medium size enterprises (SMEs), Finland has recently become an incubator for start-up companies. However, especially the role of R&D conducted by foreign firms in Finland is relatively small compared to most other European countries (Aiginger, Okko and Ylä-Anttila, 2009). Although the inward FDI stock in Finland has grown rapidly since the early 1990s, it is still 25% smaller than the outward stock

(Aiginger, Okko and Ylä-Anttila, 2009). High taxation, expensive workforce and a remote location are limiting foreign MNEs' interest towards investing in Finland. The appealing environment to local SMEs but the unattractiveness towards foreign MNEs emphasizes a schizophrenic nature of Finland to which local policy makers have not been able to react soon enough. After all, in a small open economy, such as Finland, the key policy objective is to enhance diffusion of globally developed technologies and tap into the international knowledge pool (Aiginger, Okko and Ylä-Anttila, 2009). This does not occur only through outward foreign direct investment (FDI) but also through inward FDI, which allows foreign MNEs to embed with local companies in the Finnish innovation clusters.

We examine the importance of external and corporate networks for subsidiary innovation development by utilizing the concept of embeddedness. This paper is an extended abstract so the following section only briefly discusses the literature, followed by short method and analysis sections.

Embeddedness

Modern research on embeddedness is based on Granovetter's (1985) classic piece, in which he defines embeddedness as the contextualization of economic behavior in on-going patterns of social relations (Dacin et al., 1999). Relational embeddedness stresses the importance of direct cohesive ties as a mechanism for gaining fine-grained information from other actors. MNEs are unique in a sense that they are embedded within different types of knowledge networks in their home and host countries which potentially allows them to accumulate their capabilities needed for innovation (Cantwell and Mudambi, 2005;) (see Figure 1). Therefore, it is no surprise that foreign subsidiaries have been found to be more likely engaged in collaborative arrangements for innovation than national MNEs or solely domestic companies (Tether, 2002).

While network research and the concept of embeddedness originally focused on understanding how the embeddedness of individuals influences their behavior, a similar argument has been extended to organizations (Gulati, 1998). Firms can be interconnected with other firms through a wide array of social and economic relationships, each of which can constitute a social network (Gulati 1998). Especially international business scholars have often studied embeddedness between organizations (e.g. Andersson et al. 2002) although the critics argue that organizations only exchange information through their employees, which should be the level of analysis. Therefore, while existing research has examined embeddedness either in individual or organizational levels, we examine both of these by utilizing two sources of data: patent citations and self-reported knowledge flows.

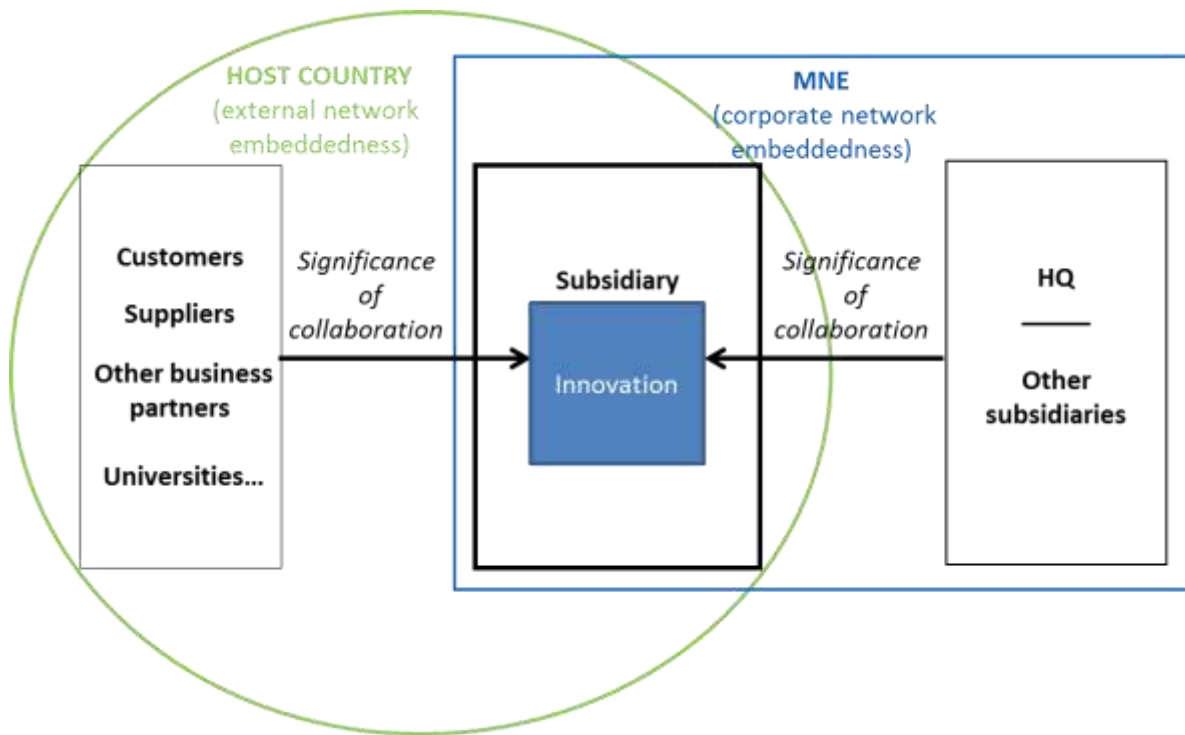


Figure 1: Subsidiary embeddedness within external and corporate networks

Data and method

Self-reported questionnaires identify the extent to which different organizational partners have contributed to the innovation development process. We examine the importance of collaboration partners of 125 innovations conducted by foreign MNE subsidiaries located in Finland. The innovation is defined as a) an improvement to an existing product, b) a significant improvement to an existing product, or c) completely new product. The data has been collected with a Finnish Innovation Survey (SFINNO) by VTT Technical Research Centre of Finland. The SFINNO database contains survey data of over 1250 innovations developed in Finland between 1985 and 2013, of which 125 had been developed by a foreign MNE subsidiary. The external partners are grouped into customers, consultants, suppliers, sub-suppliers, universities, VTT Technical Research Centre of Finland, other research institutes, competitors and other partners. Their importance is evaluated on a three score Likert-scale. The benefit of the self-reported survey is that it captures informal collaboration and tacit knowledge but it is subject to respondent bias.

Patent citation data, on the other hand, is retrieved from the Finnish Patent and Registration Office database and it examines individual-level contribution as it contains the names of individuals who are co-owners of the innovation. The limitation of this approach is that patenting is a strategic choice and hence all technological innovations may not be patented. Also patents only capture codified innovations related to production but often exclude tacit knowledge such as organizational routines (Almeida and Phene, 2004) and informal collaborations.

We take a unique approach by drawing data from both the individual level (patent citations) and unit-level (survey) embeddedness. In order to validate the findings we use data triangulation method in which we compare the findings of the survey and patent citation data with the original article through which the

innovation was identified. In addition, we interview the innovators to better understand the discrepancies between these two methods.

Analysis and results

This abstract is a research plan so only the first two steps of the analyses are completed. Thus, innovations have been identified and survey data has been collected from the innovators. The results indicate that on a scale 1 (minor significance) to 3 (great significance), domestic customers were identified as contributing more (mean 2.2) to the innovation development than domestic universities (1.8), domestic subcontractors (1.7), corporate network worldwide (1.5), domestic consultants (1.5), or other research institutes in Finland (1.3). The importance of customers was expected as it allows MNE subsidiaries to learn more about the requirements of the local market (Tether, 2002) but the smaller importance of other research institutes is surprising. Whether the domestic customers are also the most often cited partners in the patent application will be the next step to explore in this research.

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THE ROLE OF POLICY IN REGIONAL PATH CREATION: A COMPARISON OF NEW MEDIA AND BIOGAS IN SOUTHERN SWEDEN

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Keywords: regional policy, regional innovation systems, new path creation, cluster evolution

EXTENDED ABSTRACT

Over the past years, there has been a growing interest in economic geography and related disciplines in forms and determinants of new regional industrial path development (Martin and Sunley 2006; Boschma and Frenken 2011). Recent scholarly work on path renewal and new path creation has essentially enhanced our understanding of industrial change processes and the nature of path development activities at the regional scale (Garud, Kumaraswamy and Karnøe 2010; Simmie 2012; Dawley 2014). Little is known, however, about the role of policy in the emergence and development of new regional growth paths. The importance of policy interventions has received little attention so far in conceptual models and empirical analyses of regional path development (Trippl et al. forthcoming). The aim of this paper is to provide insights into the scope of policy-supported and policy-led regional industrial path development. We extend current evolutionary models of path development with an institutional perspective that enables us to discuss in a conceptual way the potentials for policy-initiated new development paths.

In the empirical part of the paper, we analyse the role of policy in the emergence and development of new industrial growth paths in Scania, Sweden's most southern province. Based on personal interviews with policy makers, representatives from supporting organizations and firms as well as a document analysis, we investigate how policy interventions and initiatives at various spatial scales have influenced the rise and evolution of two clusters, namely biogas and new media. While the first is part of the cleantech industries, the latter is considered as creative industry (Martin and Moodysson 2011; Martin and Coenen 2014). Even though the two industries have little in common when it comes to organizational structures, modes of innovation and knowledge bases, policy-led initiatives have played an important role in enabling new path creation in both cases.

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WHAT MAKES THE DIFFERENCE? ANALYSING THE REGIONAL COMPONENT OF THE INFLUENCE OF UNIVERSITY'S STRUCTURAL CONFIGURATION ON ITS PERFORMANCE

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EXTENDED ABSTRACT

Following an recent explosion of interest on the role of universities in regional development, there is a tendency to assert that contributing to regional development represents a (novel) third mission for universities alongside their traditional first (teaching) and second (research) missions. In the context of economic development, universities' general-abstract roles in creating, transmitting, circulating, extended and phasing out knowledge has become linked with their capacity to fix that knowledge in specific ways and allow its exploitation to create particular regional development benefits. There is therefore increasing interest in optimising these roles, maximising universities' specific regional contributions without undermining their ability to pursue independent scholarship and research in networks that extend beyond the region.

But missions cannot always seamlessly fit together (Pinheiro et al., 2012), particularly when this demands that universities strike a balance between making their knowledge most immediately useful for users and in serving their core teaching and research goals. This highlights the tensions between the general and specific aspects of universities' missions, between potential to build regional development activities and fitting them harmoniously into core university activities. Engaging with non-academic actors can create *prima facie* problems and tensions for a university, and we contend that more attention needs to be paid to how universities structure themselves to balance these tensions in delivering regional benefits. To date research into this problematic has split between small-scale case studies of particular organisational forms alongside quantitative analyses of which kinds of universities produce regional outputs.

We seek to bring quantitative clarity to this issue of universities' internal diversity by focusing on universities' structural and policy configuration for engagement Benneworth et al. (2014). We conceptualise these in terms of (a) formal management choices to promote regional engagement, such as the steering core, related to the leadership and strategy of each university; (b) the administrative machinery, rules, procedures and incentives that exist at institutional level to impulse knowledge transfer activities and social engagement at regional level; (c) the internal coupling, internal structures or departments for specific connection

mechanisms with non-academic agents the support structures; and (d) academic heartland, covering collective specificities of individual academics engaged with regional agents at different levels.

Our overarching question is how universities' internal organisational dynamics and structural configurations affect the production of regional outputs, according to two difficult models of university outputs (roughly corresponding to the breadth of regional mission envisaged by the university for itself): the entrepreneurial university -EU- and the regional innovation system university -RISU- (Trippel et al., 2014). The entrepreneurial university model claims universities promote regional development by engaging in patenting, licensing and academic spin-off activities, while the RISU model considers a broader spectrum of university activities, including contract research, research collaborations and informal industrial networking.

We answer this using a quantitative analysis drawing on the UK's HE-BCI survey of university engagement activities. Our analyses uses structural equation modelling to explore how these four kinds of internal structures affect the production of third mission outputs (EU vs. RISU). Our empirical results show the importance of the internal organizational configuration analysed, being the internal coupling the construct that further explains the diversity of UK university's structures. Nevertheless, the configuration of internal coupling varies between the EU and the RIS model: while in the first is composed only by the in-house license office/department, in the RIS model this department is combined also with other intermediary structures, such as those supporting the interaction with business and community, to facilitate and guarantee the successful transfer of technology to industry. In relation to the influence of internal configuration on university outputs, the steering core and the administrative machinery influence them in both the EU and the RIS university model, the latest being specifically relevant at the regional level (related to the importance of proximity where universities magnify the benefits of short distances). Internal coupling is specifically negatively influencing outputs in the EU model, a surprising result given the importance of intermediary mechanisms as the technology transfer offices (TTOs) to overcome communication barriers and effectively link academic scientist and those who could potentially commercialise research under this model. While policy makers and university managers are often quite optimistic about the impact of TTO in fostering technology transfer into the region, results presented here are in accordance with those that evidence their superfluous and counterproductive activities. Lastly, our results also suggest that more researchers (academic heartland) involved in academic engagement are not translated into an increment of performance in either university model.

Our paper demonstrates firstly that structural university configuration affects the ways in which universities produce their regional outputs, and that it is useful to analyse how other university models (besides EU vs. RISU) create regional benefits. Arguably more importantly, our results demonstrate empirically that our conceptual distinction represents a promising theoretical avenue for further exploration. Finally, we argue that given this structural difference, policies makers should consider how to tailor regional engagement policies to stimulate not merely the delivery of outputs, but also support the structural configurations best suited for their delivery.

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SMART SPECIALISATION FOR ECONOMIC CHANGE: THE CASE OF SPAIN

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Keywords: Smart Specialisation; innovation policy; Spain

EXTENDED ABSTRACT

Statement of the research problem

The concept of smart specialization comes from reflection generated around the structural "gap" between Europe and the USA (Pontikakis et al. 2009), as result of a lower economic and technological specialization and less ability to prioritize and to dedicate consistent efforts at the regional level.

Smart specialization is a territorial development model initiated mainly by authors that currently advise the Commission itself (Foray et al., 2009, Foray 2009 and McCann and Ortega-Argilés 2011). It can be summarized as *“the prioritizing that takes place at a territorial level in economic activities, scientific areas and technological domains that are potentially competitive and generators of new market opportunities in a global context versus the prioritizing that other territories carry out”* (Del Castillo et al. 2012).

Smart specialisation has been established as one of the conditionalities for accessing the ERDF in this programming period 2014 -2020 in the shape of Smart Specialisation Strategies –RIS3” (EC 2013 and EC2011). Thus, European regions carried out a process of definition of these strategies that ended recently with the beginning of the new programming period 2014-2020. These processes accounted for a number of risk and problems pointed out by Paton, J. y Barroeta, B. (2012) that will inevitably determine the success of the implementation stage.

The objective of this paper is to analyse these risks and assess the starting point of the implementation stage of the RIS3 strategies for the case of Spanish regions. More specifically, the research questions proposed are the following:

1. Do the priorities chosen in the RIS3 strategies represent the real territorial specialisation patterns?
2. What kind of policy objectives have the Strategies included?
3. What kind of policy instruments have the Strategies included for implementation?
4. Do the evaluation, monitoring and governance process reflect the postulated proposed by EC?
5. What are the main conclusions regarding RIS3 versus RIS Strategies?

Methods and data

Research has combined a twofold approach: a first one focused on a quantitative analysis to compare the specialisation priorities included in the Spanish RIS3 to the “real” (statistical) territorial specialisation pattern obtained by extended economic agglomeration mapping methodologies. A second one focused on a qualitative analysis to gather information about policy objectives and measures, monitoring and evaluation systems as well as the governance process included for the implementation stage until 2020.

- Quantitative data: statistical data from Spanish National Statistics Institute (INE) on number of establishments, GDP, employment and Input-Output regional economic accounts (www.ine.es)
- Quantitative method: specialisation pattern mapping following Del Castillo and Paton (2012), MacCann and Ortega Argiles (2011) and Frenken et al. (2007)
- Qualitative data: all the regional RIS3 in Spain available from the Spanish Ministry of Finance and Public Administration (MINHAP) (<http://www.dgfc.spgg.meh.es/sitios/dgfc/>) and each regional website for smart specialisation.
- Qualitative method: benchmarking analysis

Stage of research

The research is currently finished. It includes a detailed analysis of the regional RIS3 strategies included in the Spanish Partnership Agreement 2014-2020 (end of 2014) in terms of the 5 research questions stated in the “research problem”, as well as an assessment of each category to the recommendations initially proposed by EC in Regulations (EU) N° 1303/2013 of the Parliament and the Council.

Nevertheless, further research will may include a deep analysis of the implications on a good implementation process, and specially a further research on the governance and monitoring of RIS3 Strategies. This research is in fact another paper that is currently under development (Del Castillo et al. 2015).

Results achieved and further research

Next, there are some of the main results achieved regarding the analysis of the specialisation pattern and RIS3 economic and technology priorities (table 1 and table 2), policy objectives (table 3) and policy instruments (table 4).

Table 1 Number of regions in Spain by type of technological priority included in the RIS3 2014-2020

Type of priority	Technology domains (KETs(Num. of regions in Spain (RIS3 priorities)
Technological priority (technology domains of specialisation)	Biotechnology	16
	Nanotechnology	8
	Photonics	5
	Microelectronic	3
	Advanced Materials	11
	Advanced Manufacturing	14
	ICT	17

Table 2 Number of regions in Spain by type of economic priority included in the RIS3 2014-2020

Type of priority	Economic sectors	Num. of regions in Spain (RIS3 priorities)	Level of specialisation identifies (Coef. Spec.)
Economic priority	Agroindustry	16	10

(sectors of specialisation)	Textile and fashion industry	7	4
	Chemical industry	5	3
	Metal manufacturing	6	8
	Machinery and equipment industry	6	7
	ICT and electronic devices	9	3
	Automotive industry	12	8
	Aerospace industry	5	6
	Naval industry	5	6
	Energy generation and distribution	15	9
	Habitat and construction	5	10
	Environmental activities	15	7
	Transport and logistic activities	10	6
	Tourism activities	13	7
	Experience activities	10	5
	Health industry	10	4
Wellness activities	14	3	

Table 3 Number of regions in Spain by type of policy area included in the RIS3 2014-2020

	Business competitiveness and R&D	Science and technology promotion	Diversification of current economic areas	SMEs policy (specific support)	Internationalisation	Education, training and talent support	Social innovation	Sustainability & environment	Networks and cooperation (incl. clusters)	ICT and Digital Agenda	Entrepreneurship (incl. entrep. discovery)	Competitiveness and R&D infrastructures
Num. regions in Spain	12	12	3	7	13	13	6	7	10	8	11	7

Table 4 Number of regions in Spain by type of policy instrument included in the IS3 2014-2020

Type of support	Policy Instrument	Num. of regions in Spain
Regulations (legal framework)	Standards and certification regulations	3
	Fiscal framework (taxes etc.)	3
	Labour framework (labour legislation)	1
	Public Procurement	12
Financial support	Grants	12
	Financial agreements	4
	Vouchers	5
	Regional incentives	4
	Loans	1
	Microcredits	7
	Guarantees	4
	Venture capital	10
	Crowdfunding	1
	Initial Public Offers (IPO)	1
Non-financial support	Incubators (Business Innovation Centres – BICs)	5
	Business accelerators	3
	Cluster associations	9
	Living labs	3
	Thematic networks and platforms	12

Type of support	Policy Instrument	Num. of regions in Spain
	Thematic observatories	6
	Technology transfer offices (TTO)	9
	Technology Centres/ R&D Centres	7
	Technology service centres	2
	Science and Technology Parks/ Innovation Poles	3

Regarding monitoring (indicators) and governance mechanisms, we will considered them in the full paper, but they are not included in the abstract due to the limitation on the number of words.

Main issues concerning RIS3 strategies in Spain lay in a broad inclusion of many priorities and a certain level of "tradition" choosing the policy instruments. In parallel, monitoring systems are designed vaguely (too broad indicators, as well as a lack of a "logic of intervention") and the governance process reflects more a "intention to be" than a "factual reality". However, we consider it as a very interesting process, where many regional authorities have included some of the key issues that may lead them to improve progressively their policies during the next seven years.

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SMART SPECIALISATION IN SMALL, YOUNG, PERIPHERAL NATIONS; INSIGHTS FROM WALES AND ESTONIA

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EXTENDED ABSTRACT

Smart specialization has become an important part of the general EU innovation and economic development policy, and member countries and regions are obliged to integrate the concept into their local policy making context (EUROPEAN COMMISSION, 2013). Whilst common guidelines are provided as to how these Research and Innovation Strategies for Smart Specialisation (known as RIS3) should be formulated (FORAY, ET AL., 2011), the approaches adopted in different places are likely to be shaped by the specific regional economic contexts, and the institutional and governance contexts within which they are being applied (MCCANN AND ORTEGA-ARGILÉS, 2014). This paper aims to investigate this phenomenon, recognised by McCann & Ortega-Argiles, with reference to a particular type of geographical setting: that of smaller, peripheral, and “young” nations. What exactly is meant by this categorisation developed fully in the paper, and the rationale is a realisation of the common challenges and issues faced by two cases of such territories when attempting to implement the smart specialisation approach.

The broad aim of this paper is to build up the body of empirical observations of the smart specialisation movement gaining momentum across Europe. At the current time, there is a rapidly growing body of work about this latest innovation and regional policy trend (FORAY, ET AL., 2011; MCCANN AND ORTEGA-ARGILES, 2013; MCCANN AND ORTEGA-ARGILÉS, 2014), but as of yet still relatively few empirical examples of nations or regions implementing smart specialisation. The paper is looking at the formation of local smart specialization strategies and how the concept is implemented in and translated to specific local policy contexts. It examines a particular regional setting that is not always well explored in the innovation literature: that of economically less favoured regions, which are located in the European periphery and have fairly short histories as autonomous and economic policy-making entities. The cases selected are Wales, a small country on the Western side of the UK, and Estonia, an even smaller country on the North-Eastern periphery of

Europe. Whilst on the surface, the two cases employed here might look very different, there are in fact a number of commonalities in their experiences of operationalising smart specialisation that can provide some interesting insights about the concept itself and the diverse regional contexts within which it is currently being employed across Europe. It is the fundamental basis of this paper that we can learn much from cross-case policy comparisons that can shed light on a policy or issue with more strength than a single, isolated case study.

As such, this paper consists of a comparative case study of research and innovation policy development in these two countries. Both are small nations of less than three million people, located on the opposite peripheries of Europe, with relatively young constitutions. They are both also relatively weak and dependent economies in the European sense, receiving the highest level of regional convergence support from Europe due to their situation of a GDP per capita of less than 75% of the European average. In both cases, also a short history of their approaches to innovation and economic development since independence/ devolution is provided, which explains the trajectory to the present day when smart specialisation strategies are being implemented in both countries.

Methodologically, the case study approach (see: EISENHARDT, 1989; YIN, 1993, 1994, 2003; EISENHARDT AND GRAEBNER, 2007; SIMONS, 2009) is followed, using a combination of methods including document analysis, policy review, and interviews to build up a picture of innovation policy practice in both countries. These case studies were then combined into a comparison, with key themes drawn out inductively as contrasts and similarities emerged. As a result, a set of key insights about the translation of the smart specialisation concept from the European to local level, in the small-peripheral-young country context have been produced.

This paper is structured as follows. Firstly, a theoretical background to the idea of smart specialisation, and indeed innovation and regional policy more generally is provided. This covers the important and inter-related existing research on innovation policy, small state theory, and policy transfer theory, all of which are important to understand the analysis presented. This is followed by an introduction to the two case studies presented, providing some background information about the two and also a short history to explain how the current political and economic situation was arrived at. Next is the methodology section, which explains the empirical research conducted and the rationale behind doing so. In the analysis and discussion section the main insights derived from conducting and combining the two case studies are presented, and the similarities and differences between the two drawn out in order to discuss the characteristics of the emergence of smart specialisation in these settings. Finally, some wider discussion of the key findings is provided, which draws out the pertinent points that are relevant beyond the two case studies presented here, and could help us better understand smart specialisation in diverse regional contexts.

A number of interesting and similar issues are being experienced by both countries in their application of smart specialisation, and indeed their trajectories are looking increasingly similar as the agenda progresses. Specifically, this paper finds that the two countries are specialising in remarkably similar areas and pursuing surprisingly similar strategies in direct contrast to the central edict of the smart specialisation approach that it will reduce duplication and competition between European regions. The comparative case study has spurred a realisation that the same issues and barriers may be faced by similar countries of a small, weak, and peripheral nature within the EU, and that their needs and experiences could be quite different from their dominant and economically successful neighbours. To better understand these processes we call for more profound research that this study is trying to provide by identifying and analysing the underlying links and challenges in the translation of a policy concept developed at a supranational level to the local context.

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SECTORAL R&D SPECIALISATION AND INDUSTRIAL POLICY TARGETING IN SMALL COUNTRIES

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EXTENDED ABSTRACT

The debate on R&D policies in Europe has concentrated recently on smart specialisation. This concept of industrial policy is aiming for better alignment to the key advantages of regional economies thus leading to larger impact, but also increasing sustainability of R&D activities (McCann, Ortega-Argilés 2011). The selection of specialisation areas enables to focus and coordinate broader set of policy measures. These focuses of R&D policies are traditionally selected based on the sector or value chain (vertically) or based of functions or activities like exports, marketing, R&D etc (horizontally).

The barriers to innovation may be revealed at the sectorial level, but the solutions are requiring broader policy approach (Edquist et al. 2004). Empirical evidence from East Asian countries is pointing to the success of more targeted industrial policies (Chang 2006). Smart specialisation (Foray 2009) can imply even narrower targeting if the stakeholders select specific needs for public intervention with so-called bottom-up approach. It is argued that by not specialising on their (economic) strengths, the lower income countries may enter vicious circle triggered by Mathew effect and fall further behind (ibid.).

Additional reasons for switching to more specifically targeted innovation policies are related to the lower success of cluster policies than expected, because the globalisation processes seemed to have weakened traditional clusters (Hämäläinen 2010). Policy implementation plays also relevant role in the realisation of strategic targets, because besides specific vertically oriented measures or smart specialisation areas, the appropriate setting of horizontal measures by using proper selection criteria for competitive R&D projects may not be aligned to targeted sectors.

Our interest in this article lies in studying public and private co-specialisation in R&D in small countries, which tries to capture the whole set of measures targeted to sectoral R&D activities and the dynamic short-term outcomes of different funding mechanisms. We study small countries as they are discouraged to focus too narrowly on the local strengths, while risking the isolation internationally in other R&D activities, but the diffusion of the public and private R&D investments among many fields may result in limited capacity yielding stronger impact in any of those fields. Small countries without broad

technological base, extensive R&D resources and infrastructure, no multinational enterprises based in the country, run the risk of being marginalised in the competition (Davenport, Bibby 1999). Earlier research finds lack of thematically targeted or goal-oriented R&D policy in small countries, often also top-down process without specific mechanisms for new emerging areas (Thorsteinsdóttir, 2000; Masso, Ukrainski, 2009), but in others, rather bottom-up approach is seen with stronger foresight present (Meyer, 2009).

Data and methodology

We use sectoral R&D expenditure data as well as government outlays (GBOARD) data from EUROSTAT database along with countries' strategy documents for identifying the targeted areas and specialisation results of sectorial R&D. We apply the methodology proposed by Dinges et al. (2007) for monitoring this sectoral specialisation of R&D activities. More specifically, revealed comparative advantage (RCA) index is applied and elaborated further by normalizing the values with respect to the EU average indicators. Based on the private and public sector R&D specialization indicators, Dinges et al. (2007) propose a methodology for empirical research bringing out in a matrix form four groups of sectors:

1) Sectors with strong public and private business R&D specialisation. From the point of view of policy, it is focusing on supporting the strongest sectors of a country. However, it has been found that the critical factor differentiating between the countries of successful and not successful industrial policies is that the former are concentrating rather on supporting the weak sectors (Rodrik 2004).

2) Sectors with neither specialisation in public and private R&D in respective country. The appropriate questions to ask is, are these irrelevant sectors or neglected for some reasons, but also are these sectors expecting further decline or would it be possible to rejuvenate these sectors?

3) Sectors with public R&D specialisation, but weak private R&D should be regarded as deserving a strategic interest or other relevant factor, why these sectors are supported by public funding.

4) Sectors with private R&D specialisation, but no public R&D. Here the explanation could be that this situation might be the result of past public R&D support, but also some other types of advantages (as monopoly market power etc.).

Preliminary results

By summarizing preliminary calculations, one can say that in case of Finland, public R&D support is given to strong sectors of the country (type 1 above), but also to some weaker and smaller sectors in terms of employment (type 3). In Estonian case, clearly, the main strategy has been on supporting the stronger sectors (type 1); the only exceptions are health care and chemicals. The other countries do not have so clear patterns, but in case of Cyprus and Malta one can note, that the sectors that receive public R&D funding seem to deviate from EU average quite strongly, which can also be explained that the fields are some niches in EU comparison.

The results reveal that the policy priorities and business R&D specialization are aligned quite differently in small countries and it is far from a perfect compliance. In Finland country priorities in R&D match better with the sectors of both public and private specialization (pulp and paper industry, metal

industry and machinery, equipment etc.). One can also explain this by long-term complementarity of public and private R&D investments. In Estonia, the case seems to be rather different. The country's strengths in R&D seem to be in infrastructure and services, but also in food industry, which were not among the targeted ones in strategy documents.

Additional factors that influence R&D specialization mismatch can be outlined:

1) The discrepancies between the existing knowledge base in countries and the needs of the economy. The cooperation between local universities and business is often at quite modest level, the possible reasons being the lower innovation capability of enterprises on the one side and sectoral misalignment of public research infrastructure.

2) Different countries are in practice often trying to specialize in the same fields, like bio and nano fields, which are not their strongest sectors economically.

3) In latter case, competitive processes behind the horizontal measures seem to compensate for this misalignment of strategic aims.

The methodology has some shortcomings:

- This kind of analysis is limited substantially by the data availability on sectoral R&D expenditure (for this reason, Luxembourg, Netherlands and Latvia cannot be included in the analysis).

- Only direct R&D investments are considered. Indirect measures (as for example, tax incentives etc.) can be quite extensive in some countries.

- The analysis is restricted by the confidentiality of the data on larger R&D investments, e.g. in case of Estonia, the data manufacturing of the coke and refined petroleum products are not given, but based on secondary sources can be estimated up to 20% from total R&D business expenditures in 2010. Therefore, we have to maintain here that the analysis presented reflects more accurately the industries, where R&D expenditures are aggregated from many smaller firms.

- The GBOARD data help to complement the specialisation analysis by showing the government outlays to R&D activities across broader economic sectors, also the data quality seems to be questionable for some countries, e.g. Estonia.

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THE SCIENTIFIC BASIS FOR SMART SPECIALISATION IN EUROPE

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Keywords: smart specialisation, indicators, scientific knowledge dynamics, path dependency, innovation policy.

EXTENDED ABSTRACT

‘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?

The notion that cities and regions should specialise thus seems intuitive. Regions cannot be good at everything, they must concentrate on what they are best at – that is, on their comparative advantage. And of course, cities and regions do specialise. The cumulative and path-dependent character of knowledge production makes it also place-dependent (Heimeriks & Boschma, 2014). This implies that locations for research are likely to specialise over time.

But, according to Hausmann the idea that cities and regions actually do specialise, and that therefore they should specialise, is a very wrong and dangerous idea (Hausmann, 2013). Hausmann argues that specialisation at the individual level actually leads to diversification at a higher level. It is precisely because organisations specialise that cities and regions diversify. This diversification leads to new innovation

opportunities. Indeed, it has been shown that the diversity of capabilities of regions and countries contributes to economic growth (Hidalgo et al., 2007).

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 geographical level these specialisation processes occur. 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 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 within the scientific fields for over a period of time.

In the first stage, 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. Are regions meaningful units of analysis? 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, related knowledge to the existing portfolio?

Additionally, we look at the smart specialisation strategies as formulated by European regions. How does this compare to the knowledge base as visible in publication data? Does the presence of industry in publication data provide additional insights?

Finally, we will articulate evidence based smart 'smart specialisation' policies that reflect the abilities of regions to diversify their knowledge base

Data and Methods

Our objective is to understand the specialisation patterns in knowledge production at different locations in Europe. The starting point of this analysis is the idea that the dynamics of scientific knowledge are path and place dependent (Heimeriks & Boschma, 2014), and that the current research portfolio of a region influences the further capacity to produce knowledge. More specifically, we aim to evaluate the impact of scientific relatedness on the patterns of specialisation at the regional level. Our methodology follows the "product space" framework in order to understand the uneven development of countries (Hausmann and Hidalgo, 2009; Hidalgo et al., 2007). In this paper, we apply the product space framework to scientific knowledge dynamics, and our 2-mode network is based on pairs of city-topics constructed from publication records over a period of time.

Publication data are retrieved from the ISI Web of Science. The data contains the addresses as identified by the ISI Web of Science. The database thus enables us to specify the number of publications and their topics (as indicated by keywords) of all locations over a period of time. As such, the data allows us to study the rise and fall of regions in co-evolution with the changing topics of research. Papers with multiple addresses were fully attributed to each location.

Analysing the level of average scientific coherence requires three main steps (Boschma et al., 2014). Scientific coherence describe, on average, how similar (understood as scientifically related) are the topics in which a city is active. At the city level, it comes close to the concept of specialisation, while aggregated at the field level it reveals patterns of path and place dependence in the process of knowledge dynamics (Kogler et al., 2013).

First, one needs to measure the scientific relatedness among key-words in a specific field. In this paper, we use a simple and normalised measure of relatedness based on the co-occurrences of key words within journal articles. We use the Jaccard index to account for the number of occurrences of each key-word. In a second step, we create a city-topic level variable "*relatedness density*" that combines the information given by the relatedness $\mathcal{P}_{i,j,t}$ between topics with the scientific activity of cities, i.e. the set of topics on which they publish. In a third step, we compute the scientific coherence of each city, which is simply the average relatedness density of all topics that can be found in the scientific portfolio of a given region.

Based on these indicators of (1) entry/exit/maintenance rate and (2) our measure of scientific coherence we then analyse the dynamics of scientific knowledge with a particular focus on patterns of specialisation and path-dependence in knowledge evolution.

In order to assess the ability of regions to articulate smart specialisation strategies in light of their existing knowledge base, we systematically analyse the content of the S3 platform¹ on smart specialisation. The regional strategies as described in the S3 Platform enable us to perform a systematic content analysis of the combined strategies in the database. Quantitative methods will be used to match keywords in the policy documents with the content of scientific publications to determine the patterns of correlation between scientific output of regions and the articulated policy strategies. Qualitative discourse analysis will help us to understand the biases in policy preferences in relation to knowledge production.

Comparison of policy strategies with the observed specialisations in scientific publications through quantitative measuring and qualitative understanding (Leydesdorff & Wouters 1996), allows us to assess the possibilities for increasingly evidence based policy using performance measurement tools and its effects of this evaluation culture on knowledge production and policy making.

The results contribute to articulating evidence based smart 'smart specialisation' policies that reflect the abilities of regions to diversify their knowledge base. An in depth case study provides additional insights in applying bench-mark evidence and methodologies to obtain detailed information on the mechanisms behind specialisation patterns.

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SOCIAL AND CULTURAL INNOVATIONS AS PILLARS OF FUTURE-MINDED CREATIVE CITY DEVELOPMENT SYSTEMS

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Keywords: Social Innovation; Creative Urban Development

EXTENDED ABSTRACT

The paper proposal below is intended to be submitted to the EU-SPRI Special Track of “ Social Innovation futures: Beyond Policy Panacea and Conceptual Ambiguity”. Since the focus of our research is twofold: on the one hand we try to clarify the term of social innovation extended to the field of cultural innovation relying on a thorough literature review with a special attention to sustainable urban development and creative cities. While on the other hand, we try to operationalize – “translate to down to earth, every day life” – these notions by the help of qualitative empirical research based on document analysis, field research and structured interviews. Finally we propose a hypothetical horizontal, inter-sectoral “future-minded” and creative urban development policy system where “bottom-up”, spontaneous and decentralized social and cultural innovation initiatives can meet the “top-down”, regularly centralized, urban development planning and policy. The recently started research is in the preparatory-exploratory phase, having done already some case studies to back our argumentation.

Cities and the development of human civilizations are intertwined, past, present and future. Cities have been the cradles of great civilizations and cultures for thousands years, from Uruk in the Fertile Crescent through the Inca Machu Picchu to the European Venice. Cities host more people (54%) today than rural areas and according to the latest world population prognosis of the UN they will be the home of the majority of people (66%) globally by 2050 (UN WUP, 2014). Cities are complex systems in their physical-material and metaphysical-immaterial meaning. As for the latest, the above mentioned ancient city “states” had already complex economic, social and political-governmental systems to govern and manage the everyday life of many thousands living in these early urbanized places. Cities have been “markets”, meeting points and places of various material and immaterial transactions, from commodities through services to the exchange of ideas and knowledge. They agglomerate the economic and political power as well as give birth to new, innovative and creative ideas. As Landry says “the city provides a critical mass. It is an accelerator of opportunities and a generator of problems. It is a laboratory for what is good and bad about living together” (Landry, 2012:126). Accepting his view we consider cities as permanent laboratories of innovations, especially important for us, social and cultural innovations. We assume that without them, cities would not

exist – at all – and survive, since their generated – multi-faceted – problems would overrun the living (surviving) opportunities. Moreover, we assume that culture and cultural innovations are quintessential elements, basis of a creative city, present and future. In principle, every individual and each city can be creative if they are exploratory and open, opportunity seeking, supportive and deliberative enough (Landry, 2012). However, as we mentioned already, cities are very complex systems, full of individuals and organizations with different views and interests, even about planning and developing “sustainable and creative cities”. Therefore – agreeing with Landry (2012) – it is very important what kind of negotiation and mediation takes place in the urban development policy process to meet the “bottom-up”, spontaneous and decentralized social and cultural innovation initiatives with the “top-down”, centralized – and presumably coherent – urban development planning and policy.

Despite the growing number of empirical research programs and theoretical overviews of the last decade (Cameron et al., 2004; Deakin and Allwinkle, 2007, Mumford, 2002; Moulaert and Ailenei, 2005) the author – personally – still can witness a “technological bias” both in the interpretation and application of innovation among university scholars and professional experts generally, and in the field of urban development particularly. Social innovation – and additionally, as a new term – cultural innovation unfortunately have received less attention, despite their essential role in integrated and sustainable urban development, rehabilitation and regeneration programs. Many case study examples from recent literature (Gerometta et.al, 2005; Moulaert et.al, 2005; Deakin and Allwinkle, 2007; Cameron et al., 2004; Landorf, 2011) parallel with empirical evidence gained so far from field study research strengthened our view that the narrowly technology minded and driven technocratic approach in urban development policies and regeneration programs can lead to ambiguous, in extreme cases to counter effective results. While in the last decades, after transition, there have been mushrooming original, grass root, bottom-up and spontaneous social and cultural innovations having serious impact on local development processes, most importantly on the life and well being of local communities either on micro (and) or macro level.

Since these initiatives and their role in sustainable urban development are rather under investigated in Hungary and Budapest, in this paper we take some steps to fulfil this gap. In the first part we attempt to overview the widespread scholarly debate on the notions of social (and cultural) innovations and their relation to sustainable local development, creative cities, social economy and civil society. Then we try to find empirical evidence for their impact using a case study approach based on documentary and field research in the second part.

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ANALYSING, UNDERSTANDING AND SHAPING SOCIAL INNOVATION: THE EXAMPLE OF 100 YEARS SOCIAL HOUSING IN THE CITY OF VIENNA

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Keywords: Social Innovation; social housing; marginalised groups; cognitive frames; institutions; social grid; social networks

EXTENDED ABSTRACT

Technological innovation has been identified as one of the most important drivers of progress, economic growth and well-being in the last decades (Nelson and Winter 1982, Dosi 1984, Metcalfe 1997). Recently, the phenomenon of social innovation has been identified as an important factor, too, reaching almost the same significance as technological innovation (Nicholls and Murdoch 2011). Interestingly, in many cases both technological and social innovations go hand in hand. What is more, technological and social innovation experience similar phases of developments and life cycles.

In this paper we want to show the co-development and at the same time the contrasting dynamics of technological social and organizational innovation. The recognition of social innovation though is less connected to economic growth than to networks, resilience and well-being (Westley 2013). Such notions gain more popularity as the credo of unlimited economic growth stimulated by technological innovation shows unequivocal signs of failure. The question is if and how the three (technological, organizational and social innovation) fit together and what we can learn from the study of technological innovation to influence the positive outcomes of social and also organizational innovation. To do this, we will utilise a life-cycle-approach, helping to analyse how an innovation starts from a niche position, becomes a regime and finally reaches the status of a “landscape” or social transformation (Geels and Schot 2007).

For a more adequate analysis of such research topics we will take a look at a long-term case study: social housing over the last one hundred years. 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 study how social innovation was able to reintegrate economically marginalized parts of the population into society and economic participation. Theoretically, our paper relates to Sen’s (1979) capability approach and Beckert’s (2010) social grid model. Beckert noted 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. He 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. Because the formation of such grids, and hence also of information, is not a neutral process, this paper will also draw conceptually on the Capabilities Approach (CA) to human development and empowerment pioneered by Sen and Nussbaum to explore the economic effects of social innovation processes on marginalized populations. As the CA already plays an influential role in framing the discussion of growth and human development amongst the poor at local, national, and international levels, this approach also fits well towards a systemic understanding of social innovation at the socio-cultural and economic levels. As such it will offer micro-level explanatory theory with which to enhance and test the macro-level analyses carried out with the Beckert framework. In particular, this project will draw on this CA for a fine-grained understanding of the people most vulnerable and marginalized from exchange structures by current economic institutions.

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. The case also relates to technological innovation, at the beginning born out of sheer despair (e.g. rationalisation in built construction and construction material, household technologies) (Novy/Förster 1991). 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 not only discuss the relations between technological, organisational and social innovation but also how to govern social innovation in order to build a more resilient society, especially improving the living situation of marginalized groups in our society - in the past, the present and the future. Historical evidence and socio-economic theory will discuss against the background of the Beckert framework:

- How social networks, for examples the Vienna grass root settler's movement of the mariginalized, those out of homes and jobs, after WWI established collective power to shape institutions, such as cooperatives (Förster 1980);
- vice versa, how the emerging institutions influenced structure of social networks in the long run and reinforced the grass root movement which in part was institutionalized in the social-democratic party of the 1920s; several technical innovations in housing construction contributed to this institutionalization;
- how these social networks shaped and diffused cognitive frames of what it meant to spread the mind sets also into other institutions as common crafts shops, education, child care, cultural activities, often designed to circumvent liberal market mechanisms;
- how cognitive frames shaped the perception of social networks and gave the marginalized an ideological base and a consciousness as a social class to be entitled to take politics into their own hand to shape the path of development toward a better future;

- how cognitive frames provided legitimation and shaped the perception of institutions as belonging to the working class which determined until today the practice of community housing in Vienna and served as a model beyond city limits and for other cities and national policies;
- how institutions made values relevant for cognitive frames and for example shaped several laws to establish longer-term reallocation of taxes from the wealthy class to social housing projects.

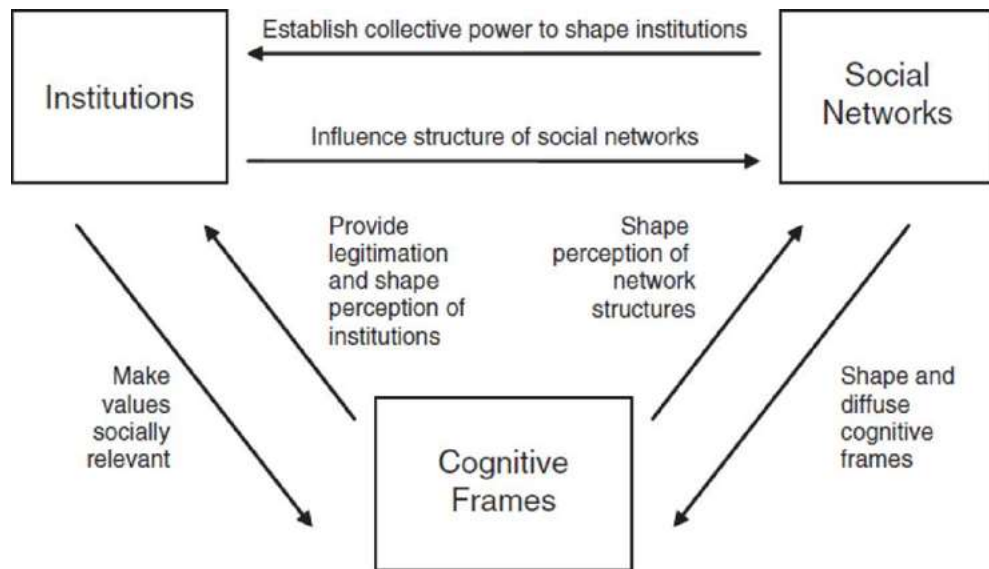


Figure 1: The Social Grid (source: Beckert 2010)

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.

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SOCIAL INNOVATION AND SOCIETAL CHALLENGES: RE-FRAMING THE CONCEPT AND PRACTICE OF ASSISTED LIVING IN BRITAIN AND NORWAY

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Keywords: Social Innovation, Challenge-driven Innovation Policy, Transition Theory

EXTENDED ABSTRACT

The field of innovation studies is in a deep state of flux. Conventional models of innovation based on the STI paradigm are no longer deemed sufficient for the era of societal challenges and mission-led research. Alternative models, most notably that of social innovation, have started to appear on policy agendas. It seems however that conceptual ties between social innovation and conventional models of innovation are only weakly developed or remain largely absent. Moreover the new models emerging remain difficult to translate into policy.

This paper seeks to address this problem by applying a number of new theoretical perspectives - including social innovation, socio-technical transitions and embedded state theory - to one of the most pressing of all the societal challenges, namely how to fashion an active and healthy ageing society. There is widespread recognition that current systems of health care provision are in need of drastic reform to address prevalent persistent problems of explosive cost increase in combination with declining quality delivery. It is no longer sufficient to merely increase productivity in the provision of existing public health services. Rather, observers call for fundamental changes to re-think and re-arrange how health care services are organized and delivered. This implies that public health service innovation requires a mix of both social and technological innovation.

Despite its resonance with policy-makers, it is probably fair to conclude that at present social innovation remains a chaotic concept (Martin and Sunley, 2003). Based on an extensive review of the literature, Benneworth et al. (2014, p.7) conclude that “the current social innovation paradigm covers a range of very different activities involving very different underpinning processes oriented towards very different kinds of societal change”. To bring more clarity and rigour to the concept of social innovation, we therefore explore how the literature on socio-technical transitions, and the Strategic Niche Management approach in particular, can be resourcefully mobilized to make sense of this concept in search of a theory. Here we focus in particular on one particular characteristic of social innovation, which is its ‘promise’ to provide alternative ways of product and service delivery that fall outside the mainstream, e.g. outside conventional state or

market organisational forms; or with a logic that is not dominated by market and profit-seeking values; or based on innovation in public service delivery. That is, we emphasize the ‘disruptive’ quality of social innovation.

Strategic Niche Management emphasizes the role of niches defined as protective spaces for the configuration and development of disruptive innovation (Kemp et al., 1998). Essentially, such disruptive innovations fail to compete successfully in incumbent selection environments due to their relative immaturity. Hence, there is a need to shield the innovation against prevailing selection pressures and to nurture its development and further evolution in terms of performance improvements so that it becomes sufficiently ‘fit’ to survive. Based on research primarily carried out in relation to low-carbon energy technologies and practices, Smith and Raven (2012) suggest three analytically distinct features of a protective space provided by a niche: shielding, nurturing and empowering. “Shielding involves processes that hold off selection pressures in the context of multi-dimensional selection environments (industry structures, technologies and infrastructures, knowledge base, markets and dominant user practices, public policies and political power, cultural significance). Nurturing involves processes that support the development of path-breaking innovation within passive and active shielded spaces through the development of shared, positive expectations, social learning and actor network building on the basis of ‘real-time’ experimentation. Empowering involves processes that make niche innovations competitive within unchanged selection environments (fit and conform) or processes that change mainstream selection environments favourable to the path-breaking innovation (stretch and transform).” (p. 1034).

An important unresolved issue concerns however what role(s) the state could play when shielding, nurturing and empowering niche-level social innovation. Some argue that niches are not created by governments but require instead experimentation with the distribution of responsibilities and the organisation of relations between state, market, civil society and science and technology (Schot and Geels, 2008). Others however assert that state intervention remains essential, as important change processes implied by Strategic Niche Management can only be engineered through political processes, and legitimised and enforced through the institutions of the state (Meadowcroft, 2011).

Ultimately this question depends on what kinds of government and states are implied, foregrounding the importance of spatial contextualisation (Coenen et al., 2012). The concept of the embedded state is employed to highlight the mode of state engagement that seems most attuned to experimentation. In contrast to the neoliberal mode, which stresses an arm’s length relationship between state and socio-economic actors, and the dirigiste mode, which underlies the “entrepreneurial state” discourse and which stresses the role of the state as a more autonomous actor, the embedded state highlights the role of the state as a learning partner alongside firms and civil society (Hausmann and Rodrik, 2003). In the embedded mode, the state is a co-learner and a co-producer and its contribution depends on its problem-solving competence in the network not its status in the hierarchy to elicit information about new areas of activity and approaches to emerging challenges. Within the latter concept, we will also discuss the challenges of multi-scalar coordination between different levels of government, alongside the need for cross-cutting measures that breakdown traditional government silos.

These theoretical arguments are used to frame place-based approaches to experimenting with new solutions and services in active and healthy ageing and ambient assisted living in Britain and Norway. In Britain we will develop these concepts through a dual approach: first, we will study bottom-up projects for building or adapting social housing to the needs of the elderly. These projects tend to combine the use of small-scale and fairly simple technologies at home, with the provision of tailored health services and innovative approaches to funding and care. Second, we will explore several top-down initiatives aimed at developing ambient assisted living technologies (AAL), which are the new wave of STI goods and services being developed at the EU level to help improve the lives of the elderly. We will explore the role of the state in stimulating the development of AAL, and question which organisational elements are missing in the public sector that would allow for the implementation of these technologies in practice. This dual approach will be a way to test the capacity of the UK state to effectively link with lower levels of administration, but also to bring together a host of different partners in bottom-up, socially driven initiatives.

In Norway the (top-down) state driven approach in the The National Program for Welfare Technology to generate experiences and to explore the possibilities associated with ambient assisted living is accomplished in order to facilitate municipal (bottom-up) procurement of new services and solutions. This policy program involving 10 pilot projects in 32 municipalities is used as an entry point to study the roles played by the public sector in addressing grand challenges. The developmental mode has so far largely been practice-oriented (DUI mode) and largely directed towards the municipalities. The study reflects on how the experimentation can be understood in terms of knowledge modes, multi-level governance and co-creation and experimentation across the public, the private and the civic sector.

The comparison between these two case studies will provide fertile ground to test both the notions of strategic niche management and the way in which different systems of national care lead to significantly different processes and outcomes in the area of ageing.

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NEW VALUE SPACES FOR EMERGING HEALTH INNOVATIONS

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EXTENDED ABSTRACT

This paper discusses a number of trends and developments visible in the field of emerging health technologies, such as diagnostics, showing that innovations embodying these trends are not just geared towards efficacy, safety, quality and low costs, but also imply specific social expectations, values and norms. As a result, health technology assessments focusing on the first set of values are missing out on important effects of innovation.

Nowadays health innovation is not bound anymore to laboratories and specialists, but is increasingly perceived as an institutional interplay with many heterogeneous stakeholders. The ‘e-revolution’ causes a shift in information distribution between medical professional and patient, in which digital self-diagnosis is becoming more important. Also more emphasis is placed on personal health systems, which tailor diagnosis, medical treatments, prevention and self-management of diseases to specific characteristics of each patient (Faulkner 2009). But, these innovations also lead to issues such as awareness raising, privacy related threats, patient surveillance, treatment compliance and user acceptance. Patients are expected to become increasingly involved in self-managing their disease and health status by pursuing healthier lifestyles, by actively monitoring a diverse range of health parameters, and by maintaining contact and sharing health data, digitally, with medical specialists and care givers. So, besides efficacy, safety, quality and costs parameters, various social expectations, values and norms of patients constitute as normative rules, emphasizing more quality-of life related values (Lehoux 2006). Furthermore, diagnostic innovation is moving from the professional medical spaces, in which the patient is often regarded as passive receiver of healthcare, into more domestic, informal care spaces, in which patients are actively involved in self managing their disease or health. Diagnostic innovations will increasingly incorporate in the domestic lives of end-users, where they meet more mundane technologies and the everyday practices of people, becoming the co-managers of their personal health and wellbeing. In domestic life health technology not only meets a medical need, but is also accompanied by increased health awareness, uncertainty about future care systems and multiple values. As the boundaries between medical professionals and patients/people are blurring, it leads to possibilities for co-creation of health and care innovation, defining the needs and wishes, creating values and co-creating solutions in practices or value spaces in which various types of stakeholders are involved. Innovation is then not just geared towards efficacy, safety, quality and low costs, but also imply specific social expectations,

values and norms. As a result health technology assessments focusing on these set of values are missing out on important effects of innovation.

The goal of the paper is to address the way we think about, conceptualize and assess diagnostic innovation and underlying values, and to re-conceptualize the so called 'value spaces' in which health technology is traditionally designed, evaluated and used (Peine & Moors 2015). We show that shifts from secondary to primary to mobile care necessitate changes in the way we about the value of health technology, such as a diagnostic innovation. More specifically, we argue that personal health systems fulfill an interesting hybrid configuration, posing hybrid values of users. Health technology should provide them with means to cope with emerging diseases and care, *and* they should stimulate activities and lifestyles that prevent diseases, indicating a hybrid identity of the health technology user.

This twofold objective implies an inherent tension between the values of medical treatment –for which compliance is essential, and evidence should be available and measurable about its effects regarding efficacy, safety, quality and costs of good functioning- and the values underlying the quality of life – for which exploration, do it yourself in the domestic environment, co-creation and meaning are essential elements (power to the patient/user). This tension, we argue, cannot be reconciled easily as its poles assume different ideas about user-technology relations. This tension between the hybrid functions of an emerging personalized health system, leading to different value spaces, thus poses a central challenge for the design, evaluation and implementation of personal health technology.

To theorize this hybrid nature of contemporary diagnostic innovations, we build on Callon's distinction between prosthetic and habilitation social policies (Callon, 2008) to analyze how policy decisions create socio-technical assemblages that impute certain types of agency on individuals. Using insights from disability studies, Callon distinguishes between social policies that produce disciplined agency where individuals are empowered to follow pre-configured scripts for individual action, the so called prosthetic policies, and habilitation policies that produce interactive individual agency where individuals are empowered to explore and develop their needs and preferences. We argue that it is an emerging key challenge of responsible diagnostic innovation to be simultaneously prosthetic and habilitating, that is, should enable individuals to follow preconfigured scripts as well as empower them to explore their needs and preferences, in order to provide stakeholders with the necessary agency to negotiate health and illness in specific socio-technical assemblages or value spaces. We use this particular framing to enumerate a number of challenges for policy makers, innovation managers and the evaluation of health technology more generally.

We are studying Point-of-Care (POC) diagnostics as an illustrative case study of an emerging personalized health system in the domains of primary and secondary patient care in the Netherlands. POC diagnostics are defined as analytical testing activities near or at the site of patient care, outside of clinical laboratories (Lee 2008). It is one of the fastest growing areas of mobile, non-invasive diagnostics. By contrasting primary and secondary patient care we demonstrate how different logics of addressing values in innovation feed into either prosthetic or habilitation policy decisions about diagnostic health technology. Based on this analysis we argue that current HTA practices need to be rethought.

To sum up, the goal of the paper is to re-conceptualize the so called ‘value spaces’ in which health technology is traditionally designed, evaluated and used. The paper uses Callon’s distinction between prosthetic and habilitation social policies to argue that responsible diagnostic innovation should be simultaneously prosthetic and habilitating, that is, should enable individuals to follow pre-configured scripts, as well as empower them to explore their needs and preferences.

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NON-PUBLIC BULK CONSUMERS AS DRIVERS OF ECO-INNOVATIONS

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Keywords: Demand side innovation, innovation policy, procurement, sustainable consumption

EXTENDED ABSTRACT

Background

Since more than ten years, demand-side related innovations policies increasingly gained attention (OECD 2011). Many OECD and emerging countries now use policy instruments to foster specifically demand-side related innovations, especially in areas where there is a significant need for the society as a whole and where the need is not sufficiently met. This political intervention related to the demand-side is based on the arguments (Edler & Georghiou 2007 and Edler 2013) like market and system failures, creation of lead markets, mission orientation. The demand side consists of different actor groups, namely private consumers, public procurement, retailers, commercial procurement and export.

Focus: Non-public bulk consumers

Within the scope of this paper, the emphasis is put on the role, the potential and the possibilities arising from the demand of non-public consumers whose purchase is of large scale: bulk consumers. As such, we define

- commercial as well as non-commercial organizations,
- non-governmental organizations,
- organizations which present themselves in the market as a central organizational unit with respect to purchasing, or which are characterized by common or bundled procurement, and
- whose shares in the concerned market sector (i.e. purchase quantities and market turnovers per product group or service) represent a significant share.

The procurement of larger quantities mobilizes a demand volume, which is assumed to stimulate eco-innovations due to its market power, and that it aides to diffuse eco-innovations faster and on a larger scale. The display of such a demand could – according to this hypothesis – offer vendors incentives to market eco-innovations (faster), lower their unit costs (economies of scale), to mobilize learning effects and to offer incentives for broader diffusion in a certain market, also concerning other demand groups.

Methods applied

In a finished research project, the role of greening demand by bulk consumers has been analysed¹. First, the project determined the relevant markets on which bulk consumers play a crucial role. Subsequently, we collected and prioritized 30 eco-innovations with a promising environmental relief potential. To collect empirical evidence on the interests, strategies and mobilisation potential, three national (German) stakeholder consultations were held, on behalf of the German Federal Environment Agency (UBA), in autumn 2013 and summer 2014. Each of them directly addressing non-public bulk consumers for one specific eco-innovation: CO₂ air-conditioning systems in passenger cars, energy-efficient commercial tumble dryers and textiles either produced of recycled cotton fibers or organic-cotton. Based on these various sources, policy strategies and measures were analysed to activate bulk consumers. To enlarge the focus and knowledge, experiences from innovation-oriented public procurement (as case studies), as well as from discussions on environmental and sustainability innovations drawn upon interviews with 19 international experts, have been added.

Key influencing factors

Based on the methods applied, we identified various key factors influencing support or hindrance for the activation of the demand side to procure eco-innovations. Altogether six clusters² could be distinguished:

- Innovation-related key factors: Quality and reliability, visibility and recognition, complexity and compatibility of (eco-) innovation.
- Supplier-related key factors: Availability of innovation(s), adaptation costs, reputation of supplier, branch-related key factors, system management, configuration of the branch, business associations, lock in dependencies.
- Demand side-related factors: liability of purchasing intention, supply channels and routines, uncertainties as to qualities, position of supplying departments, change agents, rationalities, company culture and objectives, demand side fragmentation, benefits for bulk consumers, knowledge of innovation developments.
- Context-related factors: Standards, public interest, promoters, problem awareness/minimum level of attention, setting of actors.
- Policy-related factors: Policy framework, lead markets, antitrust law.

This list hints to a considerable number of factors which influence – positively or negatively – the market introduction and dissemination of eco-innovations in the context of non-public bulk consumers as purchasers.

Specific eco-political strategies and possibilities for activating bulk consumers

¹ The paper is based on the research project “Concentrating Market Power. Bulk Consumers as Change Agents for Innovation Towards Sustainable Consumption”. The main report (Rubik et al. 2015) has been published as part of the text series of the German Federal Environment Agency (UBA), conducted by the authors between August 2012 and October 2014.

² The structure of the clusters follows Fichter & Clausen (2013, p. 96ff.).

Environmental innovations can be supported by policy in many ways. Summary overviews are to be found in Edler (2013), Horbach et al. (2003), Lehr/Löbke (1999) or Rennings et al. (2008). Based on these and the insights from our research, we believe that different levels of actions and actors are requested: Policy, bulk consumers and suppliers. The development and marketing of eco-innovation and the realisation of market potential is a risky path for suppliers, but these risks might not be too different from those for “classical” innovations. The forming of markets is a not trivial process, and it requires co-operation with clients (i.e. the purchasing companies).

We propose a series of different measures, which respond directly to the challenges of how to mobilize bulk consumers. The proposals are divided according to the “policy-cycle” (e.g. Jann/Wegrich 2003) and are depicted in Figure 3:

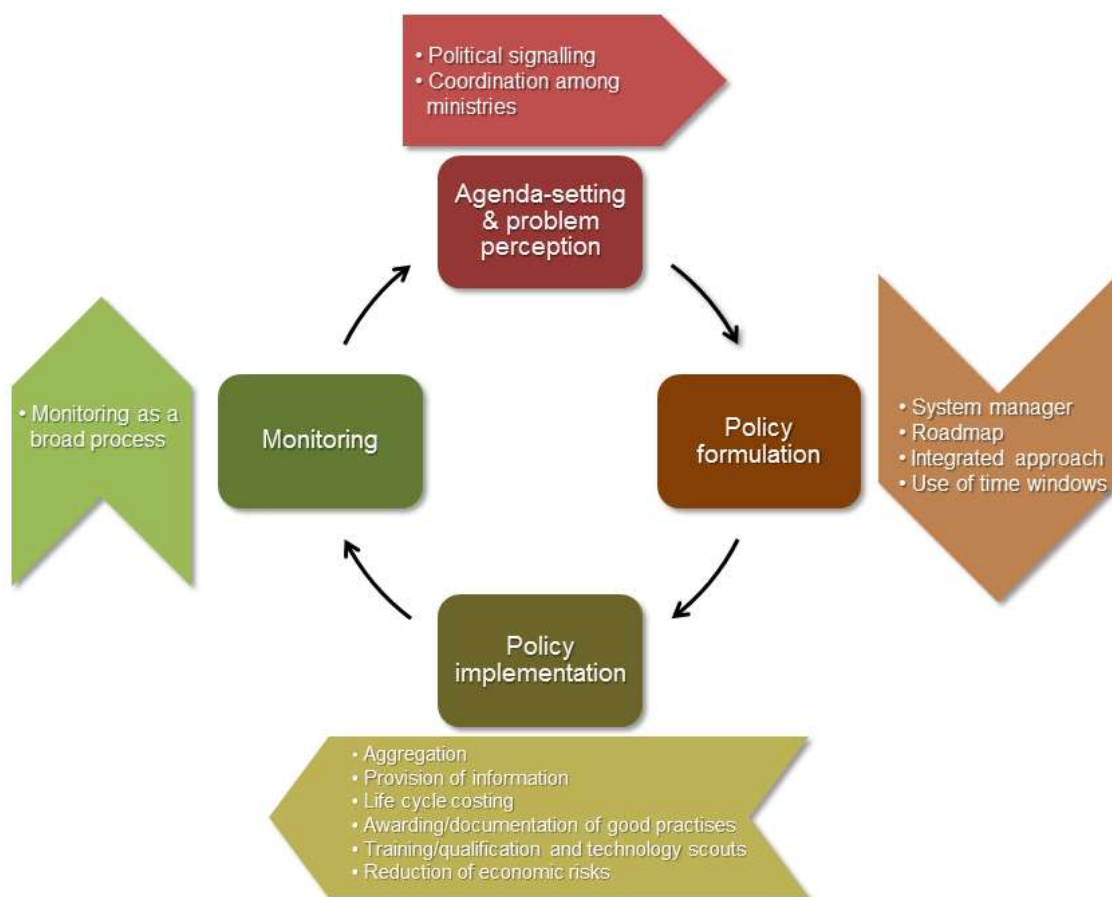


Figure 1: Overview on potential environmental policy measures for activation of bulk consumers

Conclusions

Our insights refer to a couple of aspects in the area of the long-term discussions on the market push and pull mechanisms to foster eco-innovations. A demand-side public support of eco-innovations of non public bulk consumers supplements the consumption oriented approaches directed towards public procurement and private consumers.

Overall, we conclude that the mobilisation of bulk consumers as purchasers of eco-innovations represents a promising strategy. Nevertheless, at this point in time it is not possible to guarantee the success of such a strategy, since not sufficient empirical evidence is available, yet. As a result, it is necessary to continue researching this strategy to prevent it becoming a “free ride” strategy, because the commitment of the public is one of the very foundations of it.

The previous presented measures and approaches are oriented towards the topic of this paper: How to push non public bulk consumers? With these measures, the possibility of unchaining a broad demand for eco-innovations through regulative measures such as Blind (2012) and Edler (2013) describe them, have not been addressed. Such regulatory measures, used in Germany in the area of the Renewable Energies Act (EEG), influence the framework conditions from the side of the authorities, to support demand for eco-innovations, and, consequently, to create a new market.

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PUBLIC PROCUREMENT OF INNOVATION: A REVIEW OF RATIONALES, INSTRUMENTS AND DESIGN

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Keywords: public procurement; innovation policy instruments; policy rationales; policy design

EXTENDED ABSTRACT

The primary objective of public procurement is to provide public administrations with goods and services necessary for performing and delivering public services. The specific inclusion of public procurement into national and regional innovation policy mixes (Edler & Georghiou, 2007) has recently gained a renewed interest and impetus. The OECD sets the objective “to leverage public procurement to foster innovation” in its innovation strategy (2010, p. 118). In 2011, policies and/or strategies for supporting the procurement of innovative goods and services had been implemented in more than half OECD countries (OECD, 2013). PPI is generally implemented with various designs, instruments and in various contexts, thus encompassing a diversity of categories.

The academic literature is increasingly concerned with the heterogeneity of PPI and its innovation impacts. Two broad sets of results might be identified. First, a number of typologies has been elaborated defining categories of PPI based on various criteria such as the degree of maturity and nature of the market, the type of social needs, design issues, user-supplier interaction, geographical aspects and contracting modes. Second, as the primary objective of public procurement is rarely to encourage innovation, a range of policy instruments needs to be implemented to successfully orient public purchase towards novelty. Georghiou *et al.* (2014) define “policy instruments” based on their functions at the different stages of the procurement cycle and on the deficiencies they accordingly seek to remedy.

This literature provides a variety of results about the design, context, and instruments characterizing PPI that are scattered and difficult to combine for a broad understanding of the variety of PPI. Moreover, considerations for the obstacles to innovation that public procurement may solve are marginal, although their identification is key for determining whether public procurement is an appropriate policy to foster innovation, and how it should be implemented. Indeed, by following a smart policy design approach, policy-makers must carefully consider “the nature of the problem to be solved as well as its causes” (Borrás & Edquist, 2013, p. 1518), and accordingly choose and design innovation policies.

Based on this smart policy approach, we suggest to complement the various approaches of the literature by focusing on general failures impairing innovation that could be solved by public procurement. The aim of this paper is to investigate the range of failures, on the one hand, to build an analytical framework that would justify PPI and help identifying categories and, on the other hand, to unify previously elaborated typologies by linking rationales, instruments and design of PPIs. Its overall objective is to contribute to a smart policy-making by providing with guidance as regards the choice and design of relevant instruments for innovation demand-side policies.

A two-step literature survey enables to elaborate the analytical framework and to build a unifying typology. First, a review of the literature on innovation policy is conducted to identify the failures impairing innovation that public procurement may solve. Rationales are “more or less formalised models implicitly or explicitly drawing upon academic theories or concepts that could inform policy design, implementation and evaluation” (Laranja, Uyarra, & Flanagan, 2008, p. 823). This definition underlines that a link exists between the justification of public interventions and academic theories, although this link is not straightforward. The formulation of a policy is a complex process shaped by a number of factors and contingencies, which are not restricted to recommendations derived from theories. Furthermore, policy-makers cherry-pick various elements in theories to justify their intervention in spite of possible contradictions. Due to these features of policy-making, policy analysis should not overestimate the role of academic theories therein, but not disregard them either. They can contribute to assess the appropriateness of specific policies in regard with their objectives and the economic context (Guellec, 2001). Policy analysis must be comprehensive, i.e. consider different sets of failures even though they are derived from various economic theories. Otherwise, it would not reflect the actual policy-making process and would be misleading. Moreover, the differences of focus among economic theories should be perceived as potential complementarities instead of radical oppositions (Bach & Matt, 2005). This article consequently searches for rationales for PPI among market failures (Arrow, 1962; Nelson, 1959), evolutionary gaps (Malerba, 2009), systemic traps (Klein Woolthuis, Lankhuizen, & Gilsing, 2005), and failures related to the transformation of systems (Weber & Rohracher, 2012).

An analytical framework is built based on a literature review of innovation policy rationales. This article considers that PPI can address three broad categories of failures: demand- and supply-side failures, and user-supplier interactions traps. Public procurement is essentially a demand-side innovation policy, i.e. a policy whose objective is to foster innovation by encouraging its uptake (Edler, 2009). Indeed, public procurement consists in the purchase by a public authority of a novelty to address a need. In this regard, this article has a broad understanding of what is new by encompassing the users' perspective (definition of new uses). Therefore, the scope of demand-side failures includes issues related to diffusion. Moreover, in line with evolutionary and systemic approaches, PPI is considered an instance of user-supplier interactions. Finally, PPI may target in some instances supply side failures, i.e. innovation producers' deficiencies.

The second step consists in reviewing the literature focusing on PPI through the lens of our analytical framework. First, we show that it is possible to link each type of failures to elements of policy design such as

innovation characteristics and modalities of implementation. More interestingly, each type of innovation gap can easily be associated with instruments able to overcome them. Then, we build a typology of four categories of PPI according to the type of demand-side failures addressed and to whether it concomitantly targets supply-side failures or not. Each category is refined based on the degree of user-supplier interactions required. Finally, we link failures, innovation and public procurement characteristics as well as instrument types in this typology based on the economic foundation of PPI. In other words, each PPI category is characterized by a set of rationales, instruments and elements of design. This two-step literature review allows connecting previously elaborated typologies of PPI. It also underlines the possibility of public procurement to be a hybrid innovation policy instrument able to address concomitantly demand- and supply-side failures, in specific situations.

This extended abstract relate to the final research results. They are diffused through a working paper and communications in seminars and conferences. The authors conduct further studies based on these results in order to refine and complement them.

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EVOLVING CONCERTATION - NEW CONSTELLATIONS OF ACTORS ADDRESSING GRAND CHALLENGES -

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Keywords: Science; Technology and Innovation Policy; Grand Challenges; Science in Society; Public-Private Partnership

EXTENDED ABSTRACT

New constellations of actors are emerging, and can be drawn upon for innovation policy purposes. Constellations can also be created (designed) intentionally. In practice, this will often require nudging and modulating of what is happening already. Public-private partnerships are an example of such emerging configurations. The widely agreed need to address Grand Societal Challenges requires new constellations and cooperation of actors, and is thus a site to explore such new constellations and their working.

Emerging constellations of new actors in science, technology and innovation policy

New constellations of actors in science, technology and innovation are emerging, as a patchwork of ongoing partial and contested transformations in society, industry and politics. The borders between science and society are opening up or being re-defined. We witness a “*growing interest in strategic research and accompanying institutional changes, greater citizen involvement and science becoming more reflexive about its own role and impacts. Frictions and tensions occur, partly because of these trends*” (Siune et al. 2009, 4). Key institutions like universities and funding agencies are changing, in general, and occasionally to facilitate ‘Responsible Research and Innovation (RRI)’, also without using that label explicitly. This is visible in calls for a ‘civic university’ (Goddard 2009) or the ‘new American university’ where students of diverse backgrounds and faculty aim to serve society and their communities (Crow & Dabars 2015). At the same time we see new actors like regions (and cities), Civil Society Organisations and charitable foundations becoming involved in research, education and innovation initiatives (for example in the Dutch Top Sector Innovation Policy). Obviously, more is happening than neo-liberal market-oriented moves. The direction and patterns, however, of re-configuring actor constellations are not clear yet. If we want to better understand and govern these dynamics it will be helpful to map and analyse what is happening, and placing it in larger frameworks. Such research and reflection can become an essential complement to the interactions between the various relevant organizations and actors, in terms of exchanges about good practices and exploring new collaborations – to be mobilised for innovation policy purposes.

Grand Societal Challenges as sites to explore and experiment with new actor constellations

The widely agreed need to address Grand Societal Challenges will (often) entail the requirement of wider *system transformations* (Kuhlmann & Rip 2015). In other words, more is necessary than technological and industrial innovation as traditionally studied and stimulated: also novel ways of assembling and re-assembling heterogeneous bits of work (including traditional innovation) are asked for. Here we are moving away from a focus on government and its responsibilities to consider the possibility of challenges (Grand or otherwise) being taken up in the R&D and innovation system more generally. This is important because most of knowledge production and innovation take place outside the sphere of direct influence of government agencies.

To enable system transformation, *new actor constellations* are of crucial importance. For Grand Challenges, there are good reasons to include a larger variety of actors, and consider new roles for traditional actors. The approach required to identify and to address Grand Challenges is to ‘assemble’, to create a more inclusive, socio-technical system-oriented approach, embedding policy action in society. This can be achieved in several complementary ways. First, by making sure that *key actors* are involved, which implies that actor consortia should be public-private, including charitable or philanthropic foundations playing a key role because they are free to move, and tend to go for public interest goals. Second, combined economic and social issues and related changes are a key feature of addressing Grand Challenges, so *social innovation* must be included. Third, *intermediary organisations* and spaces they offer for interactions are important to enable and improve concerted action, without having a master plan. In the course of such developments, existing organisations may transform themselves. For example, research funding agencies may play more than their traditional role of funding research proposals, now adding reference to a Grand Challenge. They can adopt a central role in defining and/or managing a concerted action (there are precedents). Fourth, such a role will require new capacities and capabilities, so *learning* and transformation will be necessary. In short, a wider understanding and concept of innovation and system transformation is required which can draw on potentially *constructive and productive interactions* between heterogeneous actors.

To make such new actor constellations constructive and productive, *concertation* is needed. Typically, actors addressing Grand Societal Challenges find themselves in distributed, even disconnected situations. Still, concertation is possible to some extent, and there are interesting examples. One can think of road mapping, often a public-private undertaking. Road mapping exercises do require a prior definition of the goal to be reached, but the actual exercises tend to discuss the nature and values of these goals as well. Thus, road mapping might be useful to address Grand Challenges, not just to specify how to get there, but also to help to articulate what the Grand Challenge might be. An interesting example of spaces for concertation are the European Technology Platforms, some of them leading on to Joint Technology Initiatives. They were set up from 2004 onwards, building on existing networks and initiatives and stimulating new ones. Strategy documents would be created identifying challenges, coordination would occur, and – hopefully – action taken. The themes often show a technology supply orientation, but there are references to broader issues like sustainability. Particularly interesting because of its bottom-up dynamics is the European Nanoelectronics Initiative Advisory Council, led by the big incumbents in the sector, and through its members also coordinating with their North-American and East-Asian counterparts. In short, concertation will allow for and become effective through dedicated *spaces*, social as well as material spaces, with emerging boundaries and stabilising internal arrangements (Rip & Joly 2012), created by institutional and policy entrepreneurs, to foster constructive and productive interactions.

Concertation through tentative (meta-)governance

Since system transformation, even when recognized by major actors as important, will be demanding given the inertia of institutions and the multitude of interests involved, it will not be easy to address the *governance challenge* that Grand Challenges present: “the other Grand Challenge” (Kuhlmann & Rip 2015). It is much easier to fall back on existing ST&I policies and instruments. Given the diverse, often even conflicting perspectives and interests of actors and the evolving nature of constellations (and of articulation of the substance of the Grand Challenges), *tentative modes of governance* are required: “*Governance is ‘tentative’ when it is designed as a particularly dynamic process to manage interdependencies and contingencies in a non-finalizing way; rather prudent and preliminary than prescriptive and persistent. Tentative governance typically aims at creating spaces of openness, probing and learning instead of trying to limit options for actors, institutions and processes. It answers political and organizational complexities and uncertainties with explorative strategies, instead of relying only on orthodox or preservative means*” (Kuhlmann et al. 2015).

Tentative governance would include a *meta-governance* dimension (Jessop 2002) addressing the ‘other Grand Challenge’ of transforming R&D and innovation systems. Meta-governance (‘governance of governance’) is visible in emerging modes of ‘social technologies’ of framing and facilitating articulation,

contestation and negotiation of competing views of coping with innovation and transformation – social technologies working as a kind of ‘crash barrier’ guiding the ongoing ‘making’ of governance across the various domains of the research and innovation system effectively. The move towards concertation by bodies at arm’s length from central policy makers is a manifestation of meta-governance.

The success of such a move, for traditional institutions of science and innovation as well as semi-independent concertation bodies will depend on the context. Taking a *longer term view*, over a few decades, one can see changes in institutions, so their inertia is not absolute. For the tentative (meta-) governance and concertation, one needs openings in the system, and actors who are able and willing to step in. That is why we emphasize the role of new combinations of old and new actors.

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THE PERVASIVENESS OF INNOVATION AND WHY WE NEED TO RE-THINK INNOVATION POLICY TO RESCUE IT

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Keywords: Innovation Models; Innovation Policy; Need, Demand and Innovation

EXTENDED ABSTRACT

In recent years, the terms “innovation” and “innovation policy” have become pervasive. As Godin has nicely shown, “innovation” is an old concept with an illustrious history, originally mainly used in the context of political innovation and often in a pejorative way. Only in the second half of the last century did innovation become an *object of policy*, mainly linked to technological innovation and economic competitiveness and progress (Godin 2012). In the last 30 years or so, innovation has become an ever more ubiquitous and dominant concept in highly intertwined political and societal discourses. Innovation is no longer only an engine of growth, but a means to cope with societal challenges (Kuhlmann and Rip 2014, Kallerud et al 2013) and to a broad systems transformation (Borras and Edler 2014).

In this contribution, we would like to reflect on the tensions that arise from this increasing pervasiveness of “innovation” in societal, political and academic discourse and policy practice. We argue that an appropriate understanding and design of policies to support innovation need to understand conceptually the connection between the underlying innovation models (the “how”) and the normative claim of innovation policy (the “what for”). By the former, the innovation model, we mean a stylised and simplified concept of the fundamental mode of the generation, drivers and directionality of innovations. By the latter, we mean the basic intentionality of policy, ranging from improving the conditions for innovation with no particular direction to supporting specific directions of innovation to change socio-technical systems in order to cope with societal challenges. Currently, the debates on innovation and innovation policy in Europe appear to add new claims without reflecting on this crucial link of the “how” and the “what for”. We argue that the increasing link of innovation to societal needs and grand challenges, this broad pervasiveness, necessitates a radical change in the way we support innovation capacities and activities. This would have to have serious organisational repercussions for sectoral policies (e.g. energy, transport, etc.), science policy and innovation policy alike.

To develop our argument we first outline the pervasiveness of innovation in societal, policy and academic discourses and policy practice and discuss the various extensions in Europe as regards innovation

policy claims “to deliver” (e.g. Stewart 2012) with a turn to challenge orientation which some observers have characterised as the dawn of a “new” mission orientation (Gassler et al 2008). We then shortly outline the operational developments in innovation policy instrumentation, including, most notably, attempts to integrate develop demand side instruments into national innovation policy strategies (Edler 2010, OECD 2011a, b). This, we argue, leaves us with a puzzle, i.e. the claim to direct innovation policy towards societal challenges without systematically integrating systematically the articulation of demands into innovation policy design.

Based on the historic importance of innovation models for innovation policy design (Mytelka/Smith 2002) we then discuss some of the key innovation models and concepts underpinning this debate, reflecting on different claims in policy practices and policy discourses with a focus on Europe. This discussion demonstrates the shift over time in terms of the dominant understanding of what drives innovation. Second, and more importantly, these different models and concepts have different implications for the innovation policy discourse. If we want to inform the current policy discourse, we need to understand these underlying, and often competing models, and inject their different implications back into the debate. Obviously, the choice of a model is neither arbitrary nor innocent. From a normative perspective, we would like to privilege those models that attempt to link the “what for” with the “how”. We accentuate the developments in Europe by shortly reflecting on the innovation model and innovation policy debate in the US, which at the Federal level we see focused on a simpler model of innovation and innovation policy.

The article concludes by arguing that broadened claims for innovation policy need to take the lessons of innovation studies and the different conceptual models of innovation processes seriously. This would mean more carefully designed and more differentiated innovation policies. We accept the limits of steerability of the innovation process, and we stress the fact that innovation policy itself will constantly be an experiment, iterative, recursive, with failures and with effects that are often unforeseeable. This should caution us against the promises of “intelligent” innovation policy being a mechanistic answer to all those broadened claims.

Discussion: we argue for broadening the concept of innovation while differentiating it at the same time. An innovation policy which claims to first and foremost deliver societal benefits would have to be built on a better match of the innovation modes, the “how”, and politically defined innovation purposes, the “what for”. A broader view of innovation policy sees it as having two functions: (1) sustaining an innovation ecosystem by supporting capabilities and connectivity, entailing proper regulatory framework conditions both for the development of (fundamental) science and innovation, and (2) giving direction for the generation and diffusion of knowledge and innovation by taking into consideration the supply *and* the demand side. These two functions need different policy approaches and different organisational set ups with some basic level of coordination, but not full integration.

The first basic function of innovation policy is a clear articulation of those innovation models that stress the need for skills, interaction, the capacity of learning, thus enabling actors across the innovation systems (horizontally) to create variation, variety and generate the pool out of which selection takes place (Metcalf 2005). This function has been at the heart of innovation policy in recent decades, residing mainly in ministries, agencies or departments with a designated innovation remit. In the understanding of this

horizontal innovation policy the role of science policy is to provide the skills and forefront knowledge that will enable directed innovation in the future. As for the second function of innovation policy, directionality, we differentiate between directionality of technology and directionality of the challenges that are to be met. The most important task of governments is to deploy intelligent discursive means to define those areas that warrant prioritising and organisational structures that allow emerging technologies to flourish and be translated into application contexts. Challenge directionality obviously is strongly linked to the technologies that are believed to hold the solution for meeting the challenge. In this perspective, the challenge is the goal and technologies provide the means, but such a relationship must be framed in a systemic context. In order to tackle a given challenge, the starting point is the insight for some kind of systemic change. This necessitates the articulation of the challenge and how it can be translated into innovation demands and in support requirements. The innovation model then would shift its *initial* focus entirely to the demand side, as already the very nature of the demand articulation matters a great deal (Kuhlmann and Rip 2014). The role of government becomes paramount in making choices between challenges, in supporting the articulation of the challenge and the reasons why it meets an underlying societal *need*. Next, governments must demonstrate the political will and capacity in supporting the uptake of innovation, i.e. the translation of the challenge into *demand*. This can be achieved through governmental purchasing or through bringing in present and future users by supporting demand conditions and capabilities in the system more broadly. If taken seriously, challenge directionality, entails a radical shift of responsibility for innovation policy to those ministries, departments and agencies which are responsible for the challenge. This may include the coordination with other organisational units, as many challenges do not neatly fit governmental structures. However, the ministries responsible for a given challenge are in the driver seat, and ministries or funding agencies responsible for horizontal capabilities and connectivity turn into supporting agents. The role of policy then is to support a societally accepted definition of directionality and design instrumentation that channels knowledge production and innovation in the desired direction. We realise that the process of innovation, much like the process of fundamental research although different in the way it is expressed, is inherently uncertain. Any policy, be it innovation or science policy, attempts to contain this uncertainty and channel it into the desired direction. This is as much as intelligent challenge directionality can hope to achieve. The rest is up to the cunning of uncertainty and the surprises it holds in store (Nowotny, 2015).

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MOVING INNOVATION POLICY FROM A COMPETITION TO A TRANSFORMATIVE CHANGE AGENDA

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Keywords: Innovation policy; world in transition; foresight; experimentation; fusing of knowledge; new institutions

EXTENDED ABSTRACT

This paper will develop the argument why innovation policy needs to get out of the ghetto of a too narrow focus on science and technology. The main reason is that the world is in transition. This shifting context for innovation puts completely new demands on innovation policy. In the first part of the paper I will discuss the various dimensions of the world in transition. I will not only deal with the current economic crisis, the digital revolution, globalization, and the emergence of new consumer markets both in the West and the Global South, but also discuss a number of persistent problems in the modern way of provisioning basic needs and argue why this is not sustainable in the long run. The conclusion of this section will be that we need to move away from a costly “business as usual approach” to these problems, and that it is time to address these issues head on through an innovation policy lens which aims at transformative change (and less at gaining a competitive advantage).

In the second part I will discuss the opportunities and limitations of innovation policy addressing these challenges. Innovation will be positioned as a core characteristic of modern capitalist societies. It will be argued that we are in the need of a new social contract for an inclusive capitalist society and economy in which we keep our ability to innovate, yet also find new ways of directing and embedding innovations into socially desirable directions from the outset. It is not only firms and the state who are key stakeholders for a future innovation policy, but also consumers as users need to be involved, as well as citizens and civil society. If we accept that the core problems of the world in transition can and should be addressed through innovation policies, the next question is which will be addressed in the final part of the paper is what such as policies should look like? I will argue that innovation policy should do two interrelated things: stimulate investment and provide direction. It should stimulate investment throughout the entire innovation chain, from invention, to innovation and diffusion. We need to think far beyond support for R&D and the prioritisation of specific research avenues. What is necessary is support for the constant tinkering and re-making of systems, and the development of new services and organisational models to meet social as well as economic challenges. We need to ensure that all actors benefit, not only firms but also the state and the public. Secondly it should provide direction to innovation, which is not always easy. It should begin with the opening up of innovation portfolios, allowing consideration of a greater diversity of options, without falling back all-too-easily on polarised “for” or “against” arguments. Instead, innovation policy should allow for more explora-

tion and experimentation outside the narrow boundaries often set by incumbents, with scientific advice based on a wider range of perspectives, and nurture a policy making process which provides an opportunity for various stakeholders to challenge dominant and less-dominant views. Innovation policy involves fundamental political questions, which present crucial areas for democratic deliberation. So innovation also has the potential to reinvigorate the future of our fragile democracies.

How then can innovation policy help to provide direction? I would like to propose four options – not as a comprehensive set but as a way to fire the imagination: firstly, foresight; second, experimentation; thirdly, through innovative institutions, and fourthly, fusing a wider range of expertise. All four avenues will be elaborated on in the paper. For Foresight it will be argued that the non-linear nature of technical change means new developments will inevitably occur in ways which could not be foreseen. To overcome this problem, foresight should be organized as a continuous effort across the entire innovation chain from invention to wider diffusion – involving both social as much as technical processes. We need to use foresight more effectively as an instrument for giving voice to a wide range of expectations and aspirations about the future and for orientating and directing investment decisions. For experimentation, it will be argued that we need to experiment more and on a larger scale with new emerging technologies. There is no lack of demonstration projects and pilots with new technologies. However, they are often organized in an ad-hoc fashion, focus on technical challenges, and then leave it to the market to commercialize and standardize solutions. They are often not geared towards exploring and exploiting how new technologies present opportunities for addressing societal challenges, and then how to capture value in a later stage of the innovation chain. We need to allow for bigger experiments, build more connections between them, and focus on experimenting with societal impacts too. Perhaps innovation policy should provide consortia of actors, including market, state and civil society ones, a licence to experiment with new solutions on a much larger scale than is currently the case, and for a suitable, longer time period. For the third stream which focuses on new institutions, it will be argued that we need to bring together state, business, academic and wider societal actors to facilitate discussion and negotiation on the direction of innovation. In our current system we have on the one hand policies and programs for the promotion of new technological opportunities through R&D support and tax credits, for example, via the policies of Innovate UK. On the other hand, there are policies for discussing, controlling and regulating the negative impacts of technology. What is missing are institutionalized processes to facilitate societal learning and create a culture in which responsibilities can be shared. For the fourth stream of fusing a wide range of expertise, it will be argued that sociotechnical change needs education and training programs which go beyond specialist career paths and develop a next generation of leaders who understand the need to work in interdisciplinary teams and are able to combine technological and social aspects in order to innovate.

THE DYNAMIC SIMULATION OF TIS FUNCTIONS IN TRANSITIONS PATHWAYS: NICHE/REGIME ACTORS AND POLICY DRIVERS FOR CHANGE

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Keywords: Transitions modelling; TIS; MLP

EXTENDED ABSTRACT

Introduction

The research problem addressed by this paper is to develop an explicit theory of the role of TIS functions in determining the dynamics of innovation. For technologies that represent a radical change in the socio-technical system, the niche-regime structure and dynamic interactions of the MLP is used to provide a theory of the potential dynamic pathways (Geels and Schot, 2007). These are used to structure the possible sequences through time of Niche-Regime-Landscape dynamics, which determine different phases in a (potential) transition. The TIS functions have different weights in different phases of a transition, such that the system of TIS functions has different feedback loops in the different phases. The implications for the use of policy intervention to support the dominant TIS feedback loop in different phases of a transition are discussed.

Weber and Rohracher (2012) compare the two frameworks and argue that they are complementary. Markard and Truffer (2008) develop a scheme to combine the two frameworks, and propose that a TIS usually includes more than one niche, while a niche usually acts around a particular technology. A TIS can be considered to interact with multiple regimes. However, they do not address in detail the internal functioning and dynamics of a TIS or a regime.

Dynamics of TIS functions: a model structure

The agents in the Sectoral system of Innovation (SSI) are mapped using the structure of Kuhlmann and Arnold (2001). This is extended using the TIS innovation functions (Bergek et al., 2008) to identify the innovation functions performed by the actors in the SSI. This is shown for a typical SSI in figure 1, developed from Köhler and Frencia (2011) and Senger and Köhler (2015).

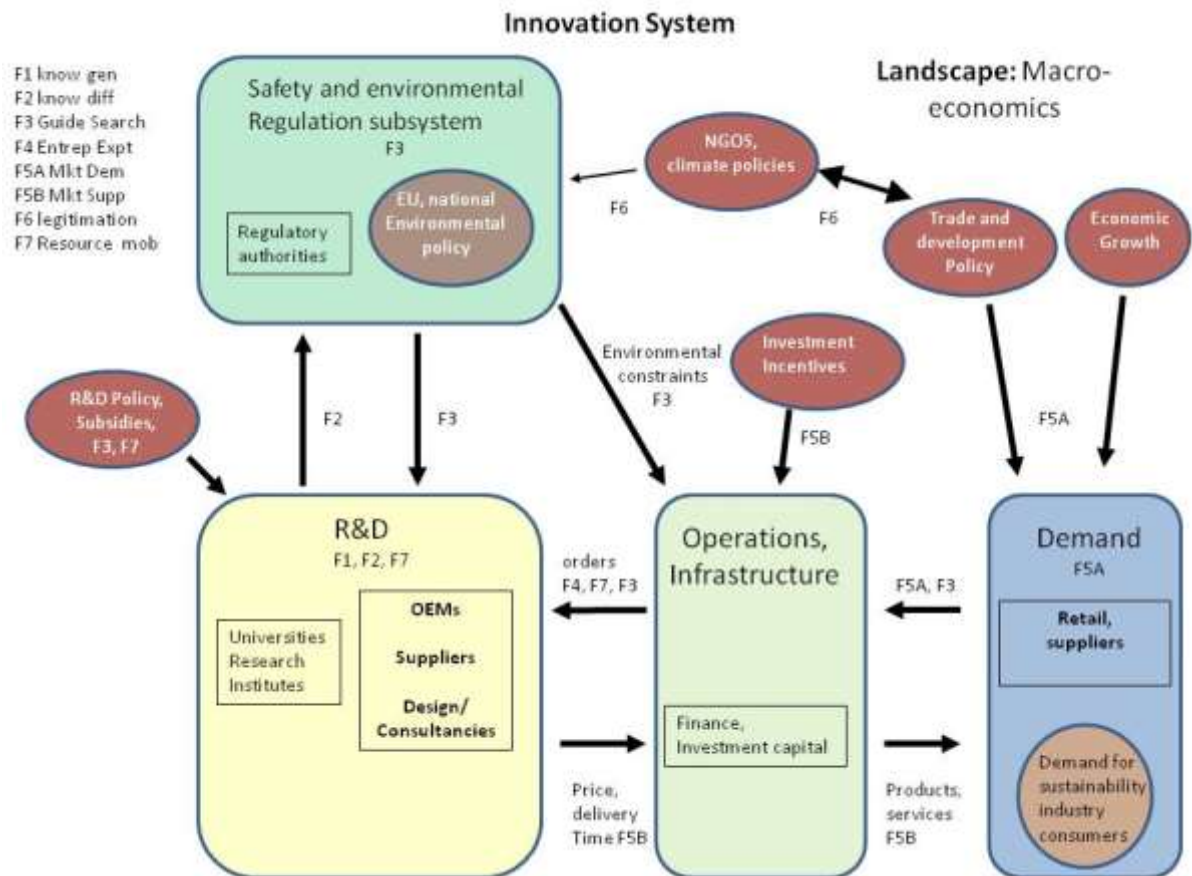


Figure 1 Innovation system diagram with TIS functions mapped to actors.

The analysis of the structure of a TIS as having a range of actors performing innovation functions enables a representation as a system of functions, with different actors in the TIS contributing to one or more functions. Potential TIS function interlinkages can be determined from the actor analysis and the identification of the functions that they perform. The TIS functions are then considered in terms of the niche-regime structure of the MLP. Bergesk, et al. (2008) state that a TIS is associated with a particular technology, but may share actors, institutions and networks with other TISs. In the transitions case study literature, a niche is often associated with a particular technology while there may be several niches that coexist in a particular sector (Köhler et al., 2009). A general example is shown in figure 2.

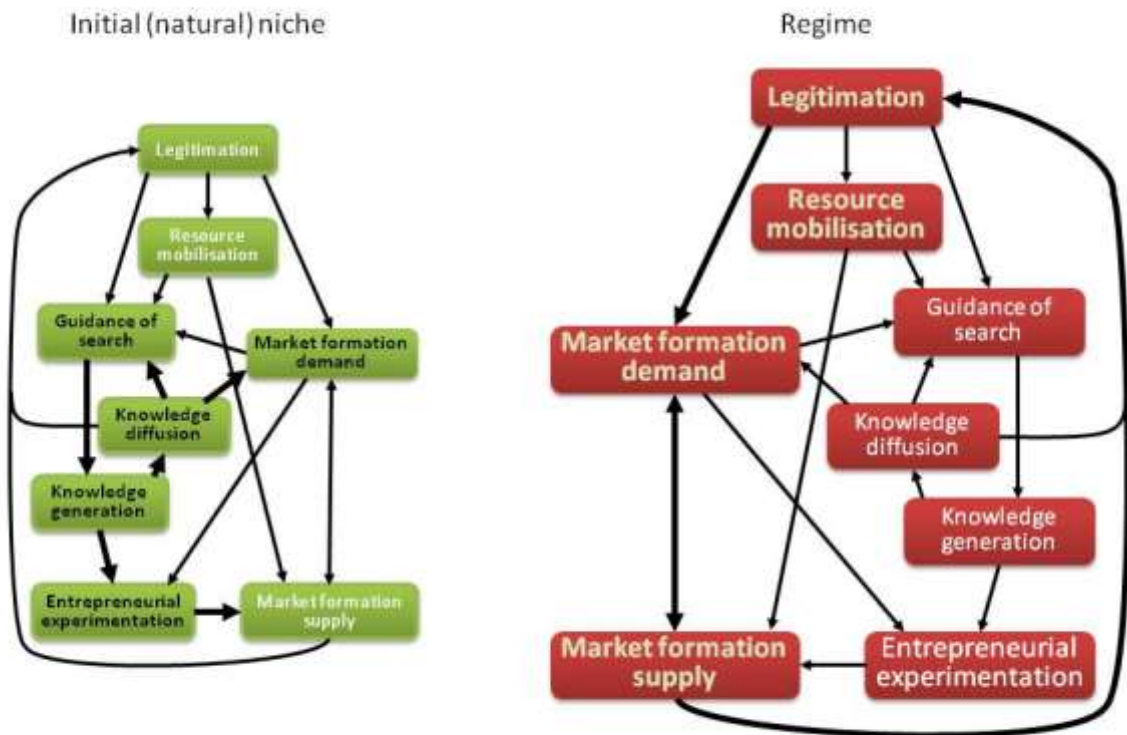


Figure 2 General system of TIS functions

Walz and Köhler (2014) argue that a regime has a common culture and institutional structure with a dominant technological solution, but employing a range of behavioural practices. An examination of the SSI structure shows that a regime has the same types of actors and functions. While a niche concentrates on new ideas to meet new requirements (e.g. mitigating climate change) in society, the regime is dominated by established economic relationships, which supports its strong market position, and by use of its influence for legitimation. If the niche technology does not yet have a market and there is no production for sale, then knowledge development comes about either as an internal process of the knowledge development function or as a result of the guidance of search function. This idea is derived from the Motors of Innovation approach of Suurs (2009).

If the new requirement becomes more widely accepted (e.g. through the new knowledge generated by the niche), the niche is further legitimised and can grow. This is illustrated in figure 3.

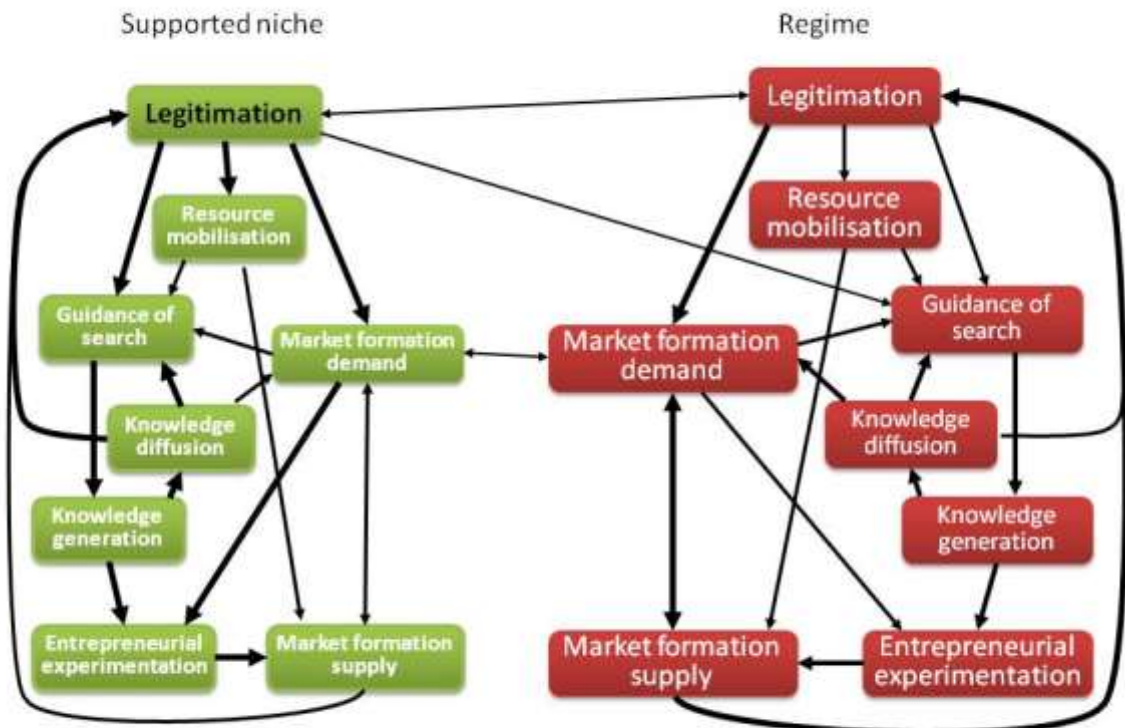


Figure 3 Niche growth (green) and regime as innovation function systems; initial stable regime

The TIS function system enables the internal dynamics of both an individual TIS and the regime SSI to be analysed. The MLP extends the TIS by providing a theoretical framework for the state of niches and regimes at different stages in a transition pathway and their interactions through time, including the influence of the landscape. For example, if there is a new landscape pressure on the regime which reduces the legitimacy of the regime (e.g. increased importance attached by society to reducing environmental pollution) this is a negative influence on the market demand for the regime's products. At the same time, if a niche exists that promises to reduce pollution, the same landscape change will strengthen the legitimacy of the niche. This could then enable entrepreneurial experimentation to happen, because the market demand is seen to be stronger and the niche might then move into a take-off phase.



Figure 4 Formation of a combined niche-regime market

The MLP argues that the regime, when threatened by a niche, may intervene to reduce the threat. For example, the regime may adapt by adopting elements of the niche technology and TIS, in particular the suppliers. The regime technology is no longer dominant. The niche and regime markets are combined with the niche knowledge functions contributing to the new adapted technology market.

All functions are eventually combined and the niche finally becomes part of the adapted regime, where the niche technology knowledge development is combined with the strong market feedback loop of the regime (figure 5). This is similar to the reconfiguration pathway of Geels and Schot (2007).

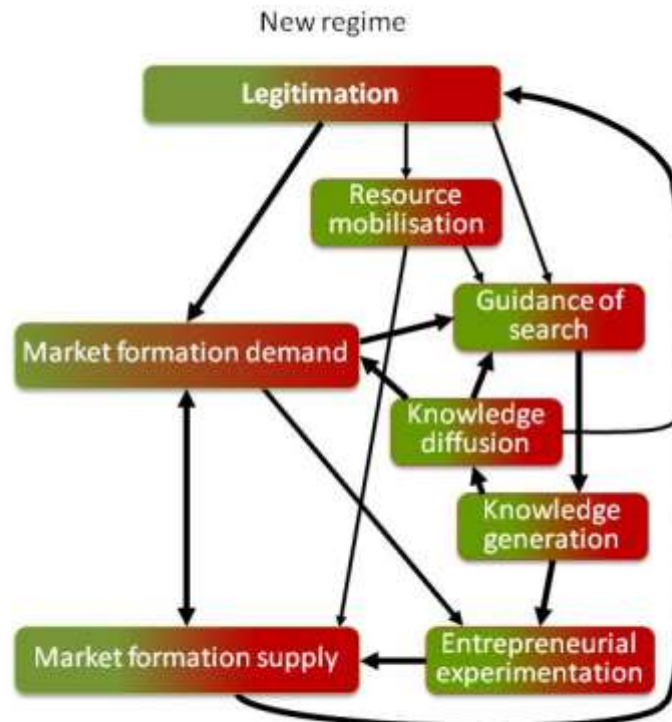


Figure 5 Regime reconfiguration, niche absorbed and the niche knowledge, market and legitimation functions adopted by the regime

Alternatively, the regime may try to discredit the niche by playing down its advantages (and raising its own advantages). In this case it depends on the duration and strength of support (incl. legitimation) for the niche, whether it can eventually outcompete and replace the former regime and become itself the new regime.

Modelling and Policy/Governance insights

The framework outlined here is a system dynamics structure and can be modelled using a system dynamics approach. The niche and regime would have an internal structure provided by the TIS framework of actors and the contributions of the various agents to each of the TIS functions, combined with the (potential) links between functions, including the niche regime interactions shown in figures 2 and 4.

This framework can generate important policy insights. An analysis of the innovation functions will identify the main feedbacks in the niche TIS and the regime SSI. Different scenarios for the development of feedbacks between the niche and regime functions will generate different potential transition pathways. It will then be possible for a given empirical case to identify feedback paths that need supporting, given the current state of the niche TIS and regime SSI and to assess how new feedbacks may be required to further

develop a new technology. Future work will refine the framework through case studies of eco-innovation and develop a detailed system dynamics model structure.

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TRANSITIONS AND CRITICAL FRAGMENTATION: A PERCOLATION MODEL

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Keywords: Transitions; Diffusion; Networks; Percolation; Simulation model

EXTENDED ABSTRACT

Technological and social transitions are generally understood as a shift in the dominant paradigm (Geels, 2010). A new paradigm has to oust the existing, established old paradigm in order to become dominant, overcoming path dependence and the almost irreversible character of technological development. Understanding the triggers of a regime shift is key to stimulate a sustainability transition (Zeppini et al., 2014).

From a diffusion perspective, the new paradigm has to diffuse in a population where the old paradigm is dominant and benefits from increasing returns to adoption. A critical mass of adopters is usually needed for a population to switch from an old paradigm to a new one (Arthur, 1989; Bruckner et al., 1996). This critical mass can come from several sources, like a market niche or coordination between agents. Thus, a traditional explanation for a paradigm shift is a high concentration of adopters of the new paradigm in the overall population.

Nonetheless, a paradigm shift generally requires several tries to be successful. That is to say, several candidate paradigms fail to become dominant, before one successfully replaces the old paradigm. A usual justification is that the process of trial-and-error echoes an exploring process where new candidate paradigms learn from the failure of the previous ones. The candidate paradigm that replaces the old regime is assumed to be better than the ones who failed and good enough to become dominant.

In this paper we suggest that new technologies that succeed in replacing a dominant one might not be better than previously failed attempts, but might just arrive at the right time. Every new technology diffuses to a small amount of people, gradually shattering the ground of advocates of the old regime. Due to increasing returns to adoption, agents experience a social reinforcement in adopting the same technology of their social contacts. After several technologies have failed to replace the old regime, the population is fragmented between several candidate paradigms and the old regime: the social reinforcement for the old paradigm is weakened. A new technology that comes in that moment can find the right conditions to diffuse and replace the old regime, without being intrinsically better than the previous ones. The triggering event of transitions is then a “critical fragmentation” of adopters, rather than a “critical mass”, which characterises more traditional explanations of technological regime shift.

We analyse our hypothesis with a model of repeated diffusion processes for a population embedded in a social network. We model diffusion in a percolation framework (Solomon et al., 2000) that represents a word-of-mouth communication in a social network (Campbell, 2013). All technologies have the same intrinsic value, although the population perceives them as different due to the social influence of increasing returns to adoption. Agents update their perceived value of a paradigm with its diffusion among their friends compared to the number of friends that still remain in the old regime. Thus, diffusion is driven by local social influence.

We find several conditions under which our model reproduces realistic patterns of regime shift. The first condition concerns the intrinsic value of technologies. If this value is too low, a new technology can never become dominant. On the other hand, technologies with a very high intrinsic value will immediately replace the old regime, without a need for previous failed trials, as their intrinsic value is high enough to compensate the increasing returns to adoption of the old regime. The most realistic scenario of several attempts preceding a successful transition requires that such intrinsic value be near to the percolation threshold of the network.

A second condition is that for a transition to occur new technologies need to have some advantage over older ones in order to attract adopters of failed technologies. Otherwise, the population remains fragmented over different technologies, none of which can become dominant. Finally, the diffusion process needs a moderate level of social reinforcement or increasing returns to adoption. If social reinforcement is too low, the number of advocates of a technology is irrelevant for its diffusion. On the other hand, too much social reinforcement can lead to a herd movement where all the adopters of a technology jump to the next arriving technology, without allowing for a fragmented population. This result depends on the intrinsic value of technologies, and only holds when the intrinsic value is on the threshold of the percolation process.

In conclusion, this paper posits a new explanation of technological transitions under increasing returns to adoption which is alternative with respect to traditional arguments based on trial-and-error or critical mass. We suggest that a new technology becomes dominant when arriving at the right moment, instead of being better than failed attempts. The right moment consists of a social base which is sufficiently fragmented among different competing options. Such fragmentation causes a shift of the percolation threshold of the network towards lower values. The trigger of regime shifts is thus a “critical fragmentation” of the population, rather than a critical mass of adopters of the new technology.

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TOWARDS EMPIRICAL MODELLING OF AN INTEGRATED TIS-MLP APPROACH: AN EXPLANATORY CASE STUDY ON WIND TURBINES

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Keywords: sustainability transitions; system dynamics modelling; wind energy; technological innovation systems; multi level perspective

EXTENDED ABSTRACT

Meeting sustainability challenges requires not only innovations but also transitions towards sustainability paths. The last years have seen both numerous applications of technological innovation systems in the field of sustainability technologies and studies which look into niche development and regime shift from a multi level perspective. This paper describes work in progress and investigates how such a regime shift could be modeled by using a system dynamics approach, with the objective of developing a model structure. Thus, it augments more general conceptual advances with an evidence based case study and extends theoretical analysis towards empirical modelling.

Conceptual basis

The modeling approach draws on four aspects underlined in the literature: First, authors such as e.g. Bergek et al. (2008) or Hekkert and Negro (2009) see the development of innovation systems influenced by virtuous or vicious circles among the different innovation functions. Thus, the feedbacks between this functions allow to account for the internal dynamics of innovation system dynamics and provide an inward looking perspective (Smith and Raven 2012). Secondly, the MLP approach sees the development of a sustainable niche influenced by the interaction of a niche with landscape and regime, which puts the development of a specific technology into a wider perspective of transition pathways and regime shift (Geels and Schot 2007; Geels 2011). Thus, drawing on the MLP approach allows for taking the external dynamics into account. Third, both approaches have been criticized for neglecting advocacy, political economy, and also spatial dimensions of importance of interaction of IS on a global scale (Markard et al. 2012; Smith and Raven 2012). Thus, these elements of a socio-political environment (Geels 2014) are also used in order to make the approach more actor specific. Fourth, the conceptual approach builds on Walz and Köhler (2014), who see a sustainability transition characterized by various niches developing, which share a common systemic relationship with a regime.

Application to wind energy in Germany

The concept of modeling based on these four elements is elaborated for the case of wind turbine innovations in Germany. Applying the modeling concept to a specific case helps to test the feasibility of combining the elements described above, and makes it more specific to define the challenges lying ahead. Wind energy has been chosen because it is one of the most thoroughly analysed sustainable TIS (e.g. Bergek and Jacobsson 2003; Walz 2007), and provides a good example for successful TIS development, which could be used as a guide for modeling. In case of transition of electricity system, various forms of renewable energy technologies each form a niche (Figure 1). They face a common regime characterized by centralized, fossil fuel based power stations, around which a complex web of institutions, complementary technologies, and markets has been co-evolving, which perpetuate carbon lock-in. It is assumed that regime-niche interaction follows a more disruptive transition path. There is an internal dynamic within each niche, described e.g. in various TIS case studies. There are also influences of the landscape on both regime and niches. Furthermore, one niche might be directly or indirectly influenced from development in another niche or from international developments.

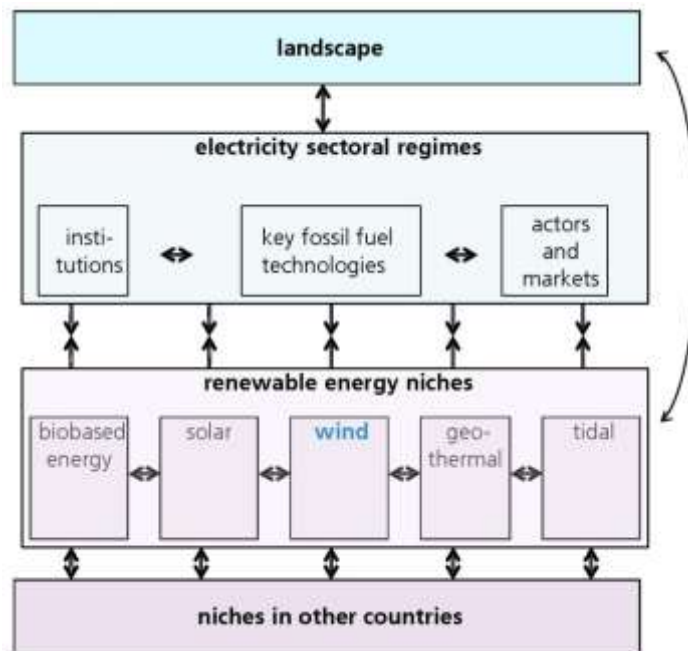


Figure 1: Level of aggregation of technological innovation system within multi level perspective

Positive and negative feedback loops

Bergek and Jacobsson (2003) emphasize that the development of IS runs through different phases. We follow this notion, and see the development of wind energy innovation system in Germany characterized by 3 different phases, which trigger additional feedback loops between the elements. Figure 2 shows the main feedback loops within each phase, and indicates which type of actors might be involved.

The formative phase was characterized by establishing a positive feedback loop, which increased the level of activity of actors in manufacturing, research, and R&D policy, and led to interaction between these actors (see black arrows in Figure 2). Landscape development towards greening society, earlier experience of Danish producers and nuclear phase out debate after Tschernobyl started the formation phase and gave “guidance to search” (F3). This influenced in particular research and manufactures of turbines, and led to an increase in knowledge generation (F1) and entrepreneurial experimentation (F4). An increased level of entrepreneurial activity further fostered knowledge generation (F1) and subsequent knowledge diffusion (F2). This positive feedback loop was further fueled by the resource mobilization (innovation function F7) brought forward by public and private research programs.

The second phase is characterized by growth of the niche in protective space. This was initiated by interaction towards additional innovation functions, resulting in additional feedback loops (green arrows in Figure 2). In particular, the function legitimacy (F6) was influenced by the landscape (climate change becoming an important issue). The network building among manufacturers, but also results of entrepreneurial experimentation and knowledge generation and diffusion gained attention among policy makers and NGOs and increased legitimacy for wind power. This increase in legitimacy resulted in legislation ensuring market formation (F5), and has led to substantial diffusion of wind turbines. Market formation itself led to various feedbacks, which drove down technology cost, and increased the competitiveness of the domestic manufacturers. Imports from foreign producers were reduced, and Germany developed a position as net exporter which furthermore strengthened legitimacy. Furthermore, manufactures and operators received additional guidance of search and ideas for entrepreneurial activity, strengthening the positive feedback cycle established during the formative stage.

The third phase is characterized by new challenges, which are ambiguous in their effect and even might threaten further development (blue arrows in Figure 2). Availability of additional sites and capacity of existing grid are forming bottlenecks for further expansion. New foreign players threaten the prospects of domestic technology suppliers. There is a delicate balance between technology cost decrease and increasing policy costs of expanding diffusion. If a decrease in legitimacy follows from these effects, policy is more likely to scale back policies which would

result in reversing the dynamics of IS growth. If, on the other hand, the retarding effects are overcome, the regime is likely to be weakened furthermore, and co-evolution will remove some of the aforementioned obstacles. Thus, there exists a valley of death of regime substitution, which policy makers have to address in their decisions on changes in policy.

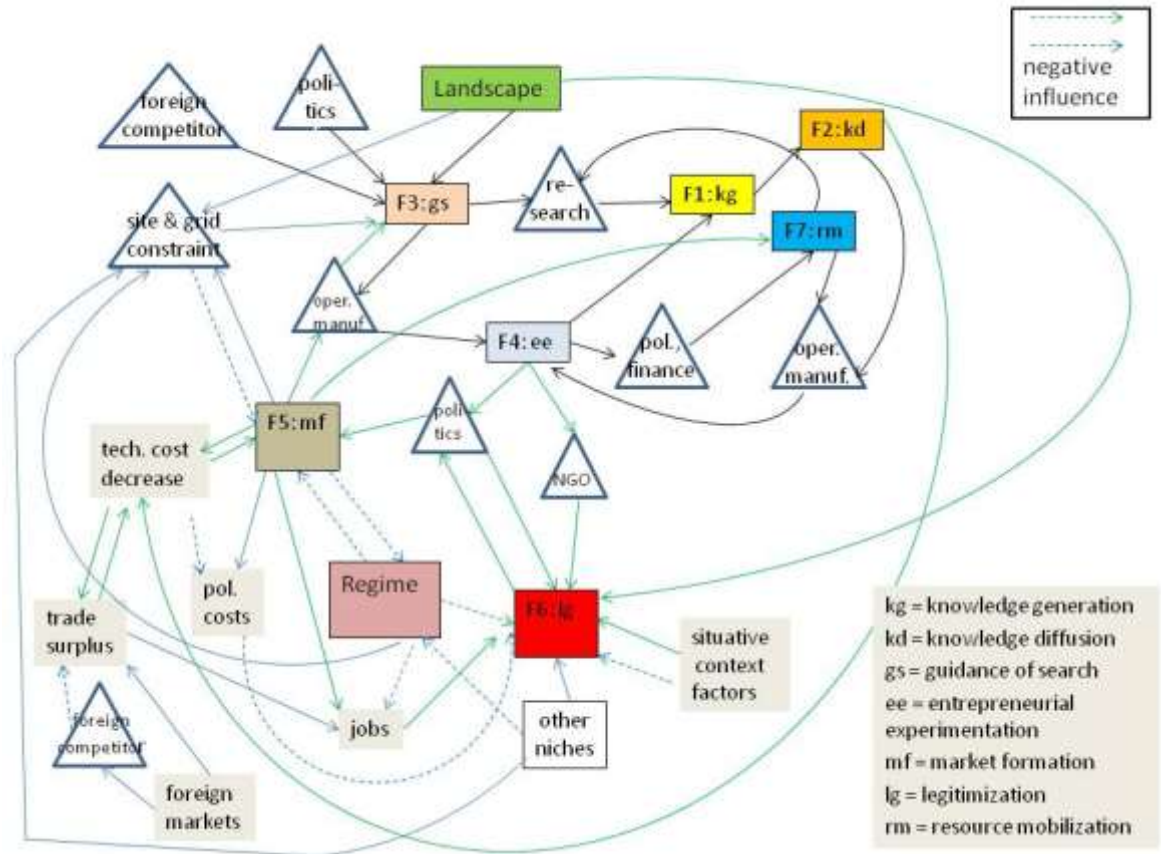


Figure 2: Feedback loops and actors involved in the 3 phases of German wind energy development

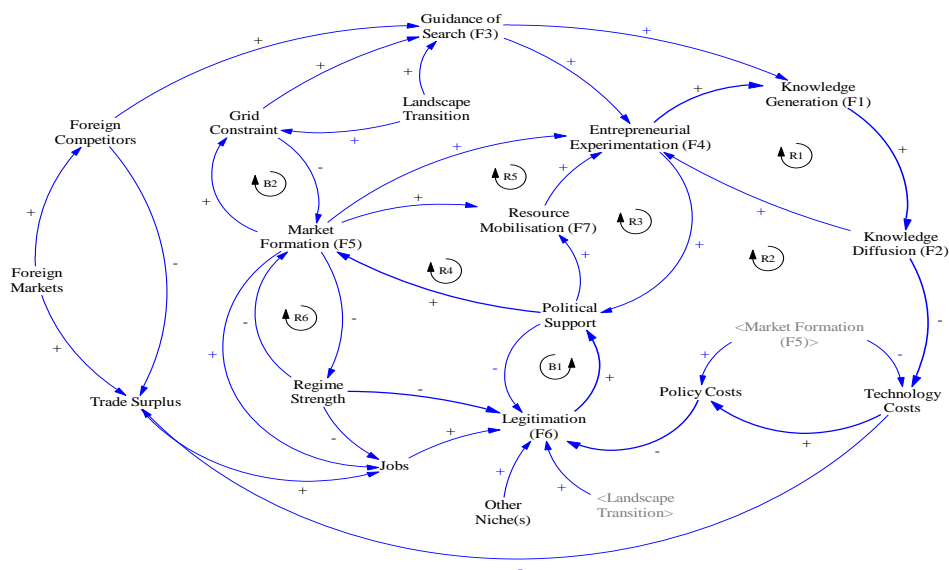


Figure 3: Modeling of system development of wind energy in system dynamics methodology

System dynamics translates the qualitative system structures into cause-effect diagrams, which form the basis for a quantitative structure with stocks and flows for computer-based simulations. Figure 3 presents the results of the modeling exercise. The signs indicate whether the influence of one variable on the next one is positive or negative. All in all, there are 8 feedback loops, which drive the development of the system. Some of them are also negative feedback loops, which reduce or even might reverse expansion of the system. Furthermore, threshold values and expectations play an important role. Especially if realized market formation is below expected market formation, the dynamics of the system might be reversed.

Lessons learnt and future challenges

The paper shows that the approach of modeling the dynamics of transitions with a system dynamics approach is highly promising: It is able to integrate the internal dynamics of TIS with the external dynamics of MLP. The case of wind energy in Germany shows feedback loops, which explain the internal dynamics between the innovation functions. Landscape is important for starting positive cycles; however, it can also be a retarding influence in later stages of development. Interaction with the regime is especially important for legitimacy and market formation. There are various tipping points of dynamics, which are characterized by counteracting influences of internal dynamics and regime resistance. Situative context factors and landscape influence play an important role in deciding which way the dynamics is continuing. It also can be seen that the dynamics changes over time, with legitimacy and market formation become more prominent in later phases. Aspects of advocacy, political economy play an important role, and are connected with effects of globalizing value chains.

Future challenges arise with regard to measuring the variables. For some innovation functions, measurable variables already exist (e.g. market formation (MW installed), resource mobilization (€), knowledge generation (patents, literature). Many of the auxiliary variables can also be measured by traditional variables (trade surplus, foreign markets, costs). Other functions require additional research to come up with measurable proxies (guidance in search, legitimacy). Additional challenges also lie in the measurement of landscape influence and strength of regime. Furthermore, additional challenges arise with regard to the functional relation between the variables.

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DIFFERENTIAL OUTCOMES TO STRATEGY – EXPLORING FACTORS SHAPING THE RETURNS TO INNOVATION POLICIES IN CHINA AND RUSSIA

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Keywords: innovation policy, innovation system, implementation, actor strategies, expectations, path plasticity

EXTENDED ABSTRACT

Two of the world's largest emerging economies – China and Russia – have been positioned as “Rising Powers” in global arenas of science, technology and innovation. In particular, both countries put great emphasis on seizing early opportunities in developing strategic, emerging technologies. Additionally, each country has been undergoing transformations in economic structures and other innovation system aspects, including institutional frameworks, governance approaches, and actor roles. There are multiple points of comparison between China and Russia, including a shared legacy of centrally-planned regimes and more recent economic reforms and market orientations. There are present-day similarities in the strategic goals of their respective innovation policies, and in active innovation policy learning from the US and Europe. Nevertheless, it is also evident that China and Russia differ significantly from each other as to innovation system performance.

Existing research has highlighted strong and weak attributes of innovation policy outcomes separately for China (Liu and White, 2001) and for Russia (Radosevic, 2003). Limited comparative research on a very broad scale highlights key policy learning opportunities of technological development of China and Russia, as well as a very diverging outcomes of these innovation policies (Klochikhin and Shapira, 2012; Klochikhin, 2012). However, policy oriented top-down studies and input-output studies often treat lower-level processes underpinning policy results and innovation system performance as a black box. This research paper undertakes a structured analysis of innovation policy returns with a focus on micro-level system dynamics. We suggest that focusing on the micro-level orientation and activities of innovation system actors underpinning policy implementation provides useful insight for explaining between (and also within) country differences in outcomes for innovation policies that ostensibly appear to be comparable.

This paper frames the problem of micro-macro systemic interactions in the iterative way through which actor expectations and subsequent strategies shape innovation policy implementation processes in an institutional context – which, in turn, influences the next round of an expectations cycle and bears on whether trajectories follow path dependency or open up path plasticity (see Figure 1). Lawrence et al. (2011) enacted the notion of “institutional work” to depict that actors can actively engage with the institutional

environment in which they are embedded. This paper argues that micro-dynamics of the innovation system, such as modification of actor strategies, may lead to re-interpretation and re-enactment of institutional schemas through institutional work.

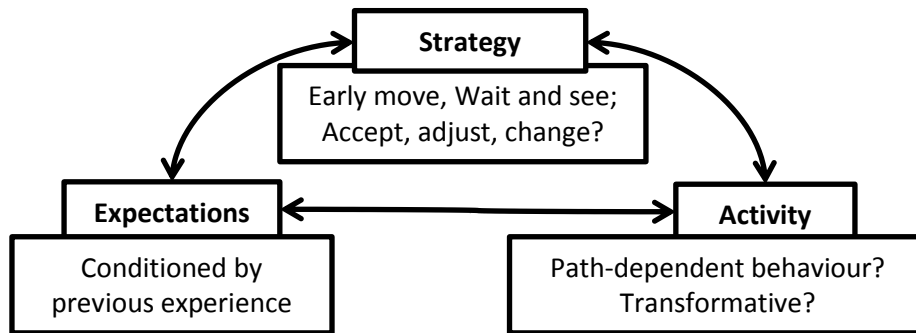


Figure 1. Expectations - Strategies Cycle Hypothesis

The conceptual framework that is adopted situates actors' expectations, strategies and activities in the broader context of technological innovation systems (TIS) of an emerging technology. In the paper, an "innovation system actor" is defined as an active holistic agent who possesses intentionality, engages reflexively with its environment, and formulates objectives and strategies in achieving them. Whereas the issue of actor dynamics has been previously addressed in the innovation studies literature (see e.g. Markard and Truffer, 2008 and Budde et al., 2012), this research recognises individual as well as organisational actors, but also distinguishes them from other agents of the system, such as technologies and artefacts. The construction of actor strategies by the way of actor expectations, and the enactment of these strategies in transitional periods is the focus of this research. Interactions between actor activities and the institutional context serve as important factors shaping the returns to innovation policies. In particular, actor activities are heavily influenced by actor expectations and strategies (Budde et al., 2012), while the institutional contexts feature both path dependency and path plasticity (Storz, 2008).

The paper draws on both primary data and secondary sources. Primary data collection methods included semi-structured interviews with a wide range of innovation actors in both countries (central and regional government officials, academics in emerging technologies and STI policy research, government think tanks, managers from firms, directors from science parks and incubators), as well as a focus group workshop conducted in Shanghai engaging academic and industrial actors. The interview protocol was structured along a functional approach to innovation change analysis (Hekkert et al., 2007) and included an overview of activities related to innovation, the positioning of the actor within institutional framework, perceived systemic problems, strategies of coping with technological and institutional change, as well as drivers, motivations and expectations. Secondary data, such as organisational documentation and statistics have been employed to complement the primary data. A case study focus on nanotechnology is adopted in order to track developments through the lens of a leading-edge, high priority new technology so as to peer into and gain an understanding of broader systemic process. Both China and Russia have pursued an emphasis on large-scale nanotechnology-related policymaking, drawing extensively from example of the US National Nanotechnology Initiative. A research framework that examines similar patterns in the dynamics of

expectations and strategies among actors of a similar type is used to link changes in strategies with innovation policy outcomes. The first round of fieldwork (in China and Russia) was finished in April/May 2014, and the data analysis and further conceptualisation is currently underway. A second round of fieldwork is planned for May/June 2015. We will present a fully-completed paper at the conference.

We anticipate a series of findings and insights. In particular, we presume that changes in expectations about the present and future socioeconomic environment factor highly in influencing changes in innovation strategies. Moreover, in the Chinese context, strategy change will be more likely to result in technologically-intensive and other innovative strategies among private sector actors. We suggest that the character of the dialogue between actors and the different capabilities of policy implementation comprise a set of the major forces shaping differential returns to similar innovation policies in China and Russia. While factors of path dependency are strong in both countries, path plasticity – where actors stretch institutional boundaries and more flexibly overcome constraints – is stronger in China. An overall perception of actors is that plasticity in linkages is more conducive to entrepreneurship, while path dependencies can stifle such activities. The flexible interpretation and utilization of institutional settings have led to different characteristics of “path plasticity” of the two countries. The high plasticity actors are seen where academic-industry linkages are made. Path dependent approaches are more present in limited collaboration networks. However, it appears both countries have been poor in encouraging collaborations between large and small firms. Innovation actors of these countries have different expectations projecting different forms of direction, considering future challenges or re-establishing path dependencies. Scientific personnel, returnees and cross-border migration factor highly into how these states connect with international collaboration networks and in turn shape home country expectations, strategies and mobility. The paper concludes by considering implications of the research for theory, innovation systems transition, and policy practice in emerging economies.

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Excellence in Cohesion: Exploring Synergies between Smart Specialisation Strategies and Knowledge and Innovation Communities

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Keywords: Regional innovation governance; Knowledge and Innovation Communities (KICs); Smart Specialisation Strategies (RIS3); Excellence; Cohesion; Structural funds; Horizon 2020

EXTENDED ABSTRACT¹

In recent years, regional and innovation policies have found unprecedented common ground under diverse pressures to deliver competitive advantage (Vanthillo & Verhetsel 2012). In European policy this is clearly reflected in the current cohesion policy. For the new programming period 2014-2020 for the structural funds around 100 bn euro has been earmarked for research and innovation. The spending has been linked to the ex-ante conditionality for regions to have a regional smart specialisation strategy (RIS3) in place. Central to such strategy is the bottom-up identification of a limited set of priorities for which regions think they have potential to obtain a comparative advantage, through close collaboration especially among regional businesses and research organisations. Such process is also referred to as process of discovery and is understood to be an ongoing process, not a one-off exercise. At the same time European innovation policy has paid increasing attention to pan-European regional collaboration. For instance, as part of the Horizon 2020 the EU decided in 2013 to endow the European Institute of Innovation and Technology (EIT) with 2.7 billion € for the period 2014 to 2020 in order to scale up and increase the number of its Knowledge and Innovation Communities (KICs). KICs aim to develop ideas with potential to become world leading innovations, by integrating research, innovation and education (the knowledge triangle). The regional focus is represented by a set of co-location centres for each KIC, innovation hotspots focusing on excellence and pooling actors from the knowledge triangle in one physical place (a city) and the Regional Innovation Scheme that facilitates the exploitation of created knowledge in the regions around Europe.

While European cohesion policy and innovation have clearly distinct rationales, the similarities seem many: the bottom-up approach, the central role for business and research and education actors, the focus on both market potential and on addressing societal challenges, a shared governance and monitoring between stakeholders, etc. Intentions also exist within both policies to support the development of European level value chains by linking regional initiatives. Looking at current practices, the collaboration between KICs and RIS3 entail important opportunities. Recently the EIT launched a Regional Innovation Scheme (RIS), aiming

¹ * The views expressed in this abstract are personal opinions only, not reflecting the official opinion of the European Commission and the European Institute of Innovation and Technology.

to increase the innovation capacity in areas and regions in Europe not directly benefitting from the EIT and its KICs². The RIS scheme, focusing on thematic alignment, encourages the further development of collaboration between KICs and RIS3. Looking at the thematic areas of KICs, and at the most ‘popular’ regional priorities under RIS3 (see Eye@RIS3 tool³) a wide potential of synergies and complementarities exist. There seems to exist similar opportunities also for collaboration with other initiatives, such as European Innovation Partnerships, Joint Programming Initiatives and ERA Chairs.

Focus of the paper

In this context this paper looks at the conceptual similarities and differences between the concepts of RIS3 and KICs, and places them in the wider landscape of European research and innovation instruments. Findings from the conceptual comparison are applied to the thematic field of climate change, in order to identify current collaboration practices, potential synergies for increased coordination, and related barriers⁴. Results have implications for potential increased collaboration at different levels of implementation, and give input to further development of the theoretical basis behind the concepts of RIS3 and KICs.

The paper builds on desk research comparing the literature as well as current European policy practices in regional innovation governance, on hands on experience from the S3 platform⁵ of the Joint Research Centre’s Institute for Prospective Technological Studies and from the European Institute for Innovation and Technology, and from an analysis from current innovation governance practices addressing the challenge of climate change in Europe.

Conceptual comparison

Setting up RIS3 (Research and Innovation Smart Specialisation Strategy) in every European region has become an important objective of EU cohesion policy. The notion of smart specialisation is a virtuous process of diversification through the local concentration of resources and competences in new domains that represent possible paths for transformation. Smart specialisation strategy, thus, involves putting in place a process whereby such a dynamic of new speciality development can be facilitated with punctual and targeted governmental intervention in order to support in a preferential way the most promising new activities in terms of discovery, experimentation, potential spillover and structural changes (Foray 2014).

² RIS is based on the following key principles: A coherent and structured outreach scheme, excellence, thematic alignment, voluntary and autonomous implementation by KICs, and openness and transparency (Source: EIT).

³ Eye@RIS3 is a database, developed by the S3 platform, to give an overview of regions' priorities in order to enable others to position themselves, to find their unique niches and to seek out potential partners for collaboration (<http://s3platform.jrc.ec.europa.eu/eye-ris3>).

⁴ For example, a set of technical and administrative barriers exist in combining funding from European Structural and Investment Funds (ESIF) and from Horizon 2020. The Stairway to Excellence project (S2E) aims to support post 2004 EU regions and countries in developing and exploiting synergies between both funding sources.

⁵ The S3 platform is the competence centre of the European Commission on Smart Specialisation (<http://s3platform.jrc.ec.europa.eu>).

The EIT achieves its mission by fully integrating all three sides of the ‘knowledge triangle’, i.e. higher education, research and business, in Knowledge and Innovation Communities (KICs). KICs carry out a whole range of activities, covering the entire innovation chain – including training and education programmes, reinforcing the journey from research to the market, innovation projects and business incubators. The EIT has provided the KICs with a great degree of autonomy to define their legal status, internal organisation and working methods. The KICs are driven by a pursuit of excellence in all of their activities and are established with the aim of reaching the necessary critical mass to achieve systemic impact, including the creation of new businesses and new jobs, and the promotion of new skills and entrepreneurial talent in the economy.

Table 1 Conceptual elements compared between the concepts of RIS3 and KICs

Item	RIS3	KICs
Core of the concept	Entrepreneurial process of discovery	Bottom-up co-creation
Stakeholder involvement	Business, research, public actors, civil society	Business, research, education (knowledge triangle)
Core objective	Develop comparative advantages for regional development and cohesion	Develop world leading innovations with societal impact through excellence
Societal challenges	Regional	Global
Market development	Regions into global value chains	Global markets
Collaboration	Interregional collaboration part of the concept (open)	Among co-location centres (defined); RIS (open)

Case description

The conceptual elements are discussed within the domain of climate change mitigation and adaptation in Europe. In particular, comparative analyses are made to understand intersections between the conceptual approaches and potential synergies and complementarities. The selected efforts of Climate KIC and on RIS3 on climate change (see Eye@RIS3) and further ramifications to other European initiatives are identified, namely to European Innovation Partnerships, Joint Programming Initiatives and ERA Chairs.

Results

The comparative analysis of the smart specialisation strategies of the cohesion policy and the knowledge triangle integration of the EIT provide improved understanding of the intersections between these conceptual approaches and potential synergies and complementarities, and allow for further advancing their theoretical basis. The case analysis provides insights on these aspects within the domain of climate change mitigation and adaptation in Europe and allows establishment of further connection with other European initiatives in view of overall development of the European innovation landscape.

Policy implications

The improved understanding of potential synergies and complementarities of the approaches contribute to the establishment of a common ground for joint efforts and further alignment of European innovation policy instruments.

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SOCIAL INNOVATION AS A FORM OF SOCIO-TECHNICAL TRANSITION

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Keywords: Social innovation; socio-technical transitions; multi-level perspective; niche-regime interaction

EXTENDED ABSTRACT

The field of social innovation suffers from a relatively under-theorised notion of innovation in trying to explain how new forms of social organisation are able to create new capacities for action. One key problem is in explaining processes of upscaling, when small-scale societal experiments are able to achieve purchase and address the underlying causes of deep-seated problems of social exclusion and injustice. The multi-level perspective of socio-technical transitions has emerged to attempt to understand how disruptive new technologies are introduced in ways that can change wider social trajectories to be more sustainable. The basis of transitions theory involves looking at the dynamic interplay over time between three levels, regimes, niches and landscapes, and the way that these shape trajectories. The concepts also can be applied sensitively to ideas of social innovation, and stress in particular the need to look beyond the immediately promising idea, but also to the need it is addressing, the other ways that need is met or unmet in markets, the ways in which this reshapes wider contextual factors, as well as the idea of a landscape of unchallengeable boundary conditions.

The central problematic with which the Social Innovation Futures project is concerned is the increasing epistemic distance that has emerged between the way that social innovation is understood within policy and scholarly communities, and the mainstream of science, technology and innovation studies (Benneworth et al., 2015). The vocal pressure for a consensus to emerge around key definitions and processes of social innovation (cf. Mulgan, 2006) in parallel with a proliferation of those definitions and a divergence of those processes is indicative of a lack of coherence in the way that social innovation is understood. The term social innovation is used to refer to such a melange of activities and interventions, and at the same time has been imbued with such transformative potential that it has attracted interest from many different parallel perspectives. But at the same time, this diversity is proving problematic for making social innovation theoretically rigorous with the result that the phenomenon is being considered as distinct from a whole set of cognate transformations associated with the shifts to societal sustainability that it may remain peripheral and fail to achieve either the conceptual or policy recognition to which it may lay a claim.

The aim of this literature review is to contribute to a narrowing of that epistemic distance, and in particular, to start to reconceptualise social innovation through the lens and experiences of a single field of

innovation studies, that of socio-technical transitions. Transitions theory is a mid-level theory that aims to create links between long-term processes of technological evolution and short-term, risk and dynamic experiments to innovate by looking at the way those short-term innovations interact with more established institutional configurations (Geels, 2011). The field is itself epistemologically heterogeneous, including those both interested in describing and understanding processes of change (cf. Geels, 2011) as well as those that are interested in the more normative dimensions, the opportunities and policy choices that may influence these ongoing processes (e.g. strategic niche management, Rotmans et al., 2001). The rationale for building this connection is that both social innovation and socio-technical transitions are processes of change in which small-scale activities are taken up and transformed in ways that change the 'rules of the game' (Benneworth & Cunha, 2015). Transitions theory conceptualises that in terms of shifts emerging within a niche driving changes to an underlying socio-technological regime. Conversely, in social innovation, there are welfare benefits for society as a whole produced as particular social innovations change power relationships in ways that reduce the relative exclusion of particular communities.

Transitions theory therefore provides a useful framework with which to bring concepts of social innovation back towards the mainstream of innovation literature, although there are clear differences between primarily technological innovation driven transitions, and social and organisational innovation driven social innovation processes. Researchers engaged with both share the common characteristic of trying to understand the processes of qualitative transformation involved in the upscaling of an innovation, when a radical novelty pioneered by 'idealists' tips over into being something that is the mainstream solution to a much wider range of problems. However, in transitions, this is often conceptualised in terms of as an issue of cost, with upscaling achieved when the new technological solution becomes more economically advantageous than the regime technology it replaces. Clearly, the concepts cannot be uncritically moved across without understanding the social life of these ideas and modes of organisation beyond the purely economy.

Nevertheless, these processes of qualitative upscaling are not at all well-articulated and understood in the social innovation literature with the result that there is an acute loss of agency, and it is to that overarching challenge that this literature review is addressed. This literature review therefore starts by presenting social innovation and in particular its characteristic as solving grand challenges by addressing a particular set of problems around socially excluded communities facing multiple deprivation, setting the conceptual challenge as being one of understanding how alternative non-economic spaces can lead to mainstream changes (section 2). To address this challenge, the literature review argues for the value of using a socio-technical transitions approach, which makes a distinction between protected alternative niches, mainstream regimes and exogenous landscapes (section 3). In section 4, the main elements of transitions theory are set out, in particular the links between the niche and the regime, linking the space of alternative imagination to the space of mainstream regulation. Section 5 reflects on how this can be applied to social innovation, and offers a discuss of some examples where it may prove useful for further understanding. Section 6 then sets out some of the limitations and critiques made of socio-technical transitions, and reflects upon their consequences for studying social innovation. Section 7 concludes that by focusing more clearly

on these processes of how particular new ideas and opportunities become fixed and materialised in networks to achieve discrete switching in development trajectories, both the multi-level perspective and social innovation have much to learn from each other.

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ON THE THEORY OF SOCIAL INNOVATIONS: TARDE'S DISREGARDED CONTRIBUTION TO THE DEVELOPMENT OF A SOCIOLOGICAL INNOVATION THEORY

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Keywords: Social Innovation; Social Practices; Reconfiguration; Practical Theory; Innovation Theory; Social Change

EXTENDED ABSTRACT

In light of the increasing importance of social innovation this paper focuses on a social theoretically sound concept of social innovation as a precondition for the development of an integrated theory of socio-technological innovation in which social innovation is more than a mere appendage, side effect and result of technical innovation. Against this background we define social innovation as a new combination or figuration of practices in areas of social action, prompted by certain actors or constellations of actors with the goal of better coping with needs and problems than is possible by using existing practices (Howaldt & Schwarz, 2010). The term ‘combination’ relates to the Schumpeterian terminology, defining innovations as new combinations of production factors. Only by taking into account the unique properties and specifications of social innovation it will be possible to understand the systemic connection and interdependence of social and technological innovation processes and to analyze the relationship between social innovation and social change.

This paper aims to outline how Gabriel Tarde’s social theory can be of benefit in developing a theoretically grounded concept of social innovations, and how it can be reinterpreted in terms of social practice theory. Defining social innovation as a new combination or figuration of practices an adequate approach can be found in recent social theory with its focus on social practices and dynamics of change. Social innovations encompass new practices (concepts, policy instruments, new forms of cooperation and organization) methods, processes and regulations that are developed and/or adopted by citizens, customers, politicians etc. in order to meet social demands and to resolve societal challenges in a better way than existing practices.

The current rediscovery of Tarde’s long-forgotten theory offering a new, for a long time only minority-interest sociology (Borch & Stäheli, 2009) runs as a mirror-image reversal of the holistic mainstream of the Durkheim tradition in favour of a microfounded methodology (Gilgenmann, 2010). For Tarde, social macrophenomena such as social structures, systems and social change are easy to describe, but

hard to explain, because the true complexity resides in the microphenomena (Gilgenmann, 2010). His basic idea is to explain social change ‘from the bottom up’, and not objectivistically, like Durkheim, ‘from the top down’, in terms of social facts and structures. Accordingly, the aim is to explore Tarde’s contribution to the microfoundation of a sociology of innovation and use it to develop a concept of social innovation as a social mechanism of change residing at the micro and meso level (Mayntz, 2004). Recourse to Tarde helps to differentially sharpen the term innovation beyond any limitation to purely economic or even business management aspects (Adolf, 2012).

For Tarde, invention and imitation are the two key elements in a sociologically grounded concept of innovation. Inventions constitute the material and motor of social change. Through diverse forms of imitation, they are integrated into social practice as the central motor of social learning. An invention, through imitation, becomes an innovation, and only then a social fact. Thus invention and imitation are the key elements in cultural cumulative evolution, which is specific to human societies (Tomasello, 2002). This mechanism makes it possible to ‘store’ existing knowledge in a specific form and pass it on. Here the central knowledge repositories are firstly the various artefacts that humans have developed in their social practice, but also the social practices themselves. Linking in with the ‘practice turn’ in the international field of social theories (Schatzki, et al., 2001), we describe social innovations in an analytical concept that is not intended to be normative, as an intentional reconfiguration of social practices. On the empirical level of the actors involved, this does not exclude normative orientations or ideas about what is socially desirable.

Tarde’s event-oriented social theory to a certain extent consists of an analytical programme, which with regard to social phenomena, facts and conditions, social order, structures and social change, takes social innovations as its starting point and makes them the theoretical and empirical focus of a truly experimental science (Tarde, 1899). Researching the many small inventions, ideas, initiatives, the intentional attitudes behind them, whether and how they spread through imitation and in so doing change at the same time and in this way bring social innovations in to the world, which as part of an emergent process join together to form ever more complex constructs and therefore produce social development and transformative social change, or in other words, the dynamism based on which social innovations arise as a prerequisite and driver of social change – this is for Tarde the proper task of sociology.

Tarde’s social theory can be understood and developed further as a theory of the “innovations of society” (Rammert, 2010), which is able to decode the relationship between social innovations and (transformative) social change, because as a forceful scientific conception of active social life its concept of innovation is free of the intense focusing on the technological and economic reference context which has been dominant since Schumpeter, and instead concentrates on social practices. It is sufficiently abstract for an all-embracing concept of innovation as social phenomenon, and at the same time enables a specification in relation to different reference contexts as well as an integrative examination of social and other innovations.

Because Tarde places the practices of imitation and its laws at the centre of his theory of social development, reference to the associated microfoundation of social phenomena provides vital input into an integrative theory of innovation. It enables us to discover how social phenomena, conditions and constructs

come into being and transform. A sociological innovation theory must therefore examine the many and varied imitation streams, and decode their logics and laws. From this perspective, the focus is always on social practice, since it is only via social practice that the diverse inventions etc. make their way into society and thus become the object of acts of imitation. Social practice is a central component of a theory of transformative social change, in which the wide variety of everyday inventions constitute stimuli and incentives for reflecting on and possibly changing social practices. It is only when these stimuli are absorbed, thereby leading to changes in existing social practices which spread through society and construct social cohesion via acts of imitation, that they drive social transformation. Thus new perspectives open up on an understanding of innovation, which adequately capture the diversity of innovations in society. The great challenge for contemporary innovation policy lies in exploiting these potentials.

The submission is intended for the Special Track “Social innovation futures: Beyond Policy Panacea and Conceptual Ambiguity”. The submission is relevant to the track because this paper (scoping paper) allows for new understanding of social innovation and for advancing towards a social theoretically sound concept of social innovation as a precondition for the development of an integrated theory of socio-technological innovation. At the same time, this also helps to gain new insights and to develop new ideas towards rethinking innovation policy.

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INCLUSIVE DEVELOPMENT IN SCIENCE, TECHNOLOGY AND INNOVATION POLICY OF THE BRICS

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Keywords: Inclusive Development, Science, Technology and Innovation Policy, Social Policy, BRICS

EXTENDED ABSTRACT

Economic growth has not been a sufficient condition for the BRICS countries to overcome the persistent social inequality gaps that affect them. Although poverty reduction has been observed, social exclusion continues to set the picture of these vast territories. In addition, territorial fragmentation, gender and race/cast inequalities, as well as the lack of access to quality public services still remain as shared problems. Added to these common problems are others, which derives of their historical legacies, such as: unemployment in South Africa, malnutrition in India, the rural-urban divide in China, the vulnerability of families with children in Russia and sharp class disparities in Brazil.

In recent years, most of these countries have been searching for new strategies to link directly economic growth and social inclusion. This ‘new generation’ of policies is stated in Science, Technology and Innovation (STI) national plans like the need to combine STI investment and social needs of the most vulnerable groups. At the same time, new approaches that highlight the ‘social’ dimension of innovation are becoming stronger. These approaches diversify the merely economic orientation of innovation to incorporate the objective of integrating social demands of sectors that generally have no voice within the STI agendas.

Since their formulation and promotion of those perspectives have taken different characteristics and ideological traits, in the academia (Arocena & Sutz, 2010; Cozzens, 2009; Cassiolato & Lastres, 2008; Bound & Thorton, 2012; Gupta, 1995; Prahalad 2006) and in international organizations (ECLAC, 2010; WB, 2010; IDRC, 2012, OECD, 2013). In the polar spectrum, it can be found since approaches that give a central role to the communities (where the dichotomy of user versus producer innovator vanishes to consider the innovation process as a factor of empowerment in itself) to those that seek to expand the market-base rooted in low income people (encouraging companies to produce low cost products and services suitable to this large segment of consumption). The strength of the State intervention and its ability to induce and prioritize agendas, as well as the State role in promoting such innovations, vary alongside with the market or communities orientation that these approaches assume. One constant has been, first, the inclusion of some of these perspectives in national STI policies and, second, the lack of clarity of their definitions, with the concomitant ambiguity in the operationalization of incentive programs. For instance, the Latin America reference literature on the subject (Bortagaray and Gras 2013; Casas, Corona, and Rivera 2013) shows that

the incorporation of ‘innovation for social inclusion’ perspective in a number of STI national plans has not been consolidated in tools that effectively generate inclusion processes.

In this sense, this paper proposes a critical review of current STI policies in the BRICS countries with the aim of analyzing how and through which perspectives and mechanisms the relationship between STI policies and social inclusion has been considered. For this, a documentary analysis of the official policies and strategies are made seeking to answer: How is defined the relationship between innovation and social inclusion in STI policy? What are the specific instruments and programs to promote this relationship? Who are the stakeholders involved and which role they have in this promotion? What are the priority areas defined by the policies in the social inclusion dimension? The paper gives special attention to the comparison of different institutional arrangements that each country deploys to articulate STI policies and social inclusion.

The analysis brings the particularities of each country in the integration of these perspectives and their main similarities. Thus, in the case of South Africa the analysis shows a transition from concerns on improving public services and basic infrastructure towards an increasing attention given to poverty reduction in STI policies. Meanwhile, within the BRICS, India is the country with a longer tradition in the application of these perspectives, especially focusing on the ‘Grassroots Innovation’ approach. In recent years, the incorporation of these perspectives within Indian formal institutions of STI has led to the building a complex network driven to social inclusion goal, but results is still weak. Brazil is nowadays internationally known by the implementation of distributive policies, with remarkable effects on reducing inequality in recent years. The income improvement has expanded the domestic market, and millions of Brazilians who stepped out of poverty entered into the consumption market. Nevertheless, STI policies didn’t take this opportunity to foster inclusive innovation. In the last decade, China put the aim of improving people’s quality of life at the top of the agenda. Accordingly, and for first time in the country, the national STI Program (2006-2020) gives priority to the promotion of health, security and environmental technologies related to people’s quality of life. Differently, in Russia there is no systemic or formalized STI policy aiming at social inclusion. Even in the ‘Strategy-2020: New Growth Model, New Social Policy for Russia’, which aims to re-direct the economy towards an innovative way of development, the initiatives aimed at integration of vulnerable social groups trough innovation processes are marginal.

In conclusion, the paper emphasizes that despite the increasing attention on STI role for social inclusion, the National Innovation Systems (NIS) in BRICS still show a weak coordination with social policies. The later are not seen as a relevant demand source for STI. This disconnection is currently presented as one of the main barriers to design NIS for inclusive development.

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SUPPLY OR DEMAND OR SUPPLY AND DEMAND? AN EXPLORATION OF THREE SBIR-TYPES PROGRAMMES

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Keywords: supply; demand; Small Business Innovation Research (SBIR)

EXTENDED ABSTRACT

Introduction

Paraphrasing Schmookler (1966), Innovation is a two-sided activity. On the one hand, it involves the recognition of a need or, in economic terms, a potential market for a new product or process. On the other hand, it involves technical knowledge, which may be generally available or may also include new scientific and technological knowledge, the result of original research activity. Needless to say, this is an oversimplification even if it captures one important aspect of a complex systemic occurrence: innovation.

Still, innovation is a systemic occurrence and the focus of innovation policy is therefore that of exploring possible synergies and conflicts between social and cultural objectives and opportunities for innovation provided by the accumulation, elaboration and recombination of knowledge; it requires coordination as well as incentives.

Innovation policy objectives have been classified according to the 'side' they are affecting. A naïve depiction may represent, on the one hand, supply side policies as designed to support the innovation process by providing for primary actors such as universities, firms and intermediaries operating within the system. On the other hand, demand side policies aim at addressing and shaping the context within which the actors operate.

Supply side measures consist in fiscal incentives and direct support to R&D and innovation, support to access to finance of innovative ventures, skill upgrade and human resources policies, entrepreneurship policy, technical services and advice, cluster, collaboration and networking policies. Demand side innovation policies comprise measures to stimulate private demand for innovation, intelligent and pre-commercial procurement policies, innovation inducement prizes and standardisation and regulation (for a more detailed analysis: Edler and Georghiou, 2007).

Our argument

Supply side or demand side instruments do not have a separate role in the innovation policy toolbox. Increasing arguments and evidence show that a systemic approach to innovation reflects on a more integrated view of demand side instruments in the policy makers' toolbox (Edquist & Hommen, 1999; Malerba et al., 2007; Autio et al, 2008). Moreover, studying the effects of policy interactions, Guerzoni and

Raiteri, (2015), found that supply side policies, tending at reducing the cost of innovation, and demand side policy, tending at reducing the risk of failure and incentivise innovation investments, work complementarily. In other words, supply and demand-side policies, appropriately combined, reinforce the impact of innovation policy intervention. The interest of the policy maker to understand supply and demand –side policy interactions is therefore rather high (European Commission, Supply and Demand Side Policies – Final report, 2015, Forthcoming).

SBIR-type programmes have been traditionally classed as demand side policy instruments whilst most recently there have been reservation as to whether they pertain to demand side or to supply side (Edquist and Zabala, 2015) or, as Rigby (2013) suggested, these are hybrid supply and demand-side programmes;

It is important to understand the nature of this type of programme because the classification has repercussions for understanding the policy framework within which they are implemented with implications for funding allocation and policy evaluation procedures.

The nature of the contention seems (is) to relate to two main issues, which represent also our research questions: 1) whether SBIR – types programmes are in fact conceptually classifiable as pre-commercial procurements or not, and 2) if SBIR-types programmes are either demand-side policies or supply side policies.

In order to advance our argument, we first develop a classification/taxonomy of PCP upon information obtained from official EC documents; mainly we refer to the Commission’s communication on pre-commercial procurement and the Commission working document (European Commission, 2007) in order to map the characteristics of the US SBIR, UK SBRI and Dutch SBIR on this taxonomy. The information on the three schemes is collected through secondary sources and interviews with the programme managers.

Findings

The SBIR-type programmes taken into consideration have many points in common with PCP but cannot be fully classified as PCP. SBRI is a programme based implementation of PCP; as such, these programmes are ‘directed’ instances of the policy, and as they are directed, they could be used for a range of things, including support of the supply side or not.

SBIR/SBRI programmes in the three countries do not have a clear/homogeneous definition. While SBIR in the US takes up a part of the R&D spending of federal departments and acts more like an R&D grant, SBIR in the Netherlands has been more explicitly linked to public procurement (NL Agency, 2011). All cases involve necessarily an interaction between the demand and supply sides. A R&D competition in stages is emphatically one that involves the publication of a set of needs on behalf of the demand side, and then a process of interaction between the demand and the supply side the result of which is the creation of knowledge. Clearly, within the SBIR framework, these interactions result either in an R&D service (where a contract exists) or a research result, where a research grant has been awarded.

Certainly, in the three SBIR-type programmes taken into consideration, there seem to co-exist elements of the supply side - such as support to R&D - and elements of the demand side such as risk-

reduction and procurement to improve public services. Other elements of the supply and the demand sides are however transpiring from a more detailed analysis. These will be highlighted and discussed in the paper.

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INTEGRATING DEMAND AND MISSION-ORIENTED INNOVATION POLICY: RATIONALES FOR THE ADOPTION AND IMPLEMENTATION OF PUBLIC PROCUREMENT OF INNOVATION AS A DEMAND-SIDE INNOVATION POLICY MECHANISM. SELECTING ROUTINES FOR INNOVATION

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Keywords: Demand-Based Innovation Policy Mechanisms; Public Procurement of Innovation; Mission Oriented Innovation Policy Integration; Institutions; Innovation Rationales; Innovation Routines

EXTENDED ABSTRACT

Brief statement of relevance

The argument for public procurement of innovation (PPI) as a demand-side policy implementation instrument that can be exploited in the mitigation of grand challenges has already been made (Edquist and Zabala-Iturriagoitia, 2012). This paper will demonstrate that the links between procurement rationales and mission innovation rationales form a central determinant of a public authority's ability to consciously implement PPI as a demand-side innovation policy tool at all, distinguishing technology-performance missions and strategic organisational performance missions as initiators of PPI. Consequently the links between demand based policy instruments and mission orientation can be made at the level of practice, and consequently reflecting on the origins of these practices provides insight into the integration and governance of combined mission oriented and demand side innovation policy mechanisms within innovation systems at the level of functions using routines as a unifying concept (Nelson and Nelson, 2002).

Research problem

Since the turn of the century there has been an interest amongst policy-makers and academics in the use of public procurement as a demand-side innovation policy mechanism (e.g. Edquist and Hommen, 1999; Edquist *et al.*, 2000; Edler *et al.*, 2005; Hommen and Rolfstam, 2009; Uyerra and Flanagan, 2010) to improve public services and overcoming market and innovation systems failures (Edler and Georghiou, 2007). However, implementing innovation procurement practices is challenging (Edler and Uyerra, 2013; Georghiou *et al.*, 2014; Lember *et al.*, 2011; Lember *et al.*, 2014), and makes considerable demands of public authorities. A central barrier is the difficulty incentivising innovation in public organisations (Potts, 2010; Luke *et al.*, 2010), potentially due to the weaker force that competition exerts upon public

organisations (Potts and Kastle, 2010) and the restriction of ‘creative destruction’ by concerns for social equity and political reputation that make experimentation unappealing (Bhatta, 2003). This infers public authorities are pre-disposed towards decisions (conscious or not) to continue using widely available, standard (or even under-performing) products and services to address the needs of the populations and environments they administer.

Yet societies have used public procurement to achieve broad social and economic outcomes since ancient Syrian and Greek cultures (Nijaki and Worel, 2012), and public procurement is an instrumental activity within government, centred on purchasing solutions for human needs or societal problems (Edquist and Zabala-Iturriagagoitia, 2012). Public procurement (as the acquisition of goods, services and works) can be considered a sub-routine sitting within a larger set of public service delivery routines, institutions and structures, designed to achieve outputs (access to health care or creating sustainable communities) within a specific context (e.g. a geographical territory and/or sub-sector such as energy). This perspective enables reflection on the (lack of) interaction between mission-orientated and demand-based innovation policy mechanisms, and the use of innovation to address ‘wicked’ problems at a series of political-institutional levels. Further, if some public organisations are responsible for both implementing policies relating to mission-oriented innovation, and encouraged to use their procurement activity to stimulate innovation, (how) is integration of demand and mission oriented policy a feature of practice?

Methods and data

The paper will use data collected during the proposer’s doctoral research, which used a multiple-method research design to analyse the problem of low adoption of PPI policies using an evolutionary-institutional approach. The design included two strategic case studies that traced the processes involved in adopting and implementing PPI within two sub-national public authorities; comparative analysis of the procurement practices being used in three city authorities who were members of a European climate change innovation network, and an analysis of the recent evolution of public procurement policy.

Results

Amongst the findings was the recognition that the adoption and implementation of PPI as a demand-side innovation policy requires integration with horizontal, or mission-orientated, policies to legitimise innovation as an organisational concern. The research found that PPI may have a technical (technology performance mission) or strategic (organisation performance mission) initiator, but both routes necessitate a process of ‘institutionalising’ the pursuit of innovation by developing justifications based in mission-oriented strategies to legitimise interventionist approaches to interacting with the market and taking responsibility for driving innovation through a specific procurement event or demand articulation programme. A ‘horizontal’ strata of sustainability policies provided a frame and “anchors” to guide the attention of public organisations towards particular problems that could be ‘solved’ using procurement policies. PPI implementation may consequently be characterised by transient windows of opportunity in which procurement events are temporarily aligned with mechanisms that focus the purchasing organisation on particular societal issues and

demand-articulation techniques that increase the likelihood that opportunities for innovation will be recognised and exploited.

The analysis confirmed a tendency for path-dependency in local authority procurement, reinforced by institutional layers; myriad organisational relationships and dependencies, and procurement cycles that recycle residual knowledge of markets and technology left behind by incumbent suppliers. Potential to select new routines leading to novel products and services is thereby curtailed. Potential for ambitious PPI may therefore depend on external shocks or path-breaking. Some path disrupting mechanisms can be orchestrated by policy-makers (e.g. new institutional frames directing new problem and solution-foci), but others will evolve organically as a result of local diversity or socio-political struggles leading to (creative?) disruption of organisational rationales. This characteristic of path-dependency in public procurement indicates its use as a demand-based policy implementation mechanism may require combinations of innovation policy mechanisms to achieve mission-oriented innovation goals by lifting the gaze of public managers beyond their existing routines and knowledge.

Stage of research

final results.

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MANAGING INNOVATION RISKS WITH PRE-COMMERCIAL PROCUREMENT AND INNOVATION SUPPORT SCHEMES

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Keywords: innovation policy; risk management; public procurement for innovation; R&D funding, pre-commercial procurement

EXTENDED ABSTRACT

There is a growing interest in deploying demand-oriented innovation policy in Europe. One of the flagship initiatives of the European Commission has been the introduction and deployment of the pre-commercial R&D procurement (PCP) approach. In this approach, development and commercialisation of innovative solutions to meet societal challenges and public sector needs are promoted through an R&D procurement programme progressing in three stages. One of the key inspirations to the European PCP model has been the Small Business Innovation Research (SBIR) programme in the United States. Variations of the SBIR approach have been also implemented in other countries, such as in Australia. These programmes aim to pull societally relevant technology and innovation from the supply chain through competitive selection process progressing typically in three consecutive phases.

Effective sharing of risks and benefits is often presented as a key feature of these pre-commercial innovation procurement and support schemes (European Commission, 2007; Wessner, 2008). The government shares the risks involved with innovation by providing financial inputs (contracts or grants) to selected firms. Benefits are shared as firms are typically given ownership to intellectual property to enable its effective commercial exploitation. The government gains value by stimulating the development of innovative supply to meet societal needs. In general, these programmes are typically portrayed as procurement programmes or support programmes with innovation-friendly intellectual property regime.

This paper explores the diverse aspects of risks and benefits in pre-commercial procurement and support schemes. The paper argues that the schemes have potential to manage risks and benefits related to innovation more broadly than is generally presented in currently available accounts. They extend beyond financial aspects and assignment of intellectual property to cover a diversity of risks and benefits related to innovation process in the context of user-producer relationship (Lundvall, 1985; Rothwell, 1994).

The paper first reviews existing literature on risks related to innovation. An appropriate point of departure is provided by recent work on risk management in public procurement for innovation (Tsipouri et al. 2010; Edler et al. 2015). In this line of research, technological, organizational, societal, market-related, financial, and turbulence risks are specified. Drawing on this work and other relevant innovation studies a

risk management perspective to pre-commercial innovation programmes is developed. We distinguish between developer risks encountered by innovative firms, and government risks as users and public financiers. Pre-commercial innovation schemes balance risks between these two parties across the user-producer relationship. In addition to financial and IPR issues, we identify various risks and benefits covering needs/demand articulation, conformance to user preferences, supplier competition, technology and vendor lock-in, market entry, innovation adoption, diffusion and market shaping.

We apply this risk management framework by analysing and comparing three variants of pre-commercial innovation programmes: the Small Business Innovation Research (SBIR) programme of the United States, the Victoria Market Validation Programme in Australia, and the pre-commercial procurement (PCP) approach in Europe. The data was collected in an ongoing European project on public procurement of innovation in the water sector. A case study comparison between selected OECD countries was conducted. In each case country, an innovation process of one novel water-related technological product was analysed. In each case the product development was supported by a pre-commercial innovation programme, and once commercially ready, the product was subsequently procured by a public authority or water utility acting as the first adopter.

By drawing on institutional theory (Powell & DiMaggio, 1991), the paper distinguishes various degrees of institutionalisation among the identified risk management practices. Some of the practices are embedded in the structure of the funding schemes and guidelines regulating them (strongly institutionalised practices), such as the competitive selection process progressing in multiple stages which effectively mitigates technology risks. Other practices represent local ways of implementing the programme in *ad hoc* basis (weakly institutionalised practices), such as close user-producer relationships contributing to innovation with high responsiveness to user requirements.

The paper makes several contributions. First, it complements the emerging literature on risk management in public procurement of innovation by applying it to pre-commercial innovation support schemes. Second, it compares three pre-commercial innovation programmes through detailed case studies providing evidence for policy learning between Europe, the United States, and Australia. Third, by distinguishing between variably institutionalised risk management practices it specifies good practices implemented on *ad hoc* basis which hold potential to be more systematically applied and become more strongly institutionalised and thus less dependent on specific individuals in charge of implementation.

Finally, the paper discusses the differences between pre-commercial innovation schemes providing contracts (PCP), grants (MVP of Australia), or both contracts and grants (SBIR). While the case study analysis does not provide any quantitative evidence of the economic impacts of each approach, the risk management perspective allows studying how the financing mode influences incentives as perceived by the firms and the government. We notice that the different modes of financing (contracts or grants) do not appear to alter significantly the firm's incentives to innovate. Instead, other programme practices, functioning as risk management mechanisms, can have relatively larger impact on the perceived incentives. These tentative findings based on a multiple case study warrant validation by further research with larger data.

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EXPLORING BIASES AND POTENTIAL EFFECTS OF S&T INDICATORS IN PERIPHERAL SPACES

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Keywords: Indicators; peripheries; marginalised spaces

EXTENDED ABSTRACT

This paper aims to explore the problems that emerge when S&T indicators are used in peripheral contexts, that is, in geographical or social spaces that are somehow marginal to (or marginalised by) the centres of scientific activity. In these situations evaluators and decision-makers are likely to use indicators that were designed to reflect variables relevant in the dominant social and geographical contexts --i.e. in the hegemonic countries, languages, gender, disciplines, etc.--, but that are usually not adequate in peripheral contexts.

We will examine various dimensions of periphery. First, the geographical: e.g. global south vs. global north, regions vs. metropolises (Aguado et al. 2014). 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 to be less researched than those of the latter (Stirling, 2014). 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 (van Eck et al, 2013).

This study investigates the mechanisms by which performance indicators tend to be biased against peripheral spaces. This would include for example, bias in language (van Leeuwen et al. 2011), or disciplinary/topic coverage in conventional databases (Martin et al., 2010). An interesting issue to consider is how the overlap across peripheries, i.e. how bias in language coverage has an effect on bias in disciplines or topics covered (Archambault et al., 2006; Piñeiro and Hicks, 2015).

We discuss how these biases may have a tendency to suppress scientific diversity and shift research towards a higher degree of homogeneity (Rafols et al., 2012). We discuss how the "objectification" of excellence by means of indicators may support the diffusion of mainstream modes of research at the expense of critical or unorthodox modes.

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AN ATTEMPT TO MEASURE INNOVATION DIFFERENTLY – RESULTS OF A PILOT SURVEY

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Keywords: Innovation statistics; Innovation Policy; Survey; Innovation measurement

EXTENDED ABSTRACT

The paper presents the final results of a pilot survey on innovations in firms. The paper contributes to the on-going discussion on the development of innovation measurement by indicating that innovations are always complex entities including various changes on organizational level and measurement of various innovations separately may give a biased impression of their occurrence in the firms. In addition, the survey indicates that firms have difficulties to define what an innovation is and thus it is difficult to measure their innovativeness reliably.

Especially OECD has a long history as an organization developing and setting the standards for STI measurement and indicators (Godin, 2005) and its work has been closely connected to indicators used at the national and EU levels. The latest development relates to the now relatively widely accepted idea that innovation policy should be more “broad-based” (OECD, 2010). The basic issue is the observation that the scope of innovation activities has broadened beyond the traditional R&D perspective. This means, for instance, that non-technological innovations such as service and marketing innovations have a growing importance alongside technological innovations and there is a number of various innovation patterns firms use. Consequently, during the last few years several indicator development projects have been launched by the OECD and EU, focusing on the measurement shortages.

While the measuring of innovation is always challenging, the widening of the scope of innovation has made measurement increasingly challenging. One of the major challenges is the definition problem: innovations can never be sharply defined (Kline & Rosenberg, 1986). Even if the Oslo Manual (OECD, 2005) have done a great deal for defining innovation for measurement, in practice it is never clear-cut what an innovation is and what is not. Concurrently with the broadening of the scope of the innovation and innovation policy, the definition problem has become increasingly complex. Difficult as it is to tell whether a product or process is innovative, it is even more complicated to judge an organisational change (method) as an innovative one. For broader concepts of innovations, there is much less research on measurement than for so called traditional innovations (Armbruster, et al., 2008). Innovation measurement is always based on someone’s subjective call on innovativeness. For instance, respondents may interpret the concept of innovation differently from what was intended in the questionnaire. There is evidence of this for instance from Australia (Arundel, et al., 2010). Interpretations can also vary from one respondent to another due to

cultural differences. There is, for instance, significant national variation in the Community Innovation Surveys, for which it is difficult to find an explanation other than different perceptions of innovation.

In this pilot survey, we have tested whether it would be possible to transfer at least part of this subjectivity from respondents to researchers by not asking about innovations but about changes and their novelty value. The idea was to omit the abstract term 'innovation' from the questions. The innovativeness of a change was interpreted according its novelty value. We also used open-ended questions to reflect novelty value. Open-ended questions were also used to alleviate another measurement problem related to the questionnaires: closed surveys restrict and lead respondents to agreed definitions and might hide useful information of real innovation processes.

The survey was targeted at the same group of companies which participates in the Finnish CIS survey. The survey included all enterprises with at least 250 employees and a sample of enterprises with fewer than 250 but more than 10 employees. The sampling method was stratified simple random sampling. Subgroups in the sampling were based on personnel size groups and industrial classification. Statistics Finland conducted the sampling. The questionnaire was sent to 2,860 enterprises by mail, and responses were collected via an online form between 18 February and 3 April 2013. The questionnaire was sent and the data collected by Statistics Finland. There were 819 accepted answers received by the deadline, giving a response rate of 28.6%.

The survey addressed changes that companies had made in the past three years. The questionnaire contained multiple-choice questions as well as open-ended questions. The response rate was higher than anticipated, probably partly due to the survey being carried out by Statistics Finland. That said, it seemed that a large part of the respondents were motivated to respond to the survey, judging by the quality of answers to the open-ended questions. The respondents appeared to be proud of their change and wanted to share their experience. Some also regarded the survey as an opportunity to voice their views, in particular to express their concerns of the future of manufacturing in Finland.

The general result of the survey was that companies are very active in making changes. In the past three years, 75% of the respondents had implemented changes. The changes described in the survey were mostly complex and indicate the need for complementary changes in the organizations. The changes comprised concurrent changes in the strategy, organisation, processes, products, etc. When something is changed, it is usually accompanied by other changes. The main reason for companies to make changes was a forward-looking desire to grow, to be more competitive and efficient. The main inspiration for changes came mainly from internal discussions within the management team not from e.g. technological pressures even though there were also technology-related inspirations for change.

While the survey revealed the complex nature of changes, it also revealed the difficulty of assessing the innovativeness of changes. This, in particular, is the case for a broader concept of innovation. It is very difficult to assess the innovativeness of anything other than product and production process changes. For these 'traditional' innovations, the results given by the questionnaire and answers drawn from the open-ended questions were in accordance. In addition, results from the survey were broadly in accordance with the results of the CIS.

The same cannot be said about the wider set of innovations. In the questionnaire, changes in the strategy and organisational methods (organisational processes) were most frequently described as novelties. Instead, in the open-ended answers their innovativeness did not seem to be equally common. This indicates that it is difficult to assess innovativeness on the basis of open-ended answers. This also raises a question as to whether a change really was a significant and novel one if there was no mention of it in the open-ended answer. This suggests that assessment of innovativeness is difficult for companies. Companies are not used to consider their processes from the perspective of the world or sector-wide novelty value. It might be also doubtful how often organisational changes or changes in business models really are innovative. At the very least, it is difficult to measure their innovativeness reliably.

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SWEDEN IS NOT THE INNOVATION LEADER OF EUROPE

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Keywords: Innovation indicators; innovation policy; innovation system; performance.

EXTENDED ABSTRACT

According to the Innovation Union Scoreboard, Sweden has been, and still is, an innovation leader within the EU and one of the most innovative countries in Europe. In the Innovation Union Scoreboard 2014 (European Union 2014: 5), Sweden has the top position (ranked number 1) of all 28 EU Member States in what is called “EU Member States’ Innovation Performance”. In the ranking there are 10 countries between Sweden and the EU average. This analysis is based on the ranking provided by one single composite indicator (SII or Summary Innovation Index), based on 25 separate indicators.

In this paper we argue that the SII composite innovation indicator provided by the Innovation Union Scoreboard is highly misleading. The data (the separate indicators) need to be analyzed much more in depth in order to reach a correct measure of the performance of an innovation system. We argue that input and output indicators need to be considered separately and measured specifically. Thereafter we compare the input and output indicators to each other (as is normally done in productivity and efficiency measurements). The outcome of this is a relevant and better measure of innovation performance.

In this paper, the performance of the Swedish national innovation system is analyzed by using exactly the same data as is used by the Innovation Union Scoreboard 2014. We analyze the relative position of Sweden regarding both input and output indicators, concluding that Sweden’s position as an innovation leader within the EU must be reconsidered. A theoretical background and reasons for selecting the indicators used is given and a new position regarding Sweden’s innovation performance compared to the other countries is calculated.

Our findings show, that Sweden remains in a high position for the innovation input indicators, ranked number 1. However, with regard to innovation output, Sweden is ranked number 10. In other words, about a third of all 28 European Union Member States have a higher innovation output than Sweden. To estimate the efficiency or productivity of the Swedish innovation system, inputs and outputs must be related to each other. When doing so, we reach the conclusion that Sweden is ranked number 24 of 28 EU Member States.

The conclusion is that Sweden can certainly not be seen as an innovation leader in Europe. This is because of the considerable gap between innovation input and innovation output, which leads Sweden to be ranked number 24 with regard to the efficiency or productivity of its innovation system. This means that the

Innovation Union Scoreboard is flawed and may therefore mislead researchers, policy-makers, politicians as well as the general public – since it is widely reported in the media.

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WHAT'S ON THE TABLE? TECHNOLOGY POLICY OPTIONS TO ENCOURAGE THE FINANCING OF BIOTECH INNOVATION

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Keywords: UK; finance; technology policy; SMEs; pharmaceuticals; biotechnology

EXTENDED ABSTRACT

The proposed paper describes work in progress exploring the options available to policy makers to stimulate the development of emerging technologies and industrial sectors. Specifically the paper describes the rationale for using (or not) policy instruments to encourage high risk, long term R&D in areas such as drug discovery. In doing so, the paper contributes to debates around the perennial question of ‘what can government do to support the growth of high-tech firms?’ by exploring the options that the UK is actually able to use. A wide range of supply-side and demand-side related policies, including mission oriented ones, are discussed.

The context for the paper is one of thwarted national ambitions. The UK has the largest pipeline in Europe of drugs under development in SMEs (as opposed to large pharmaceutical firms that pre-date waves of emerging biotechnologies), and also has supported the largest number of public (stock-market) supported SMEs in this sector in Europe (OLS 2009). Yet despite apparent promise in the 1990s and early 2000s, growth appears to have stalled and the fortunes of the sector have reversed in recent years.

In the 1990s, investors were supportive and provided capital to firms undertaking high risk R&D. However the investor community was not particularly selective and a stream of clinical trial failures, development delays and management scandals led to a collapse of investor confidence in the sector (Hopkins et al. 2013). Figure 1 shows median R&D spending of the UK sector, compared with the US, illustrating how the UK sector was at one time composed of at least some firms with comparable R&D spending to US rivals. However this position has been eroded as promising firms have been acquired, floundering firms have withered and investor scepticism about the ability to generate returns in the sector has reduced the flow of capital to new entrants.

In response to the lacklustre performance, UK Government has developed a dedicated Life Sciences Strategy to revive the sector. This move can be seen as part of a longstanding tradition of UK policy support for the pharmaceutical industry (Owen 1999) biotechnology (Sharp 1985, Orsenigo 1989) and health-related applications of the life sciences more generally (OLS 2009). As such the UK provides an opportunity to

explore the role of mission oriented policies and demand policies in the wider of a landscape of technology policy measures to support politically favoured industrial sectors.

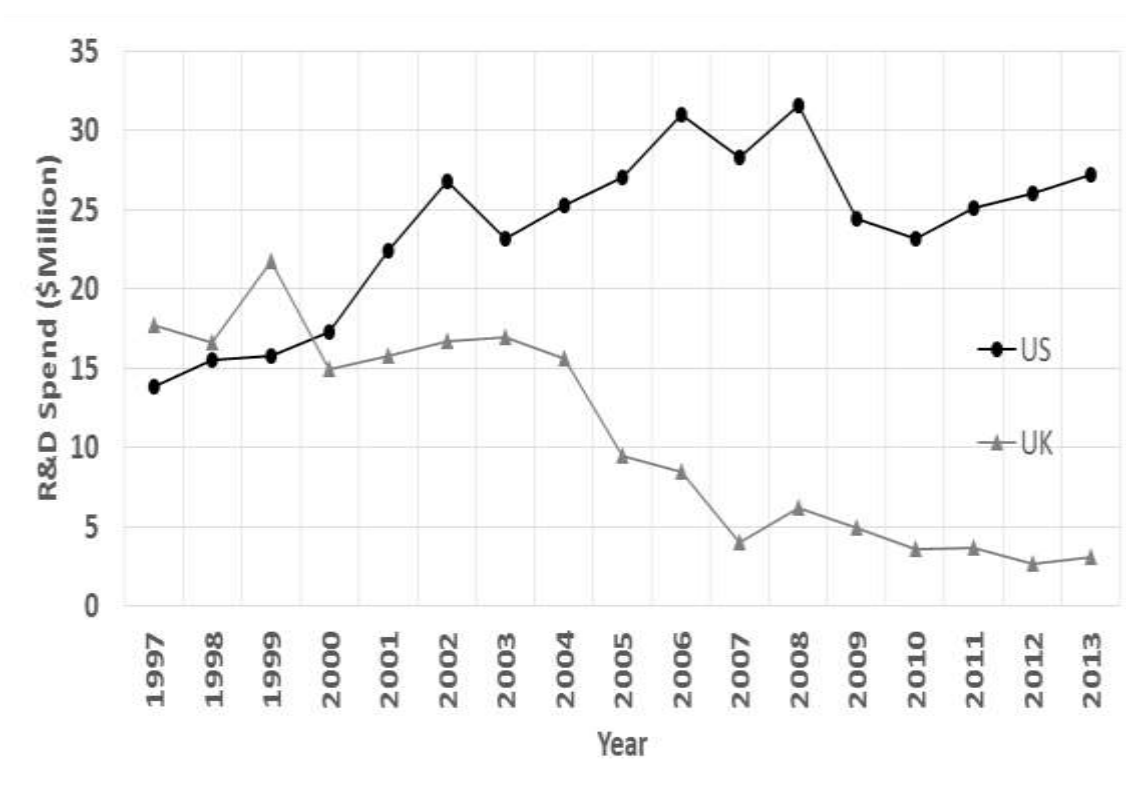


Figure 1: Median R&D spending (\$M) in US and UK drug developing biotech firms Source: Analysis developed from annual survey data collected by *Nature Biotechnology*

More generally, the paper provides a discussion of technology policy instruments used in the context of wider concerns over persistently poor performance of the UK in general in high-tech investing - see ETB's (2006) 'SET and the City' or the more recent House of Commons Science and Technology Committee Report (2013) on 'Bridging the Valley of Death'.

This paper uses Steinmueller's (2010) thematic analysis of technology policy instruments (see Table 1) to provide a framework to identify and critique different options that UK policy makers have used in order to encourage new and long established R&D intensive firms, as well as those being advocated by industry and investor lobbies.

Steinmueller (2010) identifies four themes in technology policy: Supply-side initiatives which include, for example, the use of horizontal measures such as tax incentives to encourage supply-side firms to invest further (e.g. R&D tax credits) or thematic funding, to encourage firms to participate in Government's priority areas of R&D, such as mission oriented programmes (e.g. platforms run by Innovate UK). Another key area of supply side focus is the use of incentives to encourage new sources of finance such as venture capital and business angles to develop an interest in emerging firms. Provision of complementary factors includes activities such as support for skills training in STEM subjects and related research funding to develop expertise. On the demand side, relevant policies would include the UK's pharmaceutical price regulation

scheme, or the recently established cancer drugs fund. The final theme is policies that establish institutional change, such as encouraging commercialisation activities in universities (the ‘third mission’) or the establishment of Technology ‘Catapult Centres’.

Table 1: Technology Policy Designs as identified by Steinmueller (2010)

Themes	Policy designs
Stimulating the supply side	Horizontal measures
	Thematic funding
	Signalling strategies
	Protectionist measures
	Financing measures
Provision of complementary factors	Labour supply
	Technology acquisition
Stimulating the demand side	Adoption subsidies
	Information diffusion
Institutional change	New missions for public institutions
	Creation of complementary institutions
	Quasi-public goods

The above suggests a diverse set of policies exist, in theory, to encourage the support of emerging areas of technology. However the paper will show that in practice, these are limited by national and supranational constraints such as EC state-aid provisions, WTO and the UK Treasury’s stance on technology-specific interventions, which is itself strongly influenced by the aforementioned institutions. The fiscal constraints of austerity also further limit scope for technology-specific policy interventions. Finally, policy measures require careful design (often iteratively) and evidence on the effectiveness of particular interventions may be lacking which may also inhibit uptake (House of Commons S&T Committee 2013).

The paper will argue that in a situation where technology specific interventions are difficult to introduce, horizontal measures may still be advanced. However as we will explore the benefits of these to off-target firms may produce deadweight losses for the economy while providing very little additionality in sectors of the economy of particular policy interest. UK examples of initiatives intended to boost high-tech investing but which have tended to support only marginal technology investment improvements include Venture Capital Trusts and the Alternative Investment Market (as will be discussed in more detail in the paper).

The paper argues that the result is an emphasis on policies that in principle seek to promote high-tech firms but in practice benefit investors without changing the nature of the playing field, which is not at all level, as those seeking long term, high risk, illiquid technology investments are all too aware. The result is a frustrated effort to support high-tech fields that are not competitive against other investment options that are available to would-be providers of capital.

We conclude by identifying some untried policy interventions that may be further developed and suggesting supranational restrictions on technology policy which may be overly restrictive.

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THE EMERGENCE AND TROUBLED GROWTH OF BIO-DIESEL INNOVATION SYSTEM IN TAIWAN

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Keywords: Bio-diesel; Innovation System; Taiwan

EXTENDED ABSTRACT

Research Problem

This article explores the evolution of bio-diesel in Taiwan through the perspective of technology innovation system (TIS). Bio-diesel innovation reduces the utility of fossil fuels and considerably decreases green house gas (GHG) emissions. Since 1992, the threaten of climate change which was addressed by the United Nations Framework Convention on Climate Change (UNFCCC) in was put into the central political agendas of energy policies of many governments. Following the UNFCCC, Kyoto Protocol which committed reduce GHG was opened for signature in 1997 and came into effect in 2005. Even though the Protocol currently only bind the emission of Annex I parties, the non- Annex I parties gradually faced the pressure from Annex I parties to burden the common obligation of reducing emission. Under the global trend to search for the low carbon renewable energy in order to replace oil and to reduce emission, bio-diesel innovation is encouraged by the governments all over the world. Even though Taiwan is not the signatory of Kyoto Protocol, under the global trend it inevitably was also urged to face the problem of reducing emission. Bio-diesel was thus promoted by the government policies as the response to Kyoto Protocol. Yet, until 2013, Taiwan only produced 100,000 kL bio-diesel annually (0.1 billion liters) which was far less than the global top producers of bio-diesel (IDB, 2014; REN, 2014).

Bio-diesel in Taiwan in fact emerged with the pressure of Kyoto Protocol, and the progress of the Kyoto Protocol deeply shaped the evolution of the Taiwanese bio-diesel innovation policies. In 1997, when Kyoto Protocol was opened for signature, the Taiwanese government has held the first National Energy Conference in 1998 to discuss the possibility of new renewable energies, and bio-diesel was for the first time considered as one of the potential renewable energies worth of further development. Since 2000, the Ministry of Economic Affairs has allocated the research funding to Industrial Technology Research Institute to support the innovation process on the refinery of bio-diesels with used cooking oil, the first generation bio-diesel. Such process innovation was transferred to several newly established small and medium enterprises (SMEs). Afterwards, in 2005 when Kyoto Protocol came into effect, the Taiwanese government also held the second National Energy Conference which still considered bio-diesel to be promoted. Following the conclusion of the second National Energy Conference, the regulation of the blending ratio between bio-diesel and oil was formally launched in 2008 when the domestic production system of bio-diesel was established. The Ministry of Economic Affairs implemented the new clauses of the Petrol

Administration Act and forced all domestic vehicles to refuel B1 oil in 2008 (Bureau of Energy, 2014). After the Copenhagen Accord in 2008, the Taiwanese government launched the third National Energy Conference in 2009 and after the third Conference B2 oil was imposed on all domestic vehicles in 2010. The regulation of blending bio-diesel with oil in fact formulated a stable market for domestic bio-diesel companies and accelerated the growth of bio-diesel development. Nevertheless, until mid-2014, due to the lobbying of a small group of tour bus enterprises which were not willing to use B2 oil, the Ministry of Economic Affairs abruptly terminated the regulation of B2 oil and the once formulated market of bio-diesel was completely eliminated. The domestic production of bio-diesel was then ceased after 2014 (Tang, 2014b).

The emergence and the troubled growth of the bio-diesel innovation system in Taiwan were both formulated by policies. The analysis of the influence of government policies on the ups and downs of the bio-fuel innovation system in Taiwan is the main aim of this article. We especially focus on the current policy blocking mechanisms which should be solved to accelerate the further development of the industry.

Method and data

We adopt the first-hand resources as the main the resources of our research. The resources are collected through two rounds. We have done the first round of desk research guided by the framework of technology innovation system. We sketch the system structure and functioning based on the 'event sequence analysis' established by Negro et al (2008). Afterwards, we also have done the second round of search through expert interviews. We interviewed 13 experts by using a semi-structured questionnaire with several additional questions adjusted according to different interviewees.

Result

We find out the current policy blocking mechanisms which hampered the development of bio-diesel industry. In fact, the bio-diesel policies were only consistently implemented from 2000 to 2008 yet not in the period from 2009 to 2014. From 2000 to 2008, the regulation policy of the Act Formulated the Market of B1 oil, and the Technology Development Program of the Ministry of Economic Affairs Mobilize Resources to encourage the Knowledge Development and Technology Transfer from ITRI to private companies. Such implementation of policies was legitimized by companies. Private SMEs were newly set-up. Both private SMEs and public company, China Petrol Corporation initiated the new investments in the production and distribution of bio-diesel. Nevertheless, from 2009 to 2014, although the policy objectives of the Act which tended to promote the 'sound development of the oil industry and national economy, to ensure the steady supply of oil, and to give consideration to environmental protection' were complementary with the policy objectives of the National Program, the implementation of the two policies were not consistent with each other. The implementation of the new clauses of the Act, which once expanded the market of bio-diesel to B2 eventually terminated and eliminated the Formulated Market. Even though the National Program kept Mobilizing Resources to encourage universities to Develop Knowledge of algal bio-diesel, the National Program alone could not stimulate companies to involve in bio-diesel industry. Under the condition that firms seriously lost interest in the innovation and production of bio-diesel, it was hard to identify that the two

policies together have actually developed bio-diesel industry, which would grow the national economy, energy security and would reduce emission.

The stage of research

The paper is almost completed, yet in the final stage, it should still be adjusted for further publication.

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POLICY AND FUNDING DECISIONS IN BRAZIL'S OIL AND GAS SECTOR

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Keywords: Petroleum, regulatory frameworks, innovation policy, breakthrough technologies, local content, emerging economies

EXTENDED ABSTRACT

The pre-salt oil reserves discovered in Brazil in 2007, and located at over 7000m below the sea surface, present Brazil with tremendous technical challenges but enormous potential for long-term sustainable growth in the industry. Brazil already has a solid knowledge and technology base with regards to deep and ultra-deep water exploration and production, albeit this expertise is located largely in the national industry leader, Petrobras. In many fields however, pre-salt presents a new paradigm: phenomenal depths, never before reached, and a corrosive and volatile environment, including unparalleled extremes of pressure and temperature. All these challenges have created great uncertainties in how to ensure production in the oil field, leaving the industry in pursuit of radical new technologies and confronting a period of technological change.

There are many ways in which periods of technological change can be characterised. However, the model that is most befitting of the scenario under which this research resides is that of Abernathy and Clark (1985). Whereas a preceding work from the lead author (Utterback and Abernathy, 1975) had viewed the categorisation of radical/incremental as somewhat binary, this later model suggests a continuum of polar extremes. The 'radicalness' of an innovation is determined by the extent to which it disrupts two dimensions: technology/production (design, production systems/methods, expertise, materials, supplier relations, capital equipment, and knowledge and experience base); and market/customer (customer base, customer usage, distribution and service channels, customer knowledge and experience, and modes of customer communication).

In Brazilian petroleum, what is needed in most fields is a complete breakthrough with regards to innovation. Whilst the market knowledge and customer base will endure – innovation efforts will be almost universally focussed on meeting the needs on the market – the existing technologies, most of which will not function effectively in the pre-salt oil fields, will be displaced by new technologies that offer the required performance and reliability to the market. For those firms that achieve this, their market linkages will be very much strengthened. This is Abernathy and Clark's (1985) Revolutionary Innovation.

Following the discovery of the pre-salt reserves in 2007, Brazil was considered by many to have a very bright future ahead. Current President Dilma Rousseff (at that time Secretary of State) claimed the pre-

salt reserves were Brazil's "passport to the future". Looking to ensure this future is realised, the Brazilian government has strived to generate innovation in the oil and gas industry through several policy and funding interventions over the last ten years. The interventions are clearly aimed at developing systems of innovation that are capable of Revolutionary Innovation to meet the needs of the market. These include:

- The 1% regulation: a contractual obligation that stipulates that operators of the high-yielding oil fields of Brazil must invest a minimum of 1% of the gross revenue derived from exploration and production of these fields in R&D in Brazil. Further, at least 50% of these funds must be invested in accredited Brazilian universities and public research institutes;
- Local content: operators in Brazil must procure a minimum percentage of equipment and services from Brazilian companies, referred to as 'local content'. This percentage varies from contract to contract but of late has been as high as 90%;
- Greatly-increased opportunities for grant funding (on a loan or subvention basis), primarily through BNDES (National Bank for Economic and Social Development) and FINEP (Funding Authority for Funding and Projects).

This article discusses the nature and application of the 1% regulation, local content policy and public grant funding in Brazil's pursuit of a robust, high-technology domestic supply sector for its oil and gas industry. This paper does not aim to measure the effectiveness of these policies in increasing innovation in the Brazilian oil industry. Rather, it offers an analysis of how these policies have been designed and applied to the industry and the implications this will have for the industry as it pursues growing and enduring success. The policy and funding arrangement is contrasted with that which proved so instrumental to the growth in Norway's petroleum industry during the 1970s North Sea oil boom.

There are key concerns with how each of the three aforementioned interventions have been designed. The growth emerging from the 1% regulation is in universities/research institutes and in innovation manifested within the technology centres of Petrobras and foreign operators (i.e. MNEs). The former will see an increase in the levels of expertise within universities/research institutes, as well as the number of students graduating with that expertise. These students will be well placed to take up employment at the many new technology centres in the country. However, this does not address the lack of an entrepreneurial culture and entrepreneurial opportunities that has blighted the country, leaving the oil industry dependent on importing technologies from abroad. If Brazil is to develop a substantial domestic supply sector for the industry, creating long-term sustainable growth not just in employment and expertise but in the number of highly-innovative companies therein, investment must be focussed on the domestic market, not just academia.

Secondly, the local content policy, which is clearly aimed at replicating the success Norway experienced in developing its domestic petroleum supply sector during the North Sea oil boom of the 1970s, and which was supported by such a policy, is not being applied to the pre-salt oil fields. Petrobras has been assigned the role of sole operator in these fields: the perspective of the government being that this will thereby maximise the gains from these fields for the country. However, this seems particularly short-sighted. With no obligation for Petrobras to procure goods and services from Brazilian companies, the decision of

who to procure from is made entirely within the company. This a company that is notoriously risk averse, operating in fairly unknown territory, where the cost of failure can be catastrophic (the Gulf of Mexico disaster of 2010 all too fresh in the memory). Petrobras has longstanding, trusting relationships with foreign suppliers. Without local content, there is no reason for them to deviate from these suppliers, and more so these established technologies, and procure instead from a domestic supplier.

This decision encapsulates the government's approach to the pre-salt discoveries in general. Whilst the discoveries were sold as a catalyst for the development of the country, there has been such haste in getting these oil fields producing that the supply sector could not have possibly kept up. And with the policy aligned in the way it currently is, it is difficult to see the development of supply sector occurring in the manner and to extent to which it is hoped.

Finally, there is a problem with the nature of and selection process for grant funding. Whilst subvention is available for higher risk projects, there is currently not enough subvention available. More worryingly, recent increases in financing, particularly the launch of a new fund – Inova Petro – has lead to a significant increase in loans (i.e. lower risk projects) but no increase in subvention. Given the scale of the pre-salt challenges and the need for radical innovation, it is certainly important for companies to take risks and for funding agencies to support such companies.

The process by which projects are selected for funding also raises some concerns for the prospects of the supply sector. The two leading funding agencies work together with Petrobras to determine which projects should be supported. Given Petrobras' risk averse nature and history of incremental innovation, it is safe to assume Petrobras will be steering funding towards incremental innovation. Given the nature of SMEs as typically risk-taking and as such sources of radical innovation (Kanter, 1985), it is clear how this could prove detrimental to both the domestic supply sector and the innovative capacity of the national industry as a whole.

All of the above is discussed within the context of 30 in-depth interviews, conducted in March/April 2015, with Brazilian government agencies (both policy makers and funding bodies), Petrobras, foreign petroleum MNEs operating in Brazil and domestic supplier SMEs. I conclude that while government intervention has the potential to greatly support the development of the industry's supply sector, in its current arrangement it has little chance of generating the sort of innovations that will lead to sustainable growth. What is needed is a long-term perspective, which places the patient nurturing of the industry's innovative capacity ahead of the immediate gains for the national economy from hastening these oil fields into production

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MODELLING THE CONTRIBUTION OF INNOVATIVE HUMAN CAPITAL AS A DRIVER OF FIRM-LEVEL INNOVATION AND ASSESSING THE IMPLICATIONS FOR INNOVATION POLICY

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Keywords: Innovation Policy; Innovative Human Capital; Complementarity; Human Capital; Innovation Output

EXTENDED ABSTRACT

This study explores the effect of different measures of human capital on firm-level innovation. This is an active area of scholarship with important policy implications. Innovation theory and literature highlight the importance of human capital (traditionally measured by education and training) as a determinant of innovation output. The current paper expands the debate by identifying a novel measure of human capital with respect to innovation output, and highlighting ways in which policy can support this measure.

Our understanding of innovation has evolved from the linear model of technical and scientific invention (Kline & Rosenberg, 1986) to a recognition of the importance of innovation systems (Lundvall, 2010). Higher levels of human capital (as measured by education and training) have been found to encourage innovation by generating new knowledge and developing existing methods, technologies and know-how, thus benefiting the firm. Given the widespread rise in education levels, a continued reliance on such tangible measures of human capital may lead to a decrease in the comparative competitive advantage garnered by firms for their innovation output. Hence, in order for firms to secure a sustainable competitive advantage, there is a need to evaluate human capital in terms of both tangible (education and training) and intangible measures (job satisfaction and willingness to change in the workplace, as in McGuirk et.al (2014)). This leads us to pose two research questions: 1) How is human capital best measured as a driver of firm-level innovation? 2) How can innovation policy support human capital as a driver of firm-level innovation?

This is the first study that addresses these questions (to our knowledge); its novel contribution to the knowledge base is three-fold. Firstly, we compare three ways of measuring human capital: namely, tangible measures, intangible measures, and a multidimensional/holistic concept comprising both tangible and intangible measures (which we coin Innovative Human Capital). Secondly, our econometric analysis is novel in that it tests whether complementarities exist between the tangible and intangible measures of Innovative Human Capital (IHC). Thirdly, using empirical evidence regarding the different measures of human capital, we make suggestions regarding possible future innovation policy interventions and directions.

In order to further our understanding of human capital we test four hypotheses as follows:

H1: The tangible measures of human capital contribute to firms' innovation output.

H2: The intangible measures of human capital contribute to firms' innovation output.

H3: Innovative Human Capital contributes to firms' innovation output.

H4: The measures of Innovative Human Capital complement each other and contribute to firms' innovation output.

Our empirical analysis is based on Ireland's *National Centre for Partnership and Performance Workplace Survey* (NCP) 2009¹. The dataset offers a rich variety of information about a representative sample of firms in Ireland, including the views and experience of employees during the period 2007-2008.

The standard approach in the literature measures human capital by means of the proportion of the workforce with third-level education and/or training; the extended IHC equation incorporates intangible measures into this standard model, giving equation (1):

$$IO_i = \alpha_0 + Edu_i\alpha_1 + Tra_i\alpha_2 + JS_i\alpha_3 + WtC_i\alpha_4 + Z_i\alpha_5 + \varepsilon_i \quad (1)$$

When it comes to estimating our model, we utilise a series of probit models. We estimate equation (1) three times, once each for product, service and process innovation.² Our econometric analysis is novel with respect to testing for complementarities among measures of IHC in firm's innovation production functions.

Summarising the results, we find that both tangible and intangible measures of IHC can aid in explaining the innovation output of firms. Both measures have positive effects on the three types of innovation output considered. In the case of service and process innovation there is evidence of a complementary relationship between the measures of IHC, suggesting that developing both measures together lead to greater innovation output than engaging in one or the other separately, thus supporting the concept of IHC. This complementary effect suggests that firms cannot ignore the intangible measures of IHC and focus solely on the tangibles; to do so would deny them of valuable human capital that could spur the development of service, product and process innovation outputs. Our results suggest that the focus on education and/or training in isolation as a measure of human capital is over-simplistic; it fails to address the multidimensional nature of the individual. The intangible measures of IHC not only influence firms' innovation output; they also increase the effectiveness of the traditional tangible measures. By disregarding the intangible measures, previous studies have only partially explored the complexity of human capital as a determinant of firms' innovation output.

The above findings suggest some possible implications for policy aimed at improving firms' propensity to innovate. Despite the recent emphasis in the academic literature on intangible/softer measures of human capital, a review of the policy landscape immediately reveals that policy has not kept abreast with increasing academic emphasis on such measures.

Our findings suggest that policymakers are justified in supporting education and training; that is, the traditional tangible measures of human capital as a driver of innovation. However, our most significant result is that the best predictor of innovation outputs is firms' employment of a holistic/multidimensional measure

¹ The NCP collaborated with Ireland's *Economic and Social Research Institute* survey unit and Amárach Research (research consultants) to conduct the 2009 survey.

² While it would be possible to estimate this model using a multivariate probit model, Roper et.al (2008) notes that the additional benefit of doing so is minimal. Also, as we are employing joint hypothesis tests to our coefficients, we prefer to estimate our equations in isolation.

of human capital (IHC) as a driver of innovation. This suggests that policymakers should explore possibilities for interventions via policy instruments that support both tangible and intangible measures of IHC. Such intervention should occur only where it is merited on grounds of clearly specified market or system problems, or systemic failures. On a policy level, we fully concur with Haapanen et.al (2014, 558) who argue that, “In light of increasing government budget constraints, it is more important than ever that a sufficient rationale exists for government intervention...”.

It would appear that private firms have potentially significant gains to derive from using IHC as a driver for innovation (given the significant effects of IHC on innovation output and the complementary relationships between the measures of IHC). This suggests that firms should invest in matching funding to accompany any public funding supporting interventions related to IHC.

The current study has also indirectly contributed to the important debate about policy and policy instrument mix (Flanagan, et al., 2011; Borrás & Edquist, 2013). By testing complementarities between the various measures of IHC, we indirectly highlight that achieving optimal combinations between IHC measures may call for different combinations between policy instruments aimed at promoting these measures, with the ultimate goal of accelerating firms’ innovation output leading to economic growth and competitiveness. Policy interventions that target various measures of IHC may have interdependencies and synergies, or even conflicts and tensions, between them. Given the dynamic nature of firm environments and the multifaceted nature of firms’ IHC, policymakers will need to be experimental in their interventionist approaches. A degree of trial and error accompanied by policy learning will probably be the order of the day. It should also be highlighted that any policy interventions should be evaluated from *ex-ante*, interim and *ex-post* perspectives (Lenihan, 2011). Such an approach will call for a fine-grained evaluation of the effectiveness of all policy instruments. This makes the policymakers’ task more challenging, but may ultimately contribute to better policy outcomes.

In summary, our results suggest that both tangible and intangible measures of Innovative Human Capital drive innovation outputs. We also observe significant complementary effects between these measures. This points to the value of adopting the holistic Innovative Human Capital measure as a means of assessing firms’ resources. We suggest future directions for innovation policy interventions with the objective of promoting Innovative Human Capital as a driver of firm-level innovation. The opportunities for policy interventions that help to drive innovation via IHC are both exciting and challenging from the perspective of design, implementation and evaluation of policy.

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EXTENDING THE CONTRACT FOR ANOTHER YEAR? SUBSIDIES TO FOSTER THE EMPLOYABILITY OF S&T WORKERS IN SPAIN

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Keywords: Program evaluation; S&T workers; Innovation policy; Additionality; Spain.

EXTENDED ABSTRACT

In the mid 1990's, the mechanism for directly subsidizing private firms, a traditional aspect of Spain's industrial policy, was extended to new instruments. The year 1997 saw the onset of IDE Action ("Incorporation of Doctors in Enterprises"), offering subsidies for companies hiring PhD degree holders. Then, in 2001, the Torres Quevedo Program (TQP) came to amplify subsidies to "facilitate the incorporation of PhDs and technicians to businesses and technology centers". Since then the TQP has been functioning, yet there have been no evaluations of its end results, beyond follow-up by the corresponding ministry.

The aim of this study is to analyze the early design of the Torres Quevedo Program and the factors associated with the consolidation of the employment opportunities for science and technology (S&T) workers the program subsidized. More precisely, we study the results of the first five calls of the program, published in 2001-2004, whose initial decisions were published in 2002-2006 and for which public funds were allocated between 2002 and 2008, based on information from the administrative database of the program. We have a close look at its objectives, requisites, conditions for execution and results obtained in order to determine to what extent the program contributed to the consolidation of new jobs for PhDs and technicians as science and technology (S&T) workers in the Spanish private sector, and specifically within the firms and technology centers receiving the public funding. We do so by analysing the extension of the contracts beyond the initial year of the contract to a second and to third year, taking into account that the formalization of permanent jobs was a condition to extend the subsidy to the third year.

Some studies have examined the effects of subsidies on salaries (e.g. Thomson and Jensen 2010), the determinants of demand for PhDs have also been analyzed (Garcia-Quevedo et al 2012), as have the programs supporting firms that hire PhDs (Cruz-Castro and Sanz-Menéndez 2005); however, studies about public aid programs for hiring researchers and R&D personnel by firms are not as common in the international realm. Still, there are relevant theoretical arguments supporting the effectiveness of such programs, given the relationship between the quality of human resources and the level of innovation. Authors Cohen and Levinthal (1990) underlined the capacity of absorbing knowledge on the part of businesses; since then, the concept of absorptive capacity (understood as the capacity of a business to acquire, appraise, assimilate and apply new knowledge) has become widely used in empirical studies about

business innovation and in the discourse in favor of innovation. Mowery and Oxley (1995), with an emphasis on human capital and the level/type of qualifications of personnel, define it as the set of skills necessary to deal with the tacit component of external knowledge that is transferred to the firm, or that the firm acquires, and to modify such knowledge. Zahra and George (2002) introduce the dynamic dimension, distinguishing between the absorptive capacity and the actual capacity carried out. This analytical distinction is of interest for our work in particular, with its focus on permanence.

To some extent, the permanence in the company of newly hired persons in the last year of aid could be viewed as the additionality of input (R&D personnel is no doubt involved in such activity), but our methodological approach is different. Indeed, the object of analysis itself is different. We chose to analyze permanence in the employment of PhDs and technicians hired by means of a subsidy; we are interested not in the additional effect, but rather in the factors that influence the relationship between program and permanence. The construction of a control group would not apply in this type of analysis. Secondly, our data come from the administrative records of the program. In comparison with techniques based on self-reports or surveys, working with administrative databases guarantees greater coverage of the population and reduces subjective bias, even though the variables used are the objective ones available in the administrative records.

Therefore, our aim is to analyze the duration of the subsidy as an approximate indicator of the work integration of the PhD or technician in the business, and of the increased capacity of the business. To that end, we estimate what characteristics of the funding, the persons, the entities and the projects approved are more closely related with the extension of funding for an additional year, we rely on two probit estimations (Table 1). In a first probit, we estimate what features of the contracts which received the first annuity are more significantly associated with their extension to a second year. In the second probit, we proceed the same way for contracts receiving the second annuity, to estimate the features more closely associated with an extension to a third year. We separate the analysis of the decision to renew one year from the decision to renew the following year in different regressions, to allow the relationship between the explanatory variables and the decision to renew some room for variation from one year to the next, for one reason because the subsidy decreases in quantity over the three years.

In light of the results of the study presented in the paper, we conclude the early years of the Torres Quevedo Program have contributed largely to strengthen R&D capacities in business, at least in terms of the duration of subsidized contracts. Nevertheless, we observe marked differences between contracts for PhDs and technicians. The entities which took best advantage of the subsidies were technology centers, in the case of technicians, and organizations with higher shares of R&D personnel, in the case of PhDs. If the strategy in the mid- to long-term is to consolidate jobs of S&T workers in the private sector, with the aim to reinforce R&D and innovation capacities at Spanish firms, it may thus make sense to clearly differentiate between aid for technology centers and aid for different types of firms with different programs, adjusting the focus of the different subsidies (which are temporary by definition) to each kind of recipient. In contrast, if the main objective of the program in the period considered was to increase the innovative capacity of businesses, the design of the program may not have been ideal for firms just starting from scratch in R&D capacities. In

such cases, collaboration with private technology centers or even public R&D centers may prove more efficient than hiring S&T workers directly in order to reach innovative capacity objectives. Those SMEs reluctant to apply for the program because of its heavy administrative requirements might have nevertheless benefitted indirectly, through the increased capacities of technology centers.

Table 1. Likelihood of extending the TQP contracts for one additional year.

	PhDs		Technicians	
	First to Second Year	Second to Third Year	First to Second Year	Second to Third Year
	(1)	(2)	(3)	(4)
<i>S&T worker</i>				
Woman	-0.036 (0.044)	-0.068 (0.044)	0.021 (0.036)	0.053 (0.050)
Years since undergrad	0.003 (0.005)	-0.003 (0.005)	0.004 (0.004)	0.004 (0.006)
<i>Project</i>				
Chemistry	0.023 (0.055)	0.010 (0.057)	0.035 (0.045)	-0.033 (0.068)
Computing	-0.079 (0.107)	-0.052 (0.114)	-0.051 (0.054)	-0.176** (0.087)
Other	-0.024 (0.061)	0.062 (0.061)	0.029 (0.041)	-0.078 (0.066)
<i>Entity</i>				
Technology center	0.098* (0.052)	-0.156** (0.064)	0.205*** (0.036)	0.168*** (0.052)
Large firm	-0.046 (0.071)	-0.080 (0.073)		
Less than 5 years since creation	-0.060 (0.047)	-0.100** (0.049)	0.073** (0.035)	0.080 (0.050)
Share of R&D in total staff	0.069 (0.066)	0.186*** (0.071)	0.013 (0.054)	-0.057 (0.076)
Less favored region (Obj. 1)	-0.111* (0.058)	-0.090* (0.048)	0.083* (0.045)	0.150** (0.060)
<i>Finance</i>				
Advanced payment of TQP aid	-0.025 (0.045)	0.073 (0.048)	-0.067* (0.035)	-0.086 (0.055)
<i>Contract</i>				
Salary (log)	0.059 (0.098)		0.005 (0.081)	0.126 (0.134)
Intensity of TQP aid (aid/cost)	1.039 (1.164)		1.259* (0.727)	- (1.378)
Intensity of TQP aid (aid/cost) squared	-0.501 (1.053)		-1.060 (0.656)	3.957*** (1.445)
Pseudo R-sq	0.045	0.036	0.059	0.076
Log Likelihood	- 234.8886	- 276.1954	- -403.6547	- -219.745
LR Chi2	(14) 22.24	(11) 20.39	(13) 50.78	(11) 31.37
Prob > Chi2	0.0738	0.0403	0.0000	0.0010
N	447	468	751	402

Notes: Standard error given in parentheses * 0.10, ** 0.05, *** 0.01.

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PROMOTION AND SYSTEMS OF PROMOTION IN ACADEMIC CAREERS

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EXTENDED ABSTRACT

Rationale and relevance

Universities play nowadays a key role in economic growth and social wellbeing. Over the past years universities has become more important as a result of national policies and supranational frameworks oriented to turn traditional productive systems into innovative ones (OECD 2010a). Universities, with emerging demands from new evaluation and funding mechanism (OECD 2010b), are expected to reach excellence in their missions of training high-skilled human capital, generating new knowledge and transferring research results. This requires either university differentiation or the combination, in a coherent way, of the university missions (education, research and transfer); however universities' functional complexity, sometimes with conflicting objectives, increases the pressures on researchers and their careers (e.g. Estabrooks et al. 2008).

These ongoing changes are leading to an increasing demand on universities to improve their performance regarding good education results in terms of the employability of their graduates, fund raising, publication of research outputs and knowledge commercialization. A key dimension of these challenges relates to the attraction and retention of talent, especially researchers and academic staff, but very little is known about the way in which universities transform themselves in terms of human resources policies and the extent to which the individuals and organizations 'comply' or 'decouple' from discourses about the university role in the knowledge economy.

Analytical background and contribution

Universities are usually analyzed in terms of different models of governance (e.g. Olsen 2007; Dobbins and Knill 2011). Previous research has identified differences among ideal types of universities in various relevant dimensions that shape their potential 'actorhood' for strategic action (Krücken and Meier, 2006; Whitley 2012); among those key dimensions we focus on the employment policies.

Human resources are an essential cornerstone for the success of higher education institutions; the performance of universities in different dimensions depends largely on the quality and excellence of its professoriate. This is why nowadays there is a growing competition among universities to attract and retain

high-skilled academics (Lepori et al. 2015; OECD 2008). Despite research on academic promotion is large, it is mainly focused either on the empirical research of potential factors to explain promotion (e.g. Cruz-Castro and Sanz-Menendez 2010; Pezzoni et al. 2012; Sanz-Menendez et al. 2013; Lutter and Schroder 2014; Zinovyeva and Bagues 2015) or on the functioning of normative models of hiring and promotion (e.g. Chait 2002; Trower 2000).

Notwithstanding its relevance, empirical analyses of the process of promotion and the perception of academics about their own careers, their expectations, or their assessment of the promotion criteria and systems, are very scarce. Therefore, some critical questions remain open: Have the opinions and perceptions of academic staff changed according to the changes in discourses? Is there coherence between the official policies and the academics' perceptions and opinions about their work? Have the requirements, opinions and attitudes of academics kept track with the complexity of the new missions or do they continue using classical frames?

In creating the appropriate incentives for academics, the design of access and promotion systems is essential; of course these processes are related to the levels of autonomy that universities have and their governance structures. Awarding tenured positions and promoting professors is both a selection mechanism where individuals are chosen ideally on a meritocratic and transparent basis, and an incentive to motivate individuals to improve their performance (Coupé et al. 2006). The attraction, retention and promotion of academics are complex processes that are shaped by different actors, such as national or regional governments and universities and in some cases they involve, in addition to the academics themselves, external accreditation agencies.

Access to career and promotion up to the academic ladder are quite idiosyncratic and nationally-shaped processes (Musselin 2010; Kehm and Teichler 2013). Among European countries there is a large variation regarding the systems of hiring and promotion; some countries carry out centralized national exams, while some others let universities to take the whole responsibility of the selection and promotion. Somehow in between, other countries have established accreditation systems within a two-step model. Radical changes in access and promotion have taken place in many countries, especially European, with regards to their public universities. The consequences of the different systems of access and promotion for the management of human resources and the performance of universities are understudied.

The national and policy context

If we understand promotion as the access to a permanent employment, including both civil servant status and permanent contracts, at the Spanish public universities there have been four different access and promotion systems since the eighties (a unified national system until 1983); a decentralized system under the LRU (between 1983-2002); a centralized system of national exams under the *Habilitación* (2002-2007), and an *Acreditación* system (since 2007-) for access to both types of positions, civil servant and permanent contracts.

After the first university reform in 1983, the access to the categories of *Profesor Titular* (associate professor) and *Catedrático de Universidad* (full professor) with national civil servant status was organized

around a decentralized system under the model of local tournaments that provided the universities with power to influence and shape the selection process. However, that system generated complains about the resulting levels of inbreeding and cronyism (*Science, Nature*). Such criticisms created a favorable environment to implement the 2001 University reform, which introduced a centralized habilitation system, based on formal public exams and national tournaments, for accessing to the top academic positions (professor and associate professor). The habilitation system was in place until 2007, when a new university reform introduced a two-step accreditation model. The accreditation system, run by a public body (ANECA), was a first step, while the hiring or the promotion to specific positions was managed by each university (and departments) selecting among the accredited professors (usually among those already in the university).

Objectives, research questions and data sources

This paper explores the systems and policies of promotion in Spanish universities and their results mainly from the point of view of the actors, professors and researchers.

The three models of selection that have existed in Spain over the last decades have raised controversies and debates regarding their advantages and disadvantages, their costs and benefits. That is why it is relevant to understand whether and to what extent those systems are associated to differences in the individual characteristics of the selected candidates; it is also important to address how the personal experiences of participation in the processes could have shaped the individual views' about the missions and functions of universities or the evaluation criteria for promotion.

Our explanandum in the paper are: 1) the opinions of the academics about the mission of universities and their preferences, 2) their positioning with regards to the three different promotion systems and 3) their views on the criteria for opening new positions and selecting the candidates. Based on the literature we will explore several sets of predictors: a) sociodemographic attributes that have been found relevant to account for the differences in some of the previous literature; b) factors related to human capital; c) factors related to social capital; and d) previous personal experiences (learning) of the faculty, including career advancement and satisfaction. Among others, our analysis controls for fields of science and region.

Our research provides novel evidence on academic careers in Spain based on data from an ongoing survey carried out in 2015 among Spanish university academics from sixteen public universities and eight autonomous regions. The design has been constructed to be a representative sample of the overall population of academics, gathering data from more than 3,000 respondents. Our research tackles the issues of academic careers, promotion systems and criteria from various complementary perspectives. It should be noted that the labor market situation at the time of survey was very tight, with very few new openings for new positions (and promotion) in last five years, a variable that could influence academic success and satisfaction.

Structure and expected results of the paper

Firstly the paper describes some characteristics of professors hired and promoted through the three different systems, focusing on their pre-doctoral and post-doctoral mobility, participation and coordination of national and international research projects, supervision of PhD students, publishing and patent records,

service involvement, etc. Secondly, we analyze the opinions of the academics about the main missions of the university, the balance between education, research and transfer and their own interest in combining them in their professional life. Additionally, we deal with the views of Spanish university professors about the different systems of hiring and promotion that have been recently functioning in Spain. We focus on what aspects academics think that university authorities value the most when opening a new position, stressing the tension between meritocracy and inbreeding, and between mobility and localism. We also analyze what aspects they consider that should be valued when choosing the successful candidate.

Analyzing researchers' perceptions on the current balance between contest and sponsored promotion (Turner 1960) in universities is important because it may influence their career strategies and paths, especially in terms of the strategies for further promotion, mobility and internationalization. In this paper we will focus particularly on the academics' perceptions on the dynamics of hiring and promotion and as well as on their visions of the missions of contemporary university. Our results focus on two main areas: heterogeneity among individual features of academics and conflicting vision around university, merit and promotion.

Academics are a very heterogeneous group and one may expect differentiated visions on issues related to missions or promotion, when controlling for variables such as: field of knowledge, mode of enquire, rank, and other classical variables, including gender. Along with those characteristics, we expect that different types of access may be related to different visions on the missions of the university as well as individuals' preferences on academic activities (teaching, research or transfer). Besides, using the same explicative variables we expect to get significant differences on attitudes towards a potential increase of differentiated academic profiles, one more linked to teaching and another focused in research (nowadays such differentiation barely exists in Spain).

Conflicting missions within universities could promote heterogeneity of values and, as it has been previously found out; academics holding different values within the same organization might lead to decoupling attitudes towards the university enterprise. Exploring the degree of agreement among academics with the systems of hiring and promotion put in place over the last years as well as their opinions on the changing balance between the three major missions of universities (teaching, researching and transferring of knowledge) could provide new insights.

Finally, we will provide novel evidence on whether or not experiences of international mobility have an influence on positive attitudes towards the official discourses and policies of internationalization, excellence, openness and attraction of talent.

In further research, we will address the relationship between the different organization of hiring/promotion models and the performance of individuals and organizations.

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RESEARCH, EDUCATION AND INNOVATION SYSTEMS IN THE EUROPEAN UNION: DEVELOPING NEW STRATEGIES TO COMPETE IN THE GLOBAL AND KNOWLEDGE-BASED ECONOMY

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Keywords: Research; Education; Innovation Systems; Knowledge Transfer; CERN; European Union

EXTENDED ABSTRACT

In the global and knowledge-based economy, innovation is considered the strategic factor to succeed in the competition between organisations and regions. For the European Union investing in innovation systems able to sustain the competitiveness of the European industry in the global competition represents a political priority, set out in the European innovation agenda (van Vught, 2009) , that, given the European economic crisis, can no longer be procrastinated. Innovation involves different actors (Nelson, 1993; Edquist, 1997), among which education and research organisations play a major role. As stressed by OECD, higher education and specifically university play a major role (Santiago, et al., 2008), that urged to be renewed, in order to support the production of highly skilled human capital (Cohen, Nelson and Walsh, 2002) and consequently the growth of our societies based on knowledge (Clancy and Dill (eds.), 2009). The process involves research organisations as well, considering the increasing role of tertiary education in institutions other than Universities, like research laboratories and centers of excellence (The World Bank Group, 2002) and the urgency to develop innovative learning environment consistent with the needs of the XXI century knowledge-based economy (OECD, 2007).

In this framework, the paper, discussing the results of a research study developed at CERN (Bruzzi and Anelli, 2014), aims at giving a contribution to the debate on the development of new European innovation systems. The study, aimed to propose, with an empirical application to CERN, new metrics to appreciate the ‘fertilization effect’ of the global economic system produced by the educational dimension of basic research, was focused on CERN Fellowship Programs, in order to reconstruct the professional careers of the past-CERN Fellows and measure the “knowledge transfer” promoted by CERN through its unique international learning environment in favour of young researchers, who after their research period at CERN continue their professional career

elsewhere. More specifically, the survey was carried out in 2012 and 2013 through the construction of a short questionnaire sent anonymously by e-mail to CERN Fellows who finished their CERN Fellowships in the period 2007-12 and that at the moment of the survey, according to CERN data, did not stay at CERN with a CERN contract nor continued to be associated to CERN with other kind of contracts. Our study, that registered very good response rates (46%, out of total 288 CERN Fellows, and 58%, out of total CERN Fellows actually contacted), shows that, even if university and research organization continue to employ young researchers, industry is the most important employer of the past CERN Fellows contacted, who during their career continue to be involved by employers as skilled human resources in the field of R&D and in high-tech business functions (IT&Security and Operations). They work mainly in big companies, acting in high tech sectors, such as ICT, Finance, banking and insurance and Mechanics. CERN moreover strongly contributes to the internationalisation of CERN Fellows, promoting an important effect in terms of high-skilled human capital mobility, especially at the European level and to the benefit of universities and research organisations. The study also propose the assessment of the satisfaction degree of CERN Fellows about the contribution of the Fellowship to their first job position/professional career, registering good rates of satisfaction (positive impact: 74% for first job position and 75% for professional career). Moreover, the educational dimension of the CERN Fellowships clearly emerges from the analysis of the open answers given by the Fellows, who describe the Fellowship as a formative/educational experience, very important in shaping the personality and very useful to learn technical knowledge and skills for the subsequent job positions. Moreover, CERN Fellows emphasized the opportunity to get at CERN other professional skills, such as cooperation, working in team, communications skills, independent working and the ability of dealing with responsibilities, *i.e.* the so-called soft skills very appreciated by employers.

Our study, based on a research approach that emphasizes the educational dimension of research programs and therefore new in a literature that has traditionally treated the socio-economic impact of research and the socio-economic impact of higher education as two separated fields, demonstrates the growing importance of research (and more specifically basic research) to entry in the labor market for the new generations, consistently with the specificities of a knowledge-based economy. Our results confirm that new approaches are now necessary in order to give an appropriate answer to the learning needs expressed by the knowledge/science-based economy of the XXI century, that is urgently asking for human resources with high (soft and hard) skills in order to constantly feed the innovation processes.

The results of the survey, which represented the first step of the research, feeds an original wider reflection, that will be discussed at the Conference, on the urgent renewal of innovation systems in Europe in two directions: 1) firstly, higher education&research (basic and applied

research) can no longer be treated as two separate fields, but must be considered two sides of one pillar of the industrial policies of the XXI century in order to succeed in global competition, 2) secondly, the national dimension of the innovation systems approach must be urgently overcome: in the global economy, the ‘fertilisation effect’ produced by the investment in education and research can no longer be bounded by national borders and a European perspective must be adopted in order to enhance the positive externalities produced at European and global level.

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MANUFACTURING CAPACITY, MARKET LINKAGE AND PROFITABILITY OF R&D. IMPLICATIONS FOR R&D POLICY IN SMEs

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EXTENDED ABSTRACT

The involvement of public sector in R&D activities is widely accepted in society, in contrast to its participation in other areas of economic activity (trade, production, etc.). Scientific literature has highlighted some potential “market failures” related to the uncertainty about the appropriability of the profits generated by an innovation, that can cause volumes of R&D investment lower than those socially desirable (Nelson, 1959; Martin and Scott, 2000).

Nowadays, innovation policy is mainly focused on the generic promotion of the creation of the core knowledge embedded in potential new products, and on the strengthening of intellectual property protection. But patents (and other legal instruments), although offering considerable protection to some products, do not guarantee complete appropriability of some innovations especially in certain sectors. And, as Teece (1986) showed in his seminal work, profiting from innovations may depend not only on the legal protection offered by the intellectual property rights, but on the availability of some complementary assets by firms. In this sense, R& D investment decision cannot be divorced from the strategic analysis of markets and industries.

This study takes into account the differences in sectoral appropriability regimes –depending on legal and technological factors (Ceccagnoli and Rothaermel, 2008)– to explain the strategy followed by the firm to profit from its R&D activities. We assume that this strategy is a mixed combination of innovation activities, productive capabilities, market linkage and intellectual property protection. Using panel data for Spanish SMEs over the 5-year period between 2008 and 2012, we show that the relative importance of each one of these dimensions of firm’s strategy on profitability of R&D activities, depends on the appropriability regime of the sector of activity, and provide evidence for the existence of a trade-off relation between some of them (e.g., within sectors with weak appropriability regime the profitability of intellectual protection is low, compared with the profitability of productive capabilities or market linkages, while the opposite is true for sector with tight appropriability regime).

The implications for sectoral innovation policy are straight forward, since they improve the conditions to encourage private R&D in alternative ways –one of the main targets of the European strategy for smart,

sustainable and inclusive growth—, promoting firm’s capabilities to transform new knowledge in a profitable business plan (e.g. productive capabilities and market linkage), besides the typical policies supporting the creation of the new knowledge embedded in innovation (e.g. innovation activities) and the strengthening intellectual property protection.

Studies analyzing the role of complementary assets or capabilities (such as productive capabilities and market linkages) on innovation process typically focus on their impact on the performance of large firms. In our research, we have decided to analyze the impact of such complementary assets in SMEs, using an input variable, R&D investment. On the one hand, the choosing of SMEs is aligned with our focus on the policy implications of the study, given the significant predominance of SMEs in the productive structure of the economy, especially in countries like Spain. On the other hand, the advantage of using an input variables (such as R&D investment) to analyze the impact of complementary assets, is that they differ from output variables (such as firm performance) in the sense that they reflect an active attitude towards the attainment of innovations, and are not “contaminated” by demand conditions for new products, as is the case of variables such as “sales”. Furthermore, as mentioned before, the returns from innovation depend on the availability of certain complementary assets. One particular implication of this assertion is that firms controlling these assets might find R&D investment more profitable or, in other words, the owners of these assets might find attractive certain R&D projects otherwise unprofitable. Then, at least in the case of firms engaged in R&D activities, the effect of complementary assets on innovation process might be better explained through its effects on R&D investment decisions than directly through innovation performance.

We start with the conventional approach to R&D investment from a micro-level perspective (Howe and McFetridge, 1976; David, Hall and Toole, 2000), to obtain the relation between R&D activities and other types of inputs of innovation reflecting the strategy followed by the firm. To test this relation, we take advantage of a new panel database of innovative Spanish firms (PITEC) –a CIS-type survey–, using a sample of Spanish SMEs over the 5-year period between 2008 and 2012. Given the fact that the aim of the study is to analyse complementarity between R&D and other types of inputs in the generation of new products (but not new processes), the sample only includes firms declaring innovations and R&D activities in at least one year during the period of the study, excluding those firms that are engaged exclusively in process innovations. In order to solve certain problems of endogeneity with the variables included in the model (more precisely, among R&D investment and productive capacity), all models are estimated using instrumental variables regression for panel data, through generalized two-stage least squares method.

Our sectoral analysis departs from differences on appropriability regimes highlighted in specialized literature (Martin, 2000; Castelacci, 2008). Table 1 provides an example of two sectors with different appropriability regimes according to this literature: a) Computer, electronic and optical products; and b) Software. It can be seen that while patent protection proves to be profitable in the former (given the tight appropriability regime in this sector), and not very relevant in the latter. Theory predicts that this situation will give rise to the need of developing complementary assets to profit from R&D investment. In this sense, in can be seen in Table 1 that the relevance of productive capabilities (particularly market share) and linkage

to market (particularly marketing and commercial innovations) are significantly higher in software sector, where the appropriability regime is weaker.

Table 1

Dependent variable: Own funds for internal R&D

Explanatory variables	Computer, electronic and optical products		Software	
	Coef.	P>t	Coef.	P>t
<i>Productive capabilities</i>				
Market share	1.044	0.317	5.911	0.021
Process innovation	0.903	0.011	0.831	0.006
Organizational innovations	0.718	0.056	0.736	0.027
<i>Linkage to market</i>				
Marketing	0.073	0.010	0.109	0.000
Commercial innovations	0.117	0.753	0.583	0.084
Collaboration with costumers	-0.002	0.997	-0.119	0.774
<i>Intellectual property protection</i>				
Patents	1.074	0.019	-0.125	0.823
Design registration	0.466	0.366	-0.797	0.238
Trademarks	-0.651	0.109	0.700	0.040
Copyright	0.934	0.445	0.862	0.267
<i>Innovation activities</i>				
Internal R&D (financed by other org.)	0.075	0.017	0.169	0.000
External R&D	0.087	0.010	0.038	0.214
Training for innovation	0.082	0.110	0.026	0.510
Collaboration with R&D centers	0.248	0.568	0.811	0.029
International markets	0.384	0.383	0.676	0.020
Const.	8.419	0.000	6.777	0.000
<i>Num. Of firms</i>		123		219
<i>Num. of observations</i>		615		1092
<i>R-squared</i>		0.2024		0.1778

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CUSTOMER ORIENTATION AND FIRM PERFORMANCE

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Keywords: customer orientation; user innovation; firm performance; firm growth

EXTENDED ABSTRACT

Acknowledging customer needs as important for the success of the firm has been common practice both at innovation policy level and in academic literature. But empirical evidence on the role of customer and user (C&U) orientation for firm performance and growth is still scant. This paper contributes to the empirical literature by analysing if and how C&U orientation contributes to firm performance. Our unique and recent Finnish data allow us to analyse how the intensity of C&U orientation affects the above complex relationship. Our empirical results are expected to be of relevance for demand and user-driven driven innovation policy and for the participants of this annual EU-SPRI conference.

The focus of this paper is on analysing if and how C&U orientation contributes to the performance of the firm. To be able to reach the above objective the paper addresses two research questions.

In our first inquiry we look at what determines C&U orientation. We look for empirical evidence on which dimensions relate to C&U orientation and distinguish between C&U consideration and customers and users as a source of innovation.

A second research question addresses how the C&U orientation relates to subsequent firm performance. The main focus of the analysis will be on productivity but alternative measures could be used. Using different performance measures relates to different stretches of literature from the business and entrepreneurship literature to the economics literature. More profoundly using alternative measures allow for robustness checking of the results.

It has to be stressed that our analysis will pay special attention to the degree of C&U orientation in analysing the two above described relationships. In essence our data allow us to distinguish between C&U consideration and customers and users as a source for innovation. It is useful to distinguish between different degrees of customer and user involvement as they are expected to have different impact on the firm performance.

We address the above research questions empirically based on a recent and unique set of Finnish firm level data. Recent empirical evidence on the role of C&U orientation for firm performance is still very scant, supposedly due to the lack of available data. Our paper offers new empirical evidence and contributes to filling the empirical research gap on C&U orientation and firm performance. The paper summarizes and

builds on multiple stretches of relevant literature: the economics literature on innovation and productivity, the user innovation literature, the open innovation literature, the market orientation literature and the service innovation literature. The motivation for the paper is to look for empirical evidence on the role of (different intensities of) C&U orientation in the performance of firms and to shed more light on the mechanisms at work.

METHODS: The above research questions are addressed by analysing a unique and recent dataset from Finland. The dataset contains merged firm-level data from the Community Innovation Survey (2010 wave), the Finnish business register and the financial data sets of Statistics Finland (for the 2008-2012 period).

The methods used are statistical and econometrical analysis methods.

In a first step we will describe our datasets and offer a statistical overview of how the C&U oriented firms differ from firms that are not C&U oriented. These descriptive tables will also include correlation matrices between key variables.

In a second step a more rigorous analysis follows on what drives C&U orientation in firms. In a probit or ordered probit regression model the drivers of both C&U consideration and customers and users as a source for innovation are assessed. Explanatory variables will be structural firm characteristics but also characteristics that relate to the innovation processes and activities. This first regression analysis should give insights on the mechanisms behind different degrees of C&U orientation and results will be used as an input in the next stage of the analysis.

In a third step the relationship between C&U orientation and firm performance is analysed. The paper aims at performing a careful matching exercise (ATT). The results from the above probit analysis will be used for balancing. After the benchmark analysis has been carried out further attention is gonna be paid to the effect of the distribution of growth rates on our results by applying alternative quantile regressions. In addition we will be analysing heterogeneity of effects by looking at interaction effects between C&U orientation and other key firm-level dimensions.

EXPECTED RESULTS: Not in all cases C&U orientation leads to firm growth and better performance. Indeed, ex ante we do expect a lot of heterogeneity in these effects. Heterogeneity in the effects is expected to depend on the intensity of the C&U orientation. For firm performance the role of C&U consideration is expected to be less important than that for customers and users as a source for innovation.

In addition different firm growth measures are expected to produce different results. We expect customers and users as a source for innovation to have positive effects on turnover growth but ex ante it is not clear to us that this would be the case for productivity growth too. These results would have clear implications for innovation policy makers. Furthermore from an entrepreneurship literature and entrepreneurship policy perspective it could be argued that the focus of attention should be on the firms that grow most. We will assess if effects differ over the growth rate distribution by applying quantile regressions. Ex-ante we expect C&U orientation to play different roles for different quantiles of firms.

Although our analysis is based on unique data on the role of C&U orientation in innovation processes of firms the drawback is the cross sectional nature of our data set (albeit with backward and forward looking

variables). Ideally future analysis would be based on panel data. In addition the nature of the role of C&U orientation for firm performance is a complex one and disentangling different effects is a challenging task that should be continuously upgraded based on improved theory and knowledge of methods.

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THE PRACTICE OF ENTREPRENEURSHIP: SUPPORT FOR INNOVATION ON PRIVATE FOREST LAND**

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EXTENDED ABSTRACT

The paper sets out to examine the characteristics of support for innovation processes in NonWoodForest products (NWFP). The typical enterprises and start-ups which emerge in this sector tend to be small-scale and family owned. We claim that there is a large unused potential for NWFP to support rural development and increase incomes of land owners and rural enterprises. We do not claim to have quantifiable exemplary knowledge but rather ask what makes selected and (so far) successful innovations in NWFPs special and subsequently: what were the factors that supported their development and marketing? These questions we study at hand for four empirical innovative case studies in four European rural areas. We come to the conclusion that the entrepreneurs show some common features and the appliance of very individual strategies for the realisation of their own ideas. In line with recent literature on creating innovations, all of them have used some “external” support, but at very different levels: They range from monetary support to consultation of effective support organisations and also personal non-monetary exchange-relationships in social networks within a communal area. Our results contribute to an understanding of entrepreneurial behaviour as a very individual and context-specific undertaking on the one hand and as a “universal” activity with common features and attributes on the other.

In course of the STARTREE project, we have carried out empirical research in four European regions (Finland¹, Wales, Scotland and Catalonia) by applying a combined methodology: The conduction of semi-structured qualitative interviews with the people involved (the owners and other relevant personal or stakeholders in each case). These interviews were subsequently transcribed and analysed. In parallel 15 standardised interviews with regional development agencies, R&D responsible, SMEs and interest groups were conducted. This way the paper aims to examine the support mechanisms for innovative business in NWFPs at the practical and the empirical level.

¹ To the Finnish firm we have promised full anonymity, this is why the region is not mentioned in the case. They are the first and only ones so far with this technical innovation in production.

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We first outline concepts of support mechanisms in theories of innovation. Second we assess the support mechanisms that were most important in the empirical innovative cases at hand. In conclusion we show the communalities and differences between theoretical explanations of innovation/creativity and entrepreneurship and the explanations and strategies of actual innovative entrepreneurs.

Conceptualising Entrepreneurial Innovation

It was the economist Joseph Schumpeter who first distinguished between an innovation and an invention and who subsequently argued that entrepreneurship consists of making innovations; furthermore, the status of an entrepreneur is only acquired during the process of innovation (Schumpeter 1934). What do we mean by “innovation” in NWFP? Leaning on Schumpeter’s five “types” of innovation; the introduction of a new good, a new method of production, the opening of a new market, new materials or resources and the creation of new forms of organisations (Schumpeter 1934) we summarise here that innovation in NWFPs happens when new products and services are offered for the first time. It also occurs, when technical changes in production processes or organisational changes in an operational procedure of working and labour organisation occur. A new product in this respect could be e.g. Christmas trees, berries, mushrooms, pellets, drinking water. A new service in this respect could be e.g. recreational or environmental services such as the renting of huts, guided tours, wellness seminars, sports activities. Technical innovations can change already existing processes, introduce older (historical-traditional) methods for new purposes of production or introduce completely new techniques. Organisation/marketing innovations can also change existing processes or introduce older (historical-traditional) methods for new purposes of management and marketing but also comprise the introduction of new methods of management or the foundation of cooperatives. (see Weiss 2010 et al., figure 5 and Weiss 2011). Accordingly we have studied the following four innovative examples of innovative entrepreneurship in regards to NWFPs in four European regions: A Finnish company producing birch sap² for consumers and companies. A Welsh company which commercialises organic tea picked by hand, a Scottish producer of fruitwine made with oakleaves and elderberries and a Mushroom Hotel in Catalonia, Spain. What do all of these have in common?

First, they all confirm with (objective) standards of innovativeness: Their idea is new, it is commercialised and it is unique for the sector and the region (Edquist 1997: 11pp.3; Nelson and Rosenberg 1993: 5; Weiss 2011).

Second, they all confirm with the characteristics of such enterprises in the forestry sector: They are small SMEs, some family run and all of them trade in NWFP-services or a product.

Third, they all have a specific feature of “innovativeness”, meaning the introduction of a novelty to the market:

The Finnish company is the first one to produce bottled birch sap, that keeps in room temperature without food additives, preservatives or pasteurisation. The Mushroom Hotel in Catalonia is the first hotel-restaurant

² Birch sap is a traditional drink in Northern Europe, Russia and Northern China, directly tapped from Birch trees. The sap can also be used to make birch syrup, which is used like maple syrup.

³ Especially Edquist discusses the terms at length and comes to the conclusion that “There are many potential permutations. [...]The approaches complement each other rather than exclude each other.” (1997, 12)

on private forest land which combines a payment scheme for mushroom picking with tourism services and a mycological information path that trains and informs visitors on picking practices and safe identification of edible mushrooms. The Welsh company is the first one to disseminate knowledge about currently 42 wild-growing herbs in Wales which can be plucked for tea (via a poster “free tea” and in workshops on foraging, preparation and use) and it produces locally grown tea with a blend of three different plants in each tea packet. The Scottish wine producers are the only ones who produce oak leave wine (amongst other fruit wines) in the whole UK. Whilst in Scotland the making of fruit wine is an ancient tradition and a fairly common hobby, it is unusual to find a successful fruit wine business in Scotland.

It is suggested by Freire-Gibb and Nielsen (2014) that entrepreneurs are not so different from each other, regardless of their geographical location. They show with a sample of 6.000 respondents, that there are more differences between entrepreneurs and non-entrepreneurs than between urban and rural entrepreneurs in Denmark. We argue here that this could also count for cross-national differences: On the one hand the innovative product might be contextual-specifically developed and (culturally) appreciated; especially when it comes to food products as a matter of “taste” which is very much determined by social practices. On the other hand, the attributes of entrepreneurs and the quality of entrepreneurship can be more cross-cultural or “universal”. In the following the paper deals with all the support mechanisms that were crucial in these cases.

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OPENING UP THE INNOVATION SYSTEM FRAMEWORK TOWARDS NEW ACTORS AND INSTITUTIONS

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EXTENDED ABSTRACT

It is in the nature of economic and social transitions that the newly emerging paradigm cannot be well understood within the framework of the old one. At the same time, humans tend to interpret novel phenomena as long as possible within the established paradigm (Schoemaker 2003). This is why substantial efforts are required to widen our perception filters to acquire the “futures literacy” enabling us to grasp “change in the conditions of change” (Miller 2007) in times of economic and social transition. One key aspect of honing this ability within a research tradition, is to step back and systematically review and challenge the lenses that shape our interpretation of the present and our expectations for the future. One example of such a review that is currently ongoing is the intense discussion on measures of progress and human development and the quest for new measures for monitoring progress. In the case of innovation studies and subsequently innovation policy, one of the most established analytical frameworks is the heuristics of the national and regional “innovation system”. Ever since the concept was first suggested in the late 1980es (Lundvall 1992; Edquist 1997; Nelson 1993; Cooke 1992) it was subject to numerous variations and refinements (Edquist 2005; Fraunhofer ISI 2012) and became a powerful guiding framework for a number of policy strategies most notably within the OECD context. At the time, the adoption of the innovation system concept was reflecting a novel understanding of innovation as a non-linear, recursive process with high uncertainty rather than as the mere commercial application of scientific findings that is fully determined by market forces as it was viewed within classical economics. The innovation system concept emphasised the complex system of institutions that underpin innovation processes and on its basis evolutionary economists argued for policy measures that are targeting the functioning of the full innovation eco-system instead of exclusively supporting the excellence of its individual elements. There was never an attempt to define a one-size-fits all innovation system. Rather within the given framework each country, region, sector or technology was expected to foster the system which best met its cultural context and historical situation (Nelson 1993; Frietsch and Schüller 2010). The rationale behind the innovation system approach was to strengthen innovation capacity as a precondition for competitiveness, wealth and growth without much consideration of the direction of the innovation efforts (Weber and Rohrer 2012) and often with a strong focus on high-tech innovation.

It has long since been argued that in the face of social and economic transition, the rationale of innovation and innovation policy will have to be broadened beyond competitiveness and growth (Schot 2014; Steward 2008; Weber and Rohracher 2012). Concepts like “transformative innovation” (Steward 2008) position innovation as a key element of socio-technical transitions towards sustainable production and consumption patterns. One consequence of this perception is that new actors such as cities, associations, social entrepreneurs, activists, venture philanthropists and even ordinary citizens who are involved in such transformative socio-technical reconfigurations (Geels 2005) become important innovation actors. The concepts of institutions or even organizations are much too broad to obtain an understanding of the effects and impacts these actor groups have on innovation and socio-technical transformation. Another element in this context is the increased emphasis on social innovation (Davies and Simon 2013) as well as non-technical fields of innovation. For instance, service, organisational innovation and marketing innovation (Som et al. 2012) are by no means “collaterals” of technical innovation, but should be regarded as a relevant source of competitive advantage by their own. At the same time, from within innovation management the understanding of innovation is being “democratized”. Notions like user driven innovation (von Hippel 2005), open innovation (Chesbrough 2006), collaborative innovation and commons based peer production (Benkler 2006) have long been recognized as relevant phenomena that transcend classical notions of innovation and innovation actors. Other researchers have pointed to the high relevance of non-R&D driven pathways of innovation (Som 2012; Som and Kirner 2015; Havas 2014) which are primarily based on other modes of knowledge creation than formal R&D, such as “learning by doing, learning by using, learning by interacting, learning by producing and learning by searching” (Lundvall/Johnson 1994). In addition, there is increasing attention towards the growing body of literature on highly successful “frugal innovations” that are emerging in difficult framework conditions including heavy resource restrictions (Herstadt and Tiwari 2012) and are often driven by actors from the fringes of currently dominant innovation system perspectives. Finally, regional innovation studies increasingly stress the role of social and relational capital (Carrincazeaux and Coris 2011; Boschma 2005) and emphasise the role of new innovation mediators such as associations, unions and charities for underpinning regional innovation capacity (Koschatzky et al. 2014). Furthermore, philanthropic innovation as a relatively recent organizational form of engagement in social networks and innovation systems appear to be more and more relevant (Moody 2009; John 2006). All these diverse perspectives point to the relevance of actors and institutions that received little attention in the classical innovation system concept and subsequent innovation policy strategies. Against this backdrop, we see the need to adapt the notion of the national, regional, sectoral and technological innovation system concept and in order for it to reflect the newly emerging rich diversity of innovation rationales, formats and actors. We reckon that such a renewed understanding of the concept will form an excellent basis for “strategies for knowledge, practises and organizations” for navigating innovation policies and strategies in times of social and economic transitions as underlined by the EU-SPRI conference’s call text.

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ASSESSING THE UPTAKE OF CHALLENGE-LED AND PRACTICE-BASED INNOVATION BY THE EUROPEAN UNION

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Keywords: Innovation; Challenge-led; Practice-based; European Union; Discourse

EXTENDED ABSTRACT

In the 20th century, the innovation agenda became an agenda of science-driven, technology mediated change up to the point that ‘to innovate’ almost always entails the sale of a new product (Godin, 2008). Primarily associating innovation with technological novelty had a strong influence on the discourse on innovation. Novel technology is a source of economic growth, and society became interested in managing innovation for this greater goal; it became more and more something to measure and to strive for. Its contributions to economic growth and competitiveness made it of interest to policy makers. This attention lead to a further institutionalization of this science and technology-centred innovation-paradigm (Godin 2012; Kallerud, 2010).

In the past decades the national and regional innovation systems have established themselves as the main analytical framework of studying innovation and is of major influence to policy makers forming the basis of many innovation policy strategies (Lundval, 2007). However, this framework is increasingly being contested as scholars argue that there is too much emphasis on actors within the field of science and technology as a source of innovation (Caraca et al, 2009), and economic competitiveness as the goal of innovation (Kallerud 2013; Weber and Rohracher 2012). Based on a literature review it is argued that these contestations can roughly be separated into two main categories, namely those theories that argue for more practice-based approach to IS, and those that plea for a more challenge-led approach.

Advocates of a practice-based mode of innovation move away from a narrow focus on science and technology. The practice-led approach brings number of insights. The most important ones are (1) an acknowledgement of the existence of different modes of innovation and types of knowledge (Jensen et al, 2007), and (2) broadening of what can be considered as an innovation actor (Rip et al, 2010; Bogers et al, 2010; Sharra and Nyssens, 2010). Consequently, a broader definition is embraced and innovations can take many forms such as novel advances in organisations, services and business models, and is not limited to new technologies alone. While science remains important as a fundamental source of innovation, seeing science as a direct source, or even the only major source, is counter-effective. More attention is given to interactive learning by firms, and manage feedback from the broad social and institutional environment. It acknowledges that the ability to achieve this will need the direct engagement of a diversity of ‘social partners’ such as public authorities, economic actors and citizens alike. (Steward, 2012).

Advocates of a challenge-led approach to innovation move away from the unilateral performance-driven mantra that any innovation good as it boosts economic competitiveness. The challenge-led approach is built around a number of insights. These are (1) an acknowledgement that innovations can have negative outcomes (Sveiby et al, 2012), and (2) a need for innovation policy to deal with current societal challenges (Kallerud 2013; Steward, 2008). This means a break with the over-reliance on market-based encouragement of the diffusion-oriented innovation policy led by business and a focus on additional systemic and directionality failures that justify different types of policy intervention (Weber and Rohracher, 2012).

The two contestation to the national and regional innovation systems framework are receiving growing attention and they can be considered as two separate innovation discourses of the 21th century. However, a third discourse is also emerging which can be best understood as a combination of the two. This discourse on innovation policy for sustainability transitions states that current innovation policy is too much performance-driven and science-based and that there is both an explicit need to deal with grand challenges of society, and a realisation that this cannot be accomplished by technological fixes alone.

In sum, based on a literature analysis four different innovation discourses are identified as seen in table 1. It should be read as a matrix depicting the two contestations to the innovation systems framework on its two axes, namely (1) performance-led versus challenge-led innovation, and (2) science-based versus practice-based innovation.

Table 1 Discourses on Innovation Policy

	Performance-led	challenge-led
Science-based	Conventional Innovation Systems	Mission-oriented Innovation
Practice-based	Collective Learning	Transformative Innovation

The discourse in the top-left quadrant is the dominant science-based and performance-driven innovation discourse that developed throughout the 20th century and is currently most embedded in literature of innovation systems. I will name this conventional innovation systems. The second discourse is still very much science-based but has a strong challenge-led agenda, and is most often referred to as green technology management or a ‘green’ revival of mission-oriented innovation. The third discourse embraces practice-based innovation but has no explicit challenge-led agenda and will be named collective learning. The fourth discourse embraces a combination of both challenge-led and practice-based innovation and is called transformative innovation.

Research focus and question

The European Union (EU) has a long history of supporting research and innovation in many different fields, ranging from excellence in basic research through to more applied research in agriculture and rural development, climate action, communications networks content and technology, education and culture, energy, enterprise and industry department and space research, environment, mobility and transport and regional policy. In 2010, these research efforts were combined in one common agenda, called the Innovation Union. In 2014, Horizon 2020 programme started, and can be seen as the financial instrument implementing the Innovation Union.

Since its strategic importance, financial significance (€ 80 billion funding over 7 years) and its broad scope, an analysis of the Innovation Union will give a good insight of the innovation policy discourse of the European Union. Two documents are identified as crucial, namely the official communication from the commission, and the explanation of the allocation of funds for the implementation of the Horizon 2020 Framework Programme for Research & Innovation.

How are new discourses on challenge-led and practice-based innovation influencing the innovation strategy of the European Union?

Expected results and methodology

The expected result of answering this question will be to see a struggle between the four different discourses identified, as traces of all discourses are likely to be manifested in the policy documents. The methodology used will be argumentative discourse analysis. The 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).

This means that an analysis of the policy documents has to identify the arguments and counterarguments that form discourses. These can be identified through obvious statements, but are often much more subtle and can be recognized in the form of storylines and metaphors, clichés, historical

references or analogies (Hajer 1995). Dominance of certain discourses can also be expressed in the detail of the policy initiative, through specific policy-wording, policy monitoring devices and resource allocation (Sharp and Richardson 2001). Attention to important details will help to deepen the analysis from the level of mere words to some stronger commitment and action resulting from these words.

Relevance

The outcome of this research is relevant to the conference theme as it explicitly addresses the question of opening up the innovation systems framework to new actors and institutions, and will give an insight in what way this is being done in a present-day and significant policy program. The current stage of the research is that the literature review is finalised and the document analysis is now being done. The analysis of the Innovation Union is part of a doctoral research that looks at the uptake of new theories on innovation policy for sustainability transitions within a European context.

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CROWDFUNDING AND SYSTEM FAILURES.

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Keywords: Crowdfunding; Innovation System; System Failures; Financing of Innovation

EXTENDED ABSTRACT

Crowdsourcing, that is the crowd as the origin of inspiration for innovation and as the source of novel solutions for given problems, has attracted some scholarly attention recently (Howe, 2006; Poetz & Schreier, 2012; Belleflamme et al., 2013). Crowdfunding, that is the crowd and its potential for micro-financing innovation has attracted some attention in the entrepreneurship, corporate finance or innovation management community as a variant of crowdsourcing (Ahlers, Cumming, Guenther, & Schweizer, 2012; e.g., Belleflamme, Lambert, & Schwienbacher, 2013; De Buysere, Gajda, Kleverlaan, & Marom, 2012; Mollick, 2013).

However, crowdfunding and the related set of actors (funders, platforms and entrepreneurs) have not been analyzed in their role as contributing to a new element in the innovation system.

In this paper we explore how crowdfunding integrates in the innovation system (Freeman, 1987; Lundvall, 1992; Nelson, 1993; Metcalfe, 1994; Kuhlmann, 2001; Edquist, 2005). In particular we investigate how crowdfunding addresses failures in the innovation system, that are usually considered a rationale for governmental intervention into the system (Carlsson & Jacobsson, 1997; Klein Woolthuis et al., 2005; Chaminade & Edquist, 2010).

Based on a case study about crowdfunding in Germany and Austria and based on ten extensive interviews with platform operators and entrepreneurs from various sectors we put crowdfunding into the systems failures context. We highlight that crowdfunding indeed addresses infrastructural failures, institutional failures, interaction failures and capability failures between demand, companies and other actors.

The analysis of crowdfunding in the context of innovation systems and its failures suggests a research agenda by raising questions about the systems' self-healing powers as crowdfunding can be interpreted as a service innovation (in a broad sense) that originates from within the system and that addresses and lives of the system failures. Additionally, new actors and new services in an innovation system that are so closely intertwined with the working of the system might give rise to other system failures which in turn have to be addressed by other actors, such as regulators etc.

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PUBLIC RISK CAPITAL FUNDING SHOULD BE SEED FUNDING –BUT ADDITIONALITY IS NOT THERE!

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Keywords: Innovation policy; public risk capital; innovation financing; additionality

EXTENDED ABSTRACT

The paper will address that kind of public financing, i.e. policy that is directly related to the adoption and transformation of knowledge into new products (and processes) through commercialization.

Financing is absolutely crucial for turning knowledge into commercially successful innovations and to facilitate their diffusion. It is one of the most important activities in innovation systems. Resources for financing of innovations come primarily from *private* actors. They might, for example, come from innovating firms themselves (internal capital markets), stock exchanges, venture capital funds and firms, banks or individuals ('business angels'). However, in many countries, *public* agencies also provide such finance, for instance in the form of seed capital, in support of innovation activities. Such public activity is a component in innovation policy and will be focused upon in this paper.

Hence, we will not deal with private funding of innovations in any detail here. We will use considerable effort to discuss where (in which situations) private funding is not available and why this is so. The reason is that such unavailability means that public involvement is justified, i.e. additionality is at hand. It is a matter of identifying the border line between when public intervention is motivated and when it is not. Should there be more or less public intervention, i.e. should the border line be moved? This is a crucial policy issue. Another important policy issue is to discuss the characteristics of the part of the activity of financing of innovations that is (already) performed by public intervention. Should these characteristics be changed? This is also an important policy issue.

If private capital is available, there is, of course, no need for public risk capital funding. This means that *a public funding agency shall not compete with private organizations in an 'unfair' manner on the basis of public tax-payers money*. On the contrary, the public agency shall add something to the innovation system that no other actor is able to contribute, i.e. "additionality" shall

be at hand. This means that *private initiatives shall not be duplicated or crowded out*. The additionality criteria will be developed in detail in the paper.

Detailed data on provision of public risk capital in Sweden will be presented. It will be shown that half of the capital allocated for this purpose (2 billion euros) has not been used for the purpose. The other half has been used mainly for investments in mature stages of the development of innovations and firms. These are stages where there is abundant private risk capital. Hence there is crowding out and duplication.

This has to do with the governance of the public risk capital funds. They are required to and/or inclined to make investments together with private risk capital providers on equal terms. The private risk capital providers are reluctant to invest in early stages, because of uncertainty and high risk. (This is, of course, the reason why the public risk capital funds were created to start with.) Hence the co-investment strategy “draws” public capital to late stages rather than “drawing” private capital to early stages, and the additionality condition is not fulfilled.

To correct this there are two possibilities. One is that the conditions for public risk capital co-investments with private investors have to be done on conditions that actually give the private investors an incentive to invest in early stages. The possible character of such conditions will be discussed in detail. The other possibility is that public risk capital funds invest by themselves in the seed capital stages. The implications of this will also be discussed in detail.

DEMAND-BASED POLICIES AND INNOVATIVENESS OF THE ECONOMIC SECTORS

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Keywords: Sectorial innovation, demand, innovation policy

EXTENDED ABSTRACT

The role of demand in innovation processes is widely recognized in the literature, but how this knowledge can be applied to formulate appropriate basis for policy, is still not clear. The need for incorporating demand-side aspects into systemic innovation policy is discussed in the literature seeking to balance the dominant supply-side measures generally in Europe (Edler, Georghiou, 2007; Malas-Gallart, Davies, 2006), but also specifically in Central and Eastern European countries (Tiits et al. 2004).

In this article we discuss the different role of demand-side innovation policy measures relevant for economic sectors depending on the technological trajectories of the sector. We also attempt to evaluate empirically our propositions. We apply the definition of the demand-side innovation policies proposed by (Edler 2013), considering the public measures for increasing demand for innovation (readiness for innovation, capabilities to acquire and use innovations), determining new functional requirements for products and services, and incorporation of customers to the innovation process.

The barriers of entry for the innovations can be lowered by mediating lead-users knowledge (von Hippel, 1988, Lilien et al. 2002), relevant home buyer needs and focusing on the location of potential new markets geographically (Porter, 1990). In addition, the interaction of users and producers plays essential role in the innovation process itself (Lundvall, 1988) by reinforcing the relationship between demand and innovation with positive feedbacks (Kaldor, 1981; Arthur, 1990) and encouraging further innovation by directing the investments into invention and innovation activities (Schmookler, 1966). However, as Neij (2001) points out, the need for different demand-side policy measures is related to the maturity of the sector related to the technological trajectory of the industry under discussion.

We use the taxonomy of Pavitt (1984), which has been elaborated further for services by Castellaci (2009) and for SMEs by de Jong & Marsili (2006). These taxonomies distinguish four basic groups of industries according to the sources of technologies and knowledge and profit appropriability mechanisms.

1. Supplier-dominated industries (e.g. textiles, services), where new technologies are obtained from the suppliers by investing in new components, or equipment, and where technology transfer occurs mainly through learning by doing and learning by using (hence internal knowledge sources for innovation

dominate). Appropriability is weak in these sectors and in many times there the barrier for innovation is related to the price sensitivity of the consumers. Therefore the consumer awareness, demand articulation, direct subsidies for consumers to uptake the innovations, but also other education and training measures, additionally also standard-building measures for better compatibility of different innovations would be more relevant for these sectors.

2. Scale-intensive sectors (e.g. car and steel industry), where process innovation is crucial and both internal knowledge sources (R&D activities, learning by doing) and external sources (suppliers) are used. The appropriation mechanisms appear in the form of patents and trade secrets. As those are also sectors selling to the end-market consumer, similar demand side measures like in supplier-dominated sectors, but also bulk purchases on behalf of the government as an end user, and regulations for safety, environment would be relevant.

3. Specialised suppliers (equipment producers), where innovation processes concentrate on improving results, and reliability and consumer friendliness. The knowledge sources used are internal (experience-based, skilled technicians within the firms), but also external (user influences), and the appropriability stems mainly from the local and concentrated knowledge, but also from interactions. In the case of non-high-tech users having no formal R&D personnel, the innovation occurred mostly when the user received a large order of uniform products, then a creative person on the factory floor “*used an innate sense of engineering design and machine parts lying around the factory*” (Von Hippel, 1988) and sometimes it yielded innovation in terms of the process equipment that later filtered through to the manufacturers. Here the demand side innovation policy measures related to the public technology procurement, demonstration, information, but also cluster measures are relevant.

4. Science-based sectors (like pharmaceuticals, electronics etc.), where product and process innovations are rapid, the knowledge used is internal (R&D activities), but also external stemming from universities and research institutes and the appropriability mechanisms vary from patents and waiting times to different learning curves and trade secrets. Andersen (1992) differentiates between the production of mass products where interaction is not needed and new products where the interaction is crucial. When products are novel and more complex (which might require adaptations in use on the part of the customers) or the market is poorly defined, collaboration with users is essential to ensure market expansion. For supporting these sectors, R&D procurement, technology procurement, technology platforms, demonstration, in addition also common awareness and vision building are relevant.

Data and methodology

As our goal is to study, how the demand-side innovation policy measures are related to the innovativeness of the economic sectors, we use sector-level data from EUROSTAT (CIS) from 2008-2012. The dependent variable in all models is reflecting the innovativeness of the industry; therefore it is the share of innovative firms (having product, service and process innovations) in respective period. The independent indicators available are related to innovation inputs and processes (R&D investments, cooperation indicators, but also hampering factors), but also indicators related to the output (level of the innovativeness) in previous

periods. Public policy indicators are the public support existence for innovation, procurement-related indicators available in the latest survey covering the years 2010-2012. We have also incorporated the indicator expressing public regulation quality from Worldwide Governing Indicators (WGI). The models are also controlled for the country specific effects.

Preliminary results

By summarizing preliminary calculations, the factors supporting innovation (cooperation, sources of innovation etc.) are relevant as expected in the model for all sectors generally supporting earlier industry level empirical analyses. The results show that if innovation requiring public procurement is also positively related to the higher innovation activities in the sector and if public procurement didn't require innovation, it is related to the lower innovativeness of the industry in general.

By assessing the innovativeness of industries of the science based group, the results show as expected the role of R&D investments, cooperation with universities and investments for acquisition of the external knowledge playing innovation-enhancing role. From policy variables, better regulative quality plays positive important role. If public procurement was not requiring innovation, it was related to the lower innovativeness of the sector.

In case of scale intensive industries, the innovativeness in the past periods and supplier collaboration contribute to the innovativeness, but also several barriers (personnel, but also regulative barriers) play important role in hampering the innovativeness. In this model, the procurement related indicators are having no effects in or model.

In supplier dominated and specialised supplier industries earlier innovativeness, but also openness for cooperation is contributing to the innovativeness. As the models are having multicollinearity problem, we still have to work further to find robust results.

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SOCIO-TECHNOLOGICAL TRANSITIONS AND NEW BUSINESS LOGICS – FROM CLUSTER POLICIES TOWARDS ECOSYSTEM POLICIES

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Keywords: Business ecosystem; innovation policy; economic transition; socio-technological transition

EXTENDED ABSTRACT

Micro-level innovation, especially radical niches, play an important role in socio-technological transitions that tackle with “wicked problems” deriving from the macro-level changes: like climate change, population ageing etc. Socio-technological transitions are radical innovations in structures, mindsets and practices that involve actors from different sectors, domains and scale levels (Loorbach, et al., 2010). Transitions are taking place in an interplay between three levels: changes at the landscape level that exert pressure on the existing socio-technical regime, and radical niches that may challenge the existing regime, and may act as “seeds for change” in times of regime destabilisation (e.g. Geels & Schot, 2007). Examples of socio-technological transitions are e.g. transitions in mobility systems, communication, health care, and energy production. Transitions cannot be planned nor controlled but they can be initiated, supported and accelerated, with for instance practical actions and policy measures (Loorbach & Rotmans, 2006).

The aim of this paper is to study the shift from cluster-based business logics and innovation policies towards ecosystem-based ones, and also to study the relationship between innovation ecosystems and socio-technological transitions. We argue that the shift from cluster-based innovation policies towards ecosystem based policies could facilitate the formation and diffusion of niches in a manner which can help to break the barriers between niche and regime levels and thus accelerate the wider socio-technological transition, e.g. towards sustainability.

This conceptual paper is based on combining the existing literature on changing business logics (from clusters to business ecosystems) and the literature on socio-technological transitions, which, so far, have been quite disconnected. Cluster theory was introduced by Michael E. Porter in the early 1990s and clusters have since become both an extremely popular subject of study and tools for economic development purposes. Cluster formation is based on the idea of localization economies, that is, that competitive advantages lie not inside companies but in the locations where business units are based (Porter, 2000).

Internet economy has changed the economic environment remarkably: central terms of the new business logic are business and innovation ecosystems, development platforms, technology adjacencies, value networks, crowdsourcing. James F. Moore, who first applied the ecosystem concept to a business

context, stated that competition had changed from the traditional head-to-head situation and that this change should be examined in a new way (Moore, 1993). According to Moore (1993), firms should not be seen as a part of an industry but as a part of an ecosystem where companies cooperate, compete and coevolve capabilities around a new innovation. He defines a business ecosystem as ‘a type of a business network, a collaboration to create a system of complementary capabilities and companies’ (Moore, 2006). Typically network relationships in an ecosystem are loose, which makes ecosystems adaptable as fruitless connections can be cut and new ones formed at a rather fast pace (Iansiti & Levien, 2004).

What is peculiar to the ecosystem approach is the stress on the dynamic nature of the business ecosystem. A business ecosystem is self-organizing network that revolves around new innovations. In business ecosystems the interdependent partners cooperate to co-create new value for the customer instead of merely add value at each stage of a chain, like in clusters (e.g. Gossain & Kandiah, 1998). A cluster is built around a certain industry and related businesses and therefore knowledge inside and essential to clusters is highly specialized. Business ecosystem, again, consists of complementary industries, niches and firms which require complementary and specialized knowledge pools. Unlike for clusters, geographical proximity is not the key factor for ecosystem formation. As business logics change, research and innovation must respond to this development and practices in them are challenged considerably in the near future.

Table 1 presents the stylized characteristics of clusters and business ecosystems, their structure, functions and their policy implications. By examining the characteristics of clusters and business ecosystems in parallel, it is possible to distinguish fundamental differences between these two that have an effect on their applications in policy context.

Table 1 Main characteristics of cluster and business ecosystem concepts (modified from Rinkinen & Harmaakorpi, forthcoming)

		Cluster	Business ecosystem
STRUCTURE	Geographical scope	Local/Regional	Global
	Scope	Certain industry and related businesses	Complementary industries, niches and firms
	Actors	Firms within a certain industry and related fields	Ecosystem firms and organisations
	Key actor	Lead firm	Keystone organisation
	Networks	Local networks	Global networks
FUNCTIONS	Dynamics/ driving force	Localisation economies	Complementary assets, shared value creation
	Knowledge and innovation	Highly specialised knowledge, local knowledge spillovers	Complementary and specialised knowledge pools, open innovation
	Cooperation	Cluster firms and related organisations	Ecosystem firms and organisations
	Value creation	Value chain	Value network
	Governance	Top-down	Peer-to-peer
POLICY	Public sector role	Education, training, infrastructure	Removing the bottlenecks of evolution?
	Policy objective	Foster local cluster growth and competitiveness	Nurture new entrepreneurship, foster ecosystem renewal?
	Key policy challenge	Old, declining industrial clusters	Ecosystem growth/renewal/death?

After analysing the differences between clusters and ecosystems from the perspective of transition dynamics, we suggest for instance that *ecosystems accelerate transitions because of their ability to create radical niches* that are needed for transition. The most dominant difference between clusters and ecosystems in terms of transitions is the nature of ecosystems as dynamic, self-organising networks, where various complementary assets and knowledge pools are combined and co-evolved, and makes it more probable to produce radical innovations as a result of these expertise combinations. Innovation processes and value creation in ecosystems are based on open innovation and co-creation, and therefore ecosystems are able to address new business domains (Moore 2006).

However, these radical niches often meet strong resistance due to the cognitive and institutional lock-ins in the presently dominant socio-technical regime (Geels & Schot, 2007; Walrave, et al., 2013). The inertia between regimes and industries can be seen as a root cause for the difficulties in achieving transition as well as renewing the industries (Walrave et al., 2013). Ecosystems may also *facilitate the breakthrough of radical niches as they reduce the inertia between regimes and niches*. Global multi-actor collaboration and continuous renewal of the ecosystems reduces the risk of locking in to the existing rule-systems. Governance in business ecosystems is peer-to-peer-type and distributed, rather than top-down (see also Walrave, et al., 2013), and basically, a business ecosystem can be opened up to all possible contributors and participants and thus create an organizational form of ‘distributed creativity’. Contrary to many other innovation system approaches, which mainly focus on the production system, the ecosystem approach takes into account also the systems of use, which increases the niche-regime interaction.

As a contribution and a theoretical implication, the paper clarifies the concept of business ecosystem and provides a new perspective on this quite a new policy concept in the context of socio-technological transitions, especially in emergence and diffusion of niches. This paper responds to the need of combining ecosystem and transition management approaches, as suggested for instance Walrave et al. (2013), as well as to the need of introducing new policy perspectives to accelerate and manage transitions.

Moving towards ecosystems perspective in innovation policies may also help the alignment of innovation policies and transition policies (see Alkemade, et al., 2011), combining economic growth and societal needs. Traditional innovation policies may lead to sub-optimal solutions, generating even more persistent and complex problems in the long term (Loorbach & Rotmans, 2006). More research is needed on business ecosystems, related policies and their role in societal transitions.

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SMART SPECIALISATION IN FINLAND: EMPIRICAL BOTTOM-UP VIEW

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Keywords: smart specialisation; innovation policy; cohesion policy

EXTENDED ABSTRACT

Point of departure and thematic relevance

European Union launched *Europe 2020* strategy for jobs and growth in 2010. Its key principle is to create favorable conditions for smart, sustainable and inclusive growth and there are seven flagship initiatives through which the ultimate goals can be attained. Innovation Union is one of those flagships. In addition to these EU initiatives, attaining the ambitious targets of *Europe 2020* there is clearly need to integrate different policy aspects both on EU and national level.

In this respect, the concept of smart specialisation is playing a key role. Namely, the concept has been designed to bring together the EU level innovation policy and cohesion policy which is a major challenge. The basic idea reinforce regional innovation by enabling regions to focus on and to utilize their strengths. It is worth noticing that this line of European policy is not targeted only for innovative, well-performing regions, but for all regions. The basic idea is that all the regions can have certain economic, technological and knowledge-based assets and strengths which can be utilized more effectively leading to deepening economic differentiation and specialisation of regions. This process is – with good reason – expected to Europe's knowledge-based development and innovation performance in its entirety.

From the policy and administrative point of view, smart specialisation is a quite powerful tool within the Cohesion Policy, as European Commission has adopted it as an 'ex-ante conditionality' for releasing Structural Funds for innovation measures in the regions. The practical implication of this course of conduct is that every member state and region must have a justifiable and well-grounded Research and Innovation Strategy for Smart Specialisation (RIS3) in place. Furthermore, the European Commission has very actively supported regions with their RIS3 strategy process by publishing different RIS3 guides and setting up the S³Platform for European collaboration.

In sum, bringing European innovation policy and the cohesion policy together is a major policy challenge. Thus, it is central issue when considering policies for economic and social transition highlighting the thematic relevance of this paper in terms of this conference.

Research problem and questions

This paper deals with the smart specialisation in Finnish regions. The research problem in a nutshell can be expressed as follows: What is the actual state and anticipated significance of RIS3 agenda in Finland in terms of a) policy substance (e.g. strategic priorities) and b) policy processes? To answer this question, three different views are opened:

1. Firstly, the announced RIS3 priorities, “*strategy reality*”, of Finnish regions are contrasted with their observed areas of actual specialisation, “*statistical reality*”, in the light of statistical data. The key question is to what extent the announced, strategic smart specialisation ambitions of regions are consistent and compatible with the actual empirical evidence on industrial specialisation which can be seen as the backbone of the smart specialisation.
2. Secondly, the findings derived from the comparison of “strategy reality” and “statistical reality” pave the way for the second phase investigation which aims to *explore and expose the premises of priority setting in regions*. Based on the preceding analysis, the regional actors’ attitude and rationale concerning RIS3 strategy formation are scrutinized. This qualitative section will address a myriad of factors surrounding the particularities of innovation policy in the attempt to explain the real-life logic of RIS3 design and implementation. The key question is why the regional RIS3 strategies are formulated as they are?
3. Thirdly, *a micro perspective on a RIS3 strategy* is opened. In this section, the experiences of RIS3 strategy process in South Ostrobothnia are analysed and discussed in order to deepen the understanding concerning the rationale of the whole RIS3 agenda from the regional perspective. The key question is how the guiding principles of the RIS3 can be applied in the actual strategy process in the Finnish regional policy context?

In sum, the study scrutinizes empirically the fulfillment, plausibility and value-added of smart specialisation agenda in Finland.

Conceptual approach

There is a rapidly expanding body of academic smart specialisation literature. For example, professor Dominique Foray (2015) has written a first analysis of smart specialisation approach. Still, smart specialisation is primarily a policy concept and more rigorous theoretical analysis and development will follow. The key points of this debate are examined to set the scene for the empirical analyses. Just to mention two of them: Firstly, smart specialisation is more complex process than straightforward industrial specialisation, as the aspect of R&D and innovation is strongly present. Secondly, the smart specialisation policy should be distinguished from traditional top-down policies. Thus, the concept of “entrepreneurial discovery process” (EDP) has become very essential.

In this paper, the current policy-flavored academic debate on smart specialisation and its key points will be rooted in more established theoretical and conceptual terrain in terms of both a) policy substance and b) policy processes. From the policy substance perspective the key question is, how the regional economic specialisation is linked with the innovation. In this respect, there are several useful ranging from the classical agglomeration theory to the established territorial innovation models (e.g. Moulaert&Sekia, 2003) and to

more recent concepts, such as related variety (Hartog, Boschma & Sotarauta, 2012). From the policy process perspective, the smart specialisation philosophy is closely related to concepts, such as place-based policy (e.g. Bachtler, 2010) and evidence-based policy (e.g. Sanderson 2002).

Data and methods

As mentioned above, this paper opens up three different views on the RIS3 agenda in Finland. In order to catch the very essence of these perspectives, different methods and data sets need to be applied:

- Firstly, the relationship between “strategy reality” and the “statistical reality” is analysed by comparing the analysis of regional RIS3 policy documents and the statistical analysis of the economic specialisation of regions. The statistical analysis is done by using standard methods, such as location quotient method (e.g. turnover, number of employees and number of places of business) and comparative analysis on productivity and productivity growth.
- Secondly, the analysis concerning the premises of RIS3 priority setting in Finnish regions is based on data collected through thematic interviews. The interviewees are holding key positions in regional councils which are in charge of developing and executing RIS3 strategies. Interviews are conducted mainly by telephone.
- Thirdly, a micro perspective on a RIS3 strategy is based on a case study, focusing on South Ostrobothnia. The case study stems from authors’ personal involvement and participant observation within the actual RIS3 strategy process in South Ostrobothnia.

Tentative and expected results

The status of this paper is a work in progress. So, we can only share some tentative and expected results. To begin with, the hypothesized contrast between “strategy reality” and “statistical reality” seem to exist, but it only highlights the multifaceted nature of policy priority setting process. Correspondingly, the key policy actors of regions seem to have quite different views on smart specialisation and its significance within innovation policy.

Finally, the case study confirms the complex nature of policy formulation in the region: regions have their own, original ways to conduct strategy and policy processes. These institutionally and culturally rooted ways of acting cannot be replaced with externally determined strategy agenda, even though it would be the EU flagship project with detailed policy guides and other supportive measures. Still, on the other hand, regions are interested in adopting those strategy principles and approaches that would either renew or reinforce their a) policy substance (e.g. priorities) and b) ways to conduct policy processes.

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ANALYSING THE IMPACTS OF A HIGH-LEVEL RESEARCH AND INNOVATION POLICY COUNCIL – CONCEPTUAL FRAMEWORK AND A CASE STUDY

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Keywords: Research Policy; Innovation Policy; Research and Innovation Council; Impacts; Governance; Policy Coordination

EXTENDED ABSTRACT

The question of effective coordination of research and innovation policies has recently become an increasingly important challenge for governments across the globe (e.g. Magro et al. 2014). This growing need for coordination arises from several sources. First, the increasing internationalisation, in the European case in particular the advancement of the European Research Area (ERA), has implied a need to strengthen policy-making and its coordination at the national level (e.g. Braun 2008). Secondly, the growing importance of innovation for economic development and related upraise of innovation policy has called for closer integration of research issues and innovation development (e.g. European Commission 2003). Third important dimension concerns the horizontal nature of policy problems (e.g. OECD 2005). Problems and challenges to be tackled by policy-makers are increasingly complex and cross-sectoral, and thus need to be approached with measures from a variety of policy areas. In the area of research and innovation, this concerns, naturally, the so called grand challenges areas, but also other important issues such as the demand-driven innovation policy (e.g. see Edler & Georghiou 2007). Tackling these issues requires the balancing of innovation objectives with objectives of other policy areas. In addition, the simultaneous widening and deepening of the scope of innovation policy also tends to set challenges for policy coherence (Borrás 2009).

High-level research and innovation policy councils have traditionally been an important institutional mechanism to promote policy coordination in research and innovation policies in particular in Europe but also globally in countries such as Japan, Korea, Canada and Singapore (e.g. OECD 2009; 2012). Although the councils' composition, tasks, position and role differ in different countries, they often assume several important functions such as strategic advice to the government on S&T issues, planning and allocation of the R&D budget, providing strategic intelligence to the research and innovation system and bringing a long-term perspective to the policy (OECD 2012). In the 2000s, along with the growing importance of research and innovation and increasing call for policy coherence, the role of these councils has become increasingly salient (Pelkonen & Teräväinen-Litardo 2013). In many countries, high-level councils have become key mechanisms through which governments have tried to develop a more strategic approach and to provide leadership and common visions for research and innovation development.

Although the councils' importance in national innovation systems has generally increased, there is practically no research-based evidence on the effects and impacts of their activities. This paper tackles this gap in the research literature by examining the impacts of the Research and Innovation Council of Finland in the European R&D policy context. Headed by the Prime Minister and assuming a broad composition of political decision-makers and key stakeholders of the national research and innovation system, the Council is charged with – among other things – coordinating and consolidating research and innovation policies in Finland. In terms of impact analysis, the Finnish Council is particularly interesting object of study as it has often been considered as a key element behind the success of Finnish research and innovation policy (e.g. Benner 2003). As a result, it has become an international benchmark and attempts have been made to transfer the model to several countries (e.g. Sweden, the Netherlands, Hungary, Estonia). Yet, prior to this study there is lack of evidence of the actual effects and impacts of the council's work.

The paper will develop a conceptual framework for analysing the impacts of high-level research and innovation councils. The framework will take into account the basic nature of the activities of the council and its impact logic. In particular, as such councils normally do not have decision-making power nor executive power, their impacts are primarily indirect and “soft” effects that become manifested in other actors' activities and policy guidelines. Hence the framework will combine perspectives from traditional logic-linear evaluation models (e.g. Lähteenmäki-Smith et al. 2006) and systemic evaluation models that take into account the broader operational environment and interaction therein (Dyehouse 2009). The paper will also draw attention to challenges in impact assessment of high-level policy councils that rely on indirect impact mechanisms in their activities.

In empirical terms, the paper will focus on analysing the impacts of the Research and Innovation Council of Finland during the period of 2005-2012 from three interrelated perspectives: influence on the macro-level development of the national research and innovation system (including horizontal coordination capacity and broad-based innovation policy), impact on governmental and parliamentary decision-making and impacts on the development of national R&D funding. The period under analysis is particularly interesting because the Finnish R&D policy faced severe challenges and problems in operational environment during the time. In addition, the results of the impact assessment will be reflected and compared to observations on a few similar European councils.

The paper presents final results of a study carried out in 2014-2015. It is based on multiple data sets which comprises 32 personal interviews with key Council members, policy-makers and stakeholders, an extensive survey targeted at Council's stakeholders (n=473) and document material including e.g. the Council's reports, minutes of meetings and other documents related to the Council's work as well as research and innovation policy documents and other key documents such as government programmes.

The study shows that the impact mechanisms of high-level policy councils strongly rely on interaction, discussion, sharing of ideas, expertise and dissemination of knowledge. From a systemic perspective, the Council is one actor in a multifaceted system of actors in which it cannot impose its guidelines but it has to gain its influence through different means. The study also indicates that the influence of such councils may

change over time and that these changes may be strongly dependent factors that are “external” to the council itself, such as the political situation and broader societal developments.

The empirical results of study show that during the study period the Research and Innovation Council has had relatively important impacts in the main research and policy guidelines as well as in the level of public R&D funding. Similarly, the Council activities have been reflected in the governmental programmes as well as in the activities and strategies of various actors in the national S&T system. It also appears that the Council has particularly strong impact vis-à-vis the key public R&D funding organisations while it has considerably less impact on, for instance, universities’ policies and strategies.

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INDIVIDUAL VERSUS INSTITUTIONAL OWNERSHIP OF UNIVERSITY-DISCOVERED INVENTIONS

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Keywords: Intellectual Property; Patents; Technology Transfer; Policy Evaluation

EXTENDED ABSTRACT

Intellectual property (IP) policies are among the most powerful instruments shaping the incentives that drive the discovery and commercialization of knowledge.

We examine a fundamental change in German patent law that transferred ownership rights from the inventors to their employers. Prior to 2002, university professors and researchers had exclusive intellectual property rights to their inventions. This “Professor’s Privilege” allowed university researchers to decide whether or not to patent and how to commercialize their discoveries, even if the underlying research was supported by public funds. After 2002, universities were granted the intellectual property rights to all inventions made by their employees and this shifted the decision to patent from the researchers to the universities. The policy goal was to increase patenting of university-invented technologies which is often used as a surrogate indicator of successful university technology transfer.

By changing the agent who makes the patenting decision, the abolishment of Professor’s Privilege caused a “regime shift” that substituted institutional benefit and cost schedules for those of the individual inventors. The net effect on the volume of patenting depends primarily on the relative costs between the regimes. To identify how the regime shift affected patenting, we exploit the researcher-level exogeneity of the 2002 abolishment of Professor’s Privilege along with the institutional structure of the German research system in which universities and other public research organizations (PRO) coexist. PRO researchers were not affected by the policy change and serve as a control group. We use a difference-in-difference methodology and control for the arrival of new patentable discoveries using publications and peer-to-peer matching.

Our analysis shows that fewer university inventions were patented following the 2002 regime shift. For a given discovery, the schedule of benefits to institutional owners, who are the postchange patent decision makers, is lower because the university became an additional party in the negotiations over the split of expected revenues. This partly explains why fewer inventions qualified for patent protection following the regime shift. However, the effect on expected revenues can be offset if institutional costs (broadly conceived) are sufficiently lower than those faced by individual researchers. Our results show that

institutional patenting costs were lower for the subset of university inventors who did not have relationships with industry partners prior to the policy change. For those individuals, patenting increased. But, the data also show that most German patenting professors had prior industry relationships. Post-change institutional costs were not low enough to offset the revenue effect for this group.

While these findings reflect the medium-term effects of the law change, it could still be possible that the law change results in higher commercialization in the long-run, that is, when new faculty members who never experienced the old regime of inventor-ownership enter academe. However, trends in the number of patenting researchers until 2008 do not suggest more researchers patented after the law change. On the contrary, the number of patenting professors declined, at least through 2008.

Our findings provide the strongest evidence to date that an inventor ownership system can produce more university-invented patents, and thereby more technology transfer, than an institutional ownership system. Does this imply that other countries such as the U.S. would increase university technology transfer by adopting an inventor ownership system? Not necessarily. The nature and strength of faculty-industry relationships will differ based on each country's institutions, culture, and historical evolution of networks and trust relationships. Rather than attempting a major policy change, policymakers in other countries would benefit from a better understanding of current practices. This information could be used to design incremental changes that allow technology transfer processes the flexibility and adaptability needed to fit alternative technologies and markets. Our results highlight the critical importance of understanding the nature and strength of faculty industry relationships before undertaking policy initiatives intended to foster technology transfer.

ACADEMIC PATENTING MEETS AGENT-BASED SIMULATION: PROVISIONAL RESULTS AND RESEARCH PERSPECTIVES

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Keywords: Academic patenting; Empirical evidence from Austria; Agent-based simulation

EXTENDED ABSTRACT

The relevance of patents in general and academic patents in particular has experienced growing interest by companies/universities, policy-makers, and researchers in the social sciences alike. Research on academic patenting has become popular in the United States at least since the 1980s, whereas corresponding research activities in Europe have started considerably later. Particularly noteworthy is the project “Academic Patenting in Europe” (cf. APE-INV, 2009), that has been funded as a research network programme by the European Science Foundation in 2009-2013 and succeeded in bringing together researchers from thirteen European countries. Several of these researchers have published their results in a special issue of *Industry & Innovation* (for an overview see the editorial by Lissoni, 2013).

So far, most research in academic patenting is based on quantitative empirical studies, several draw from personal interviews, and a few are just conceptual. Research questions, for instance, are directed towards comparing patent counts in diverse countries (taking into account differences in patent regimes, etc.), investigating motivations of professors for filing an academic patent (or at least to be involved in such an activity), the effects of academic patents on publication output (or vice versa) and so forth. Identified impacts of academic patenting on research, teaching, and administration have been summarised in a recent literature survey by Backs & Stummer (2015).

In a next step, research should be (also) furthered towards the development of (normative) tools that can support decision makers in finding the ‘right’ measures to stimulate academic patenting (if so intended). Given the complexity of the underlying social system, an agent-based simulation seems to be a proper methodology to tackle this challenge. Such a simulation is particularly well suited to capture emergent phenomena, i.e., system behaviour that has not explicitly been implemented by the modeller but instead results from the (simple) rules that dictate the interactions of stakeholders being modelled as heterogeneous agents (Garcia, 2005). Agent-based modelling and simulation is a rather new approach that has received considerable attention in the research of social behaviour (Squazzoni, 2010). They have been applied particularly in the domain of innovation diffusion research. A thorough discussion of pros and cons of agent-based modelling is provided by Kiesling et al. (2012).

Our current research endeavour aims at bringing together the domain of academic patenting and the modern agent-based simulation approach in an attempt to eventually provide such a decision support tool for university managers or policy-makers. While this is an ongoing project that has not reached this ultimate goal yet, still three outcomes have been achieved so far. Firstly, we have investigated academic patenting at Austrian universities by means of an empirical study that, to the best of our knowledge, has been the first one of its kind being conducted in Austria. This work has provided us with a profound overview of the status quo at Austrian universities. Secondly, we have interviewed academic inventors as well as the heads of technology transfer offices (TTOs) from several universities in order to learn about researchers' motivation for patenting and to gain deeper insights in the effects of incentives that are actually offered at Austrian universities. Thirdly, and the focus of the paper at hand, we work on an agent-based simulation that allows for testing different scenarios together with alternative bundles (i.e., portfolios) of measures that may have an impact on patenting at a university. This simulation will be parameterised according to the empirical data mentioned above. The integrative research design that has been chosen to link empirical data with the simulation approach is outlined in Figure 1.

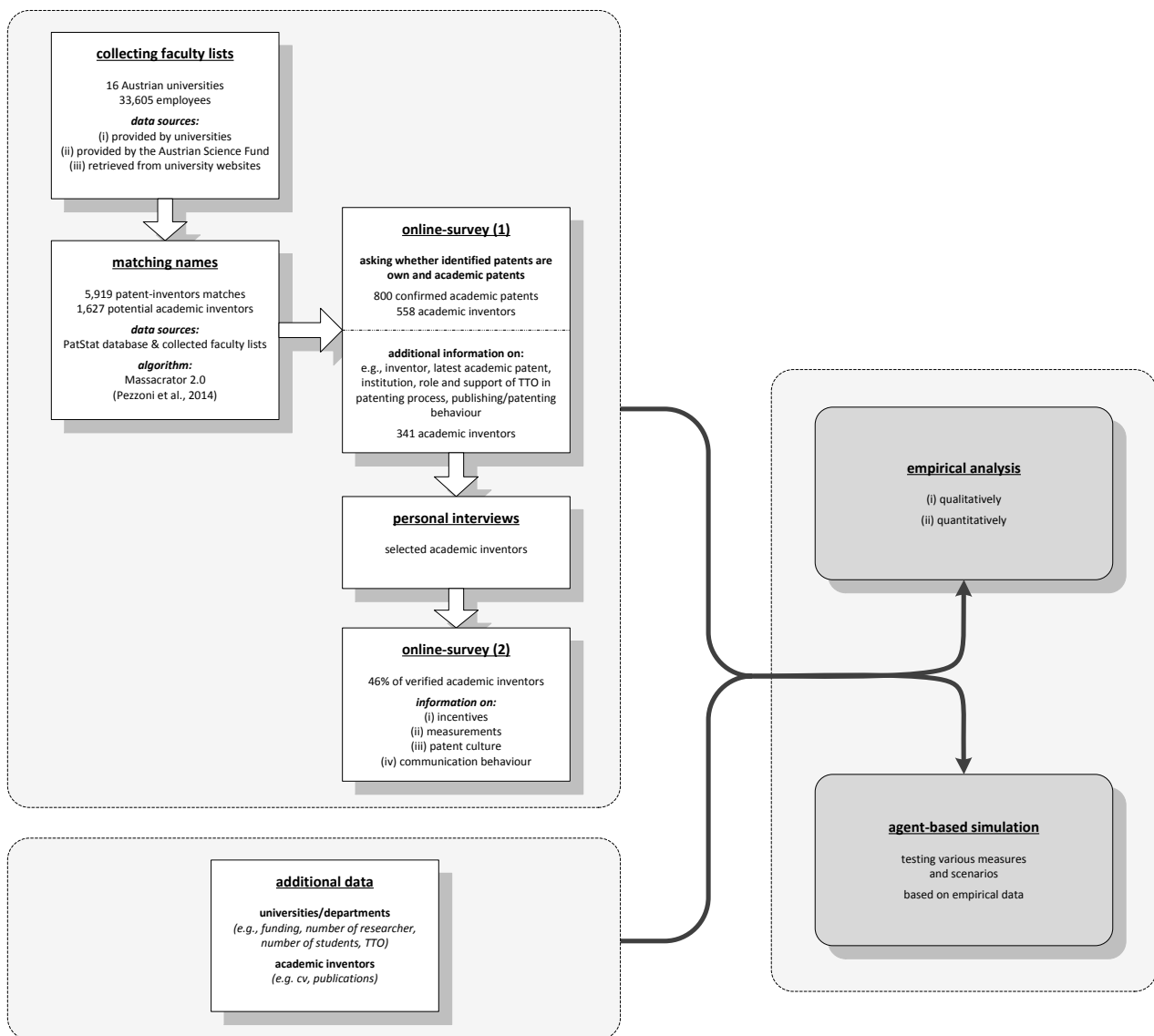


Figure 1: Research design.

We started with *collecting faculty lists* of scientists being employed at one of the sixteen established (public) universities in Austria. Since these lists are not centrally available, we resorted to three different sources, namely, (i) asking universities to provide such lists, (ii) extracting names of scientists from public available websites (in the few cases in which we have not received the lists directly from the respective rectorates), and (iii) through non-classified data from (successful) funding applications at the Austrian Science Fund (the latter data was just meant to further enrich our name list). After merging and cleaning these lists we ended up with 33,605 names. Next, Francesco Lissoni and his team supported us in *matching these names with inventors' names* from European Patent Office patent applications available in the 'Worldwide Patent Statistical Information Database' (PatStat); for details on the used name-matching algorithm Massacrator 2.0 see Pezzoni et al. (2014). This procedure left us with 5,919 patent-inventors matches referring to 1,627 potential academic inventors. In order to verify these matches, we set up an *online-survey* and contacted all the potential academic inventors asking them to confirm or to decline the ownership of the patent(s) that have provisionally been assigned to them. 558 of them responded to our request and confirmed a total of 800 academic patents. Moreover, 341 academic inventors were willing to answer some additional questions referring to their patenting and publishing behaviour as well as the role and support of the TTO in the patenting process. In addition, we conducted several *personal interviews* with academic inventors from different universities to gain even more insights. Afterwards, we set up a *second online-survey* (that experienced a rather high response rate of 46%) that focussed on perceived monetary and non-monetary incentives and perceived measures that are meant to encourage patenting activities as well as on the patent culture on the university, faculty and department level. In this survey, we also asked about the scientists' communication behaviour with respect to patenting issues as well as about the visibility of patenting and publication activities within the organization. Finally, we collected *additional data* about the identified academic inventors (e.g., CV, list of publications) and their respective universities and departments (e.g., funding, number of researcher, number of students, activities of TTO). Some descriptive results from an initial empirical analysis are described by Stummer et al. (2013).

In order to be able to prepare decision support for university management (or policy makers) we are about to implement an agent-based model that can be used for simulating the effects of various measures on the social system 'university' with respect to its ability for stimulating academic patenting activities. The empirical evidence described above then will be used to parameterise and test this simulation. Once simulation results have passed face validations with experts (particularly so, with TTO officers), we intend to model the environment for specific (real-world) departments and, ultimately, for a specific university. Obviously, this will require substantial effort for data acquisition, but would also open up an opportunity for an empirical validation as a means to build up trust in the simulation.

An agent-based simulation enables the modelling of complex emergent phenomena. Its focus does not lie on the social system as a whole, but on individual stakeholders and their behaviour which allows for capturing complex structures and dynamics without knowing the exact global interdependencies (Borshchev & Fillipov, 2004). To this end, independent and heterogeneous "agents" (e.g., researchers differing in age, educational background etc.) as well as their social interactions and behaviour (e.g., decision whether to

patent or publish research results) are modelled on a micro-level based on simple rules (cf. Bonabeau, 2002, and Baxter et al., 2003). Agents representing researchers thus act (and make decisions) on the basis of local information which on the macro-level results in dynamics of the social system that can be observed in the course of the simulation runs.

The main entities of our model are outlined in Figure 2. The model accounts for *researcher agents* who exhibit attributes like age or affinity for patents and publications and can act and react based on their limited information. For instance, researchers communicate actively with each other (within and between departments) about patenting and/or publishing (*word of mouth*) or are passively exposed to *normative influence*. During the simulation period, some researchers come up with new ideas (*inventions*) and have to decide whether to publish or to patent these inventions. This decision may be influenced by the *TTO* agent through setting different *monetary* (e.g., a bonus for each patent application) or *non-monetary* (e.g., being acknowledged on the university website) *incentives* as well as through further/additional *measures* (e.g., in-house events with patenting experts or offering consulting with respect to the patenting process).

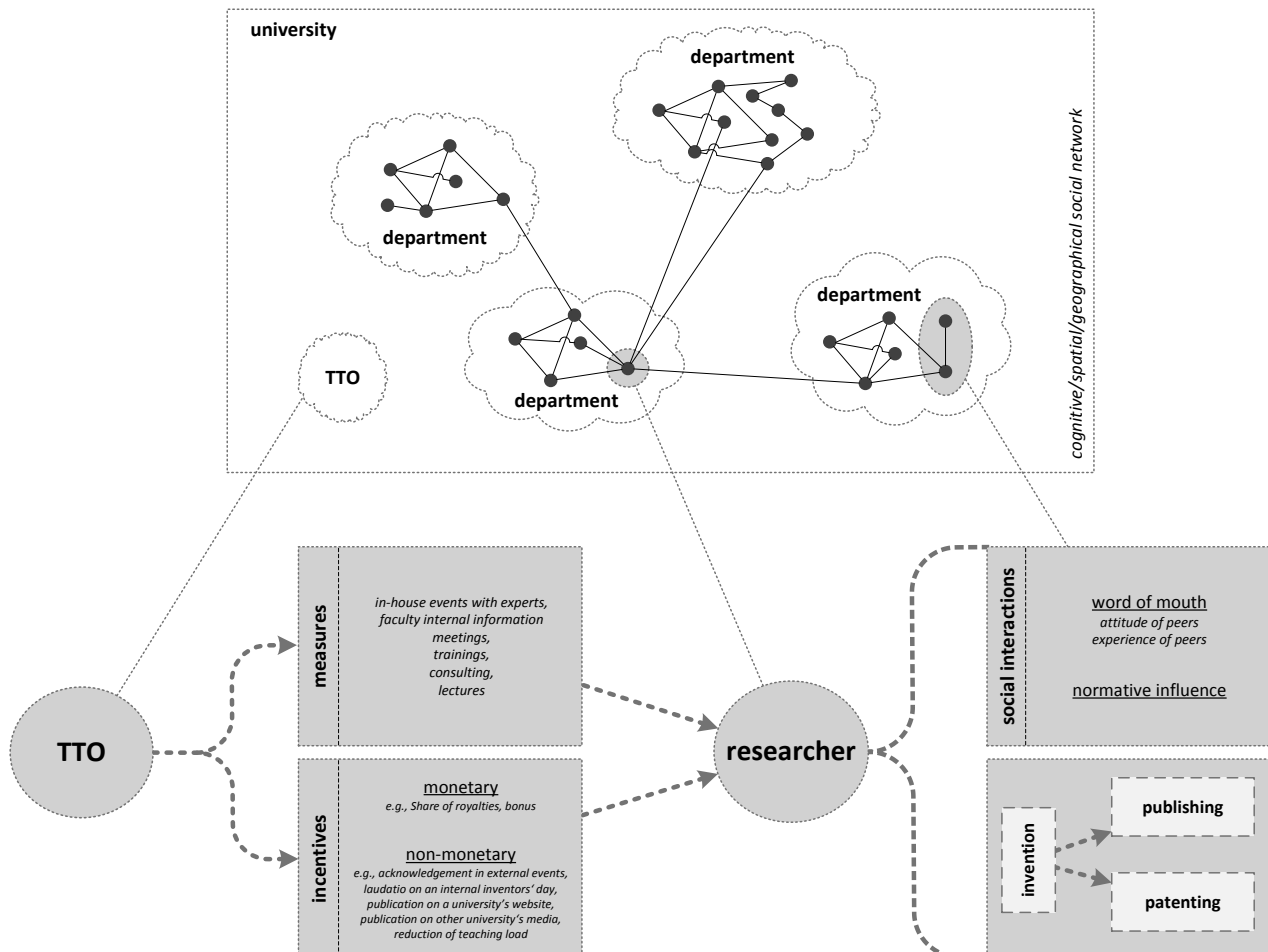


Figure 2: Agent-based model.

So far, we have implemented an initial version of the simulation tool and can elaborate on our experiences. Moreover, we will discuss challenges that need to be mastered in the course of further research activities in order to reach the goals outlined above.

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ITALIAN UNIVERSITIES ON MARKETS FOR TECHNOLOGIES: POOR MANAGEMENT OR CHERRY PICKING?

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Keywords: University; Intellectual Property; Patent quality; Technology Transfer; Policy Evaluation.

EXTENDED ABSTRACT

Academic research contributes to innovation both indirectly, through education and fundamental research, and directly, through inventive activity and related development efforts. Academic inventions can result from activities taking place at the initiative of the academic scientist and/or her institution (universities and, by extension, public research organizations - PROs); or in collaboration with industry, whether this takes the form of consulting, joint research or development partnership. They may also be jointly produced with fundamental research results, as it was the case with early laser technology, polypropylene, and recombinant DNA (Hughes, 2011; Martin, 2007; Townes, 1999); or as complements to it, a classic case being that of scientific instruments (Von Hippel, 2007).

The multiple origins of academic inventions explain the heterogeneity of their intellectual property (IP) regime. While some of them may be left without IP protection, others are patented (“academic patents”), with their IP rights assigned to one or more of the different actors of the inventive process: the scientist (academic inventor), the research sponsor (private and/or public), or the scientist’s institution of affiliation (the department or, more often, the university). Further sources of heterogeneity are legal norms concerning the assignment of IP rights over public-funded research either to universities or their faculty, as well as legislation affecting universities’ autonomy when it comes to asset management and recruitment of IP experts.

Over the past 15 year, European universities have been both pressured into and given the means of taking a more aggressive stance towards IP right appropriation, by reclaiming it either to their employees or to industry partners. This was part of a general demand to make room for technology commercialization among the university’s missions. A good illustration in this respect is the “Code of Practice” approved by the European Commission in April 2008, which explicitly recommends universities to create “coherent portfolios of intellectual property” (European Commission, 2008). In a similar vein, the Italian Ministry of Education (MIUR) considered until recently university-owned patents as the only indicators of universities’ performance in technology transfer, thus ignoring those assigned to firms or other actors (ANVUR, 2011; section 3.2).

While all of these policies are justified by the necessity to “better convert knowledge into socio-economic benefits”, little evidence exists to suggest that universities are better placed than other actors in deciding what academic inventions are worth patenting and/or in managing first the application procedure and then a patent portfolio. Nor we can any more, as it was common until recently, that the relative paucity of university-owned academic patents in the Old Continent implies a limited exploitation of academic inventions (Lissoni, 2012).

Providing this kind of evidence is particularly important in light of the fact that the share of academic patents owned by Italian universities has tremendously increased in the last fifteen years (see also Lissoni et al., 2014), but without increasing the quality with respect academic patents owned and managed by firms (See Figure 1). Using data for Italian university professors, we show that academic inventions applied and managed by universities are of lower quality than those owned by companies. We propose two explanations that refer to (i) the intellectual property (IP) management of universities and (ii) the cherry-picking of companies and professors before the patent assignment. By means of instrumental variable analysis and of a battery of indicators that make the consensus in the literature, such as the number of forward citations, the outcome of the granting decision, the assignee’s decision to withdraw and to renew the patent, we find evidence only of the cherry-picking hypothesis.

Figures

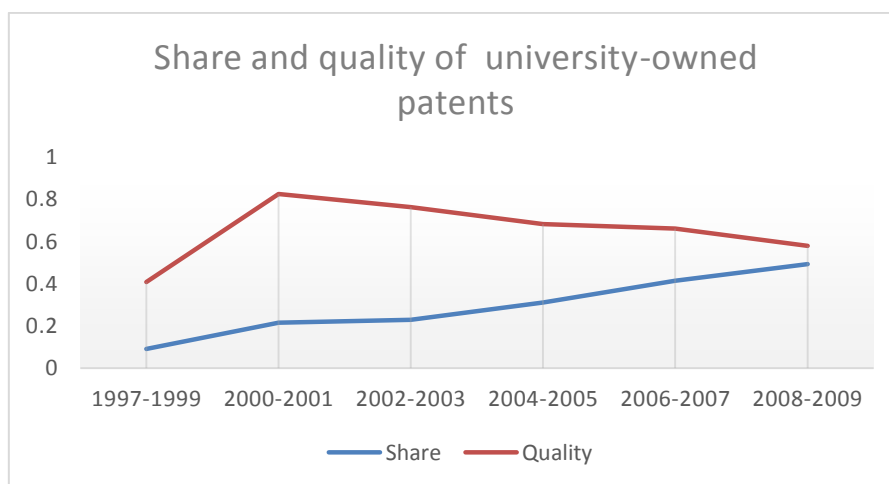


Figure 1: Share and Quality of University-Owned Italian Academic Patents.

Sample: Italian academic patents owned by universities or firms. Quality = average #citations to university owned academic patents / #citations to firm-owned academic patents.

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TOWARD A BETTER UNDERSTANDING OF BLOCKING MECHANISMS IN SYSTEMS OF INNOVATION: INSIGHTS FROM AN ANALYSIS OF THE RELATEDNESS OF PROBLEMS IN A CASE STUDY OF HIGH ENERGY EFFICIENT HOUSES IN THE NETHERLANDS

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Keywords: Systems of Innovation; problems; structural elements; feedback; blocking mechanism

EXTENDED ABSTRACT

The Systems of Innovation (SI) approach has become a popular framework for researchers and policy makers to identify why innovations are not generated, diffused and utilized in a desirable way and to formulate interventions accordingly. At its root lies the insight that the innovation process is non-linear and highly complex (see e.g. Edquist, 1997; Chaminade & Edquist, 2010). This complexity results in a multitude of feedback interactions between the elements (a.o. actors, institutions and networks/interactions) that form the system (its structure). The attention for the non-linear and complex nature of the innovation process provides rationales for policy intervention that go beyond the traditional neoclassical intervention rationale based on market failures. Contrasting the market failures rationale, the intervention rationale in SI-literature is based on alleviating problems in the system structure that inhibit system performance.

Authors use different names to indicate problems in SI. Often used terms are a.o. systemic problems (Chaminade & Edquist, 2010; Wieczorek & Hekkert, 2012), system failures (Klein-Woolthuis et al., 2005; Weber & Rohracher 2012) and blocking mechanisms (Bergek et al., 2008).

Some literature on problems in SI mentions that they do not stand alone. Johnson and Jacobsson (2001) e.g. note that “[...] there is a range of obstacles [...], which may act independently but are likely to reinforce one another” (p.95) or in Klein-Woolthuis et al. (2005) ‘Most problems in the innovation system will not be uni-dimensional but will consist of a complex mixture of causes and effects [...]’ (p.614). Also, the term blocking ‘mechanism’ suggests that feedback is part of it. However, feedback between problems is rarely made explicit and if it is mentioned it is found in between the lines or in a footnote.

Multiple authors have presented categorizations of potential problems in innovation systems (a.o. Chaminade and Edquist, 2010; Klein-Woolthuis et al., 2005; Weber & Rohracher, 2012). Such categorizations (whatever name they are given) are always presented as lists, or as Chaminade et al. (2012) puts it “almost each author has his or her own list of potential systemic problems” (p.1477). The different types of problems are usually related to one structural element. Some authors do present one or two problems in their lists that can be argued to involve feedback (e.g. Chamanide and Edquist, 2010; Weber and Rohracher, 2012). However, the feedback that is part of these problems is not made explicit and remains a black-box.

Case studies of Technological Innovation Systems (Bergek et al., 2008; Hekkert et al., 2007) often present problems as independent entities. Recent examples are blocking mechanisms in relation to IT in home care (Bergek et al. 2010) or in a case study on the Finish life science innovation system (Anne Sisko Patana et al. 2013). Feedback between the problems has no explicit role in these case studies.

In our view, presenting problems in a system of innovation as existing independently does not fit well within a framework that gives so much attention to feedback. One would expect more attention for feedback between problems in a framework that generally agrees that (1) problems are related to the elements that form the system (structure) and (2) stresses feedback between its elements (structural feedback). Therefore, the main premise of this paper is that analyses of problems in Systems of Innovation can be enhanced through more attention to their relatedness.

This paper will explore whether a SI analysis with specific attention to feedback between problems leads to contrasting or additional insights compared to an analysis that identifies independent problems. For this purpose, a case study of a more mature SI was carried out related to technologies that contribute to building energy efficient houses in the Netherlands. An overview of problems in this SI was created by following the preliminary phases of an inductive theory building exercise based on interview data. This research strategy provides the possibility for using a theoretical framework as starting point, without being restricted by it. Figure 1 shows a diagram of the identified problems and their relations.

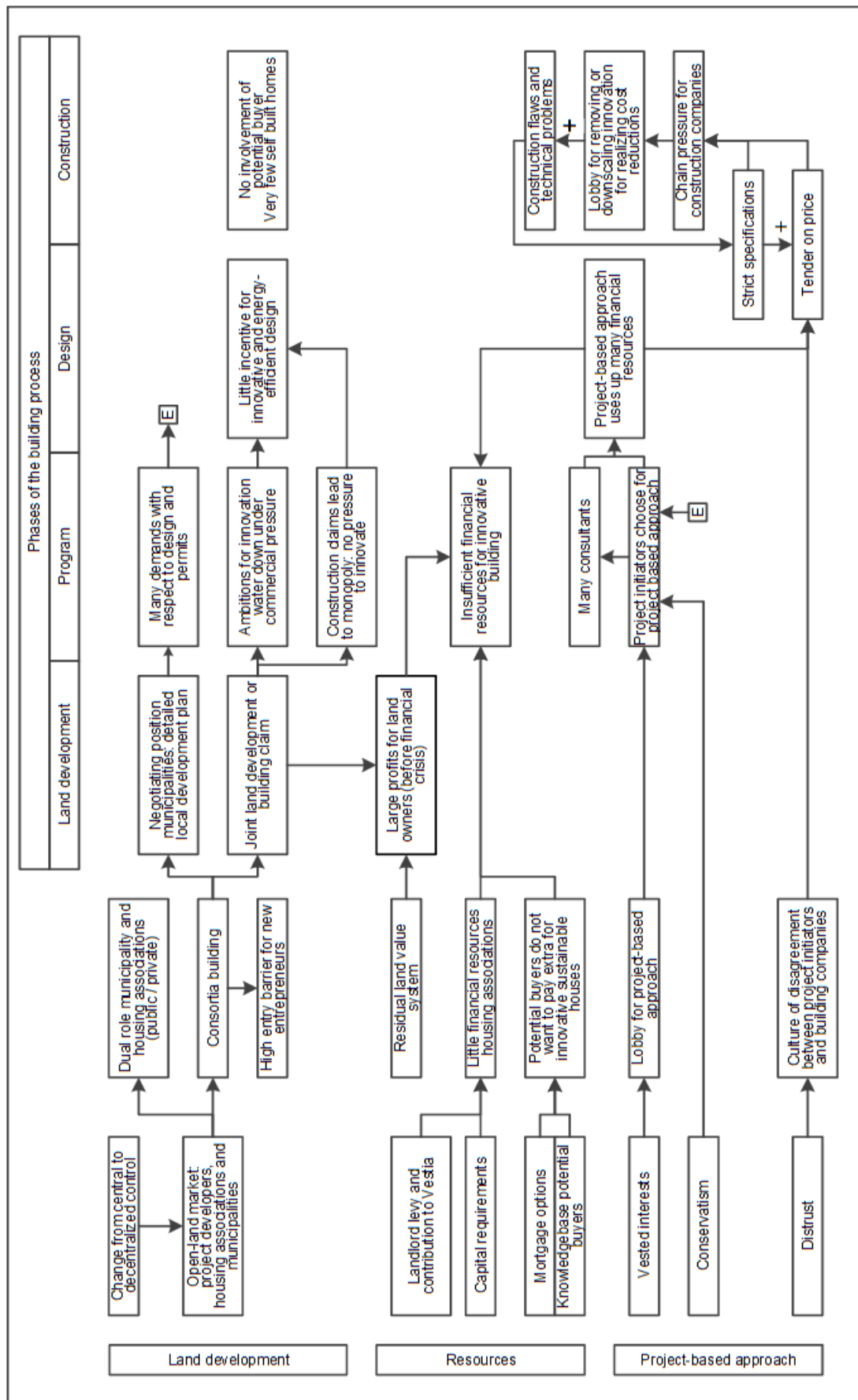


Figure 1: Problems and their relations in the SI of building energy efficient houses in the Netherlands

If we focus on the resource related problems from this figure only: a standard SI-analysis could easily identify the capital requirements and the landlord levy for housing associations, the insufficient mortgage options of potential homebuyers and their lack of knowledge as independent problems. However, deeper analysis of the feedback between these problems reveals that all of these ‘problems’ are related to either the way the land-market is organized (Residual land value system) or the dominance of an inefficient building process (Project-based approach). Intervention on these latter problems would alleviate not only these latter problems, but also the ‘problems’ that are symptoms of these problems (the earlier mentioned problems). This puts the meaning of blocking ‘mechanism’ in a new light.

These results suggest that necessary nuances in a problem analysis of an innovation system are lost when no attention is given to the relatedness of problems. Instead of a list of independent problems, our analysis was able to create hypotheses about the existence of deeper underlying mechanisms of problems. A standard SI-analysis would have led to different conclusions on what was wrong with the system, and this would have resulted in other types of recommendations on how to strengthen it.

The results imply that the current failure frameworks in SI-literature do not explicitly give enough attention to feedback between problems. Analysts that use the existing frameworks will be easily persuaded to formulate interventions for all ‘problems’ they identify. This bears a substantial risk of mistaking problem symptoms for problems with the result of unnecessary or even counterproductive interventions. An additional analysis of the relatedness between problems may reveal that a policy measure focussed on alleviating a certain problem will have limited effect as long as others remain intact or that a certain policy measure is negated by a reaction somewhere else in the system.

Although it is widely accepted in SI-literature that the structural elements interact, these interactions are not seen as a structural element in itself. This could be one of the reasons why the interactions between the structural elements are not focussed on when identifying and analysing problems. Therefore, we propose an alternative definition for two structural elements. First, the structural element *Interactions* can be reformulated to ‘interactions between structural components’. Second, this also necessitates a redefinition of the structural element *Actors* to involve both the actors themselves and their networks. If analysts use these definitions in future TIS-analysis, they will be reminded of the importance of interactions between structural elements and thus of feedback between problems.

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INNOVATION SYSTEMS AND HUMAN SPARE PARTS INDUSTRY SEEN THROUGH A COMPETENCE SET A CONCEPTUAL DISCUSSION WITH AN ILLUSTRATIVE CASE FROM TAMPERE, FINLAND

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Keywords: Innovation system, competence, university, regenerative medicine, human spare parts

EXTENDED ABSTRACT

In spite of the fact that the concept of competence is strongly linked to the innovation system literature, it has not gained adequate attention. For example, Lundvall et al. (2002) argue that the rapid rate of change undermines established competencies and calls for continuous construction of new ones. Lester (2007) crystallise the increased need to better understand competencies related to innovation systems by arguing that there are clear differences in the overall capabilities of nations and regions to adapt to the global economy with equal success. Some simply seem to be better in taking up new technological and market knowledge and to apply it effectively. In innovation systems, competencies (in direct and/or indirect interaction) generate, stimulate and/or frame the overall functioning of a system and its transformation. Conversely, missing and/or poor competencies may freeze an innovation system and lock it in the past, and thus the question may not only be about lack of an actor, incentive and/or policy tool of some kind, as is often seen.

The rationale behind constructing innovation systems is, broadly speaking, to enhance economic development, and a bit more specifically, to boost collective learning for economic and social renewal via the introduction of innovations. Simply put, the innovation system literature promises that by increasing interaction between actors who are involved in generation, diffusion and valorisation of new knowledge it is possible to systematically introduce new creations of economic and/or social significance, i.e. innovations (Edquist, 2005). All this points towards in-depth analyses of learning, knowledge resources, knowledge flows and joint, as well as separate, competencies.

This paper suggests that to truly understand innovation systems economic contribution we might gain additional analytical leverage by studying them through a set of meta-competencies. To this end, the concept of competence set is introduced. Meta-competence refers to those higher order abilities that are called for to learn, innovate, anticipate and create, and/or to generate conditions for learning and innovation. The competence set model is inspired by Eliasson's (2000) competence bloc theory that is used to focus on the

competencies needed to support the emergence of a new industry. In line with its predecessor, the competence set model focuses on the set of actors with adequate competencies required in innovation, business growth and economic renewal. The main aim of this paper is: (a) to construct a focused model of innovation systems based on competence sets, and hence (b) to identify the meta-competencies needed in the emergence of a new industry. The two interrelated research questions we set out to address are what kind of meta-competencies are called for in the emergence of a new science-based industry and how do various meta-competencies interact in a wider system? First, the concepts of innovation system and competence are scrutinised, and second the competence set model is elaborated upon by using the human spare parts industry as an illustrative case to highlight the competence set.

While conceptual in nature, this paper also follows a single case study design to illustrate and highlight how the constructed competence set may play out with a case. The study covers the theoretical middle range in that it aims to understand the emergence of a new industry in its unique context and construct a conceptual model for future studies of innovation systems and economic transformation trajectories. The emerging regenerative medicine concentration in Tampere and the prospective Finnish human spare parts industry serves as an example of emerging industry. It is embedded in the national innovation system of Finland, as well as in locally constructed innovation concentration with strong global networks (Sotarauta and Mustikkamäki, 2014). However, it does not yet have a direct antecedent in the economy, and thus entails the need to construct new competencies and/or transform existing ones to support the birth and enlargement of an embryonic industry.

The empirical study began with the analysis of secondary data, including relevant journals, related newspaper articles, annual reports, and respective policy documents. This phase identified the state of the art of the human spare parts industry both locally and globally. Next, 24 people, involved in different capacities in the development of regenerative medicine in Tampere Finland, were interviewed. Fifteen of the interviewees were employees of BioMediTech (a joint institute of the University of Tampere and the Tampere University of Technology), and the rest of the interviewees were from local and regional development agencies and Tampere University Hospital, Ministry of Employment and the Economy, TEKES (the Finnish Funding Agency for Technology and Innovation), and local firms. The main aim was to construct a generic understanding of what meta-competencies are needed to enhance the emergence of science-based human spare parts industry and describe the current situation in Tampere.

The term regenerative medicine was forged in 2000 and is now widely used to describe biomedical approaches to healing the body by the stimulation of endogenous cells to repair damaged tissues or the transplantation of cells or engineered tissues to replace diseased or injured tissues (Riazi, Kwon, and Stanford, 2009). The basic unit in regenerative medicine is a stem cell. Stem cells are biological cells found in all multicellular organisms. The potential of stem cells in clinical treatments is based on their multipotent ability. Stem cells are able to regenerate tissues and organs and act as building blocks for all tissues in the body. Regenerative medicine forms the third discipline in human healthcare alongside medicine and surgery (Polak et al., 2010), and, from a business point of view, cell therapy is defined as a fourth pillar in the healthcare industry alongside pharmaceuticals, biopharmaceuticals, and medical devices (Mason and

Manzotti, 2009). Regenerative medicine has grown rapidly and scientific achievements have created hopes for new treatments for severe incurable diseases, such as diabetes, Parkinson's disease, cancer and heart diseases. The promise of regenerative medicine is very exciting but simultaneously the cost of product development, and most notably clinical trials, for high-end applications is very high (Mason and Dunnill, 2008). The term 'human spare parts industry' is a metaphor that describes the potential embedded in regenerative medicine.

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EMERGING ECOSYSTEMS, INNOVATION POLICIES AND SOCIO-ECONOMIC TRANSITIONS: THE CASE OF SYNTHETIC BIOLOGY

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Keywords: innovation ecosystem; innovation policy; foresight; future orientation; roadmapping; synthetic biology

EXTENDED ABSTRACT

The existing literature on innovation systems and ecosystems has primarily been focused on established systems, or on systems that have been relatively well-defined in their scope and orientation. Much of this literature emphasises existing innovation systems (e.g. Lundvall 1992; Hekkert et al. 2007). In the field of foresight, the focus of literature has been on “wiring up” an innovation system (Martin & Johnston 1999) or in anticipating the future developments of quite traditionally defined industrial sectors (Andersen et al. 2014). Systemic transitions have been studied in the domains of transition management and sustainability transitions (e.g. van den Bergh et al. 2011; Geels 2002), and in regional innovation systems (e.g. Triple Helix, see Etzkowitz & Leydesdorff 2000). However, the focus in the transition studies has mainly been on the past development or the present stage of the system, and not in the emerging or future-oriented aspects. Different start-up ecosystems and their features have been benchmarked all over the world, but the analyses mostly concentrate on comparison of the ecosystems, and provide limited insights into the emergence dynamics. The impact of disruptive innovation (see e.g. Christensen, 1997) upon innovation ecosystems has also been studied, but we argue that there is still quite an open space for future-oriented analysis of emerging ecosystems.

In the paper we outline a theoretical and methodological approach for a future-oriented ecosystem analysis. Our approach explores alternative futures of an emerging innovation ecosystem. In our approach, we combine insights from the literature of strategic foresight, innovation ecosystem analysis and transition management, and propose a conceptual framework for analysing and making sense of the emerging innovation ecosystems. The key research questions are: 1) How to anticipate the existing, emerging and converging technologies, knowledge and actors that are changing the market and innovation landscape towards a new ecosystem; 2) What economic, environmental, and social changes are driving and will drive innovation development in the chosen new field; 3) and How these activities and actors are positioned in the arising ecosystem?

Our case study highlights the emerging ecosystem in the novel technological trajectory called synthetic biology (see e.g. Joyce et al., 2013; on technological trajectories, see Dosi, 1982). Synthetic biology is an emerging, and potentially disruptive, technological trajectory that will provide new products

and sustainable solutions that can make existing ones obsolete, even those bio-refinery concepts that are still under development today. Synthetic biology emerges from the interface of biology and engineering sciences, where automation, quantification, design and advanced modelling of biological systems becomes possible. Our hypothesis is that this trajectory will reorient the future of biotechnology, and has the potential to transform multiple fields, such as medicine, manufacturing, and energy production. Thus, synthetic biology will likely become an essential keyword in myriad bioeconomy strategies.

As a disruptive trajectory, synthetic biology calls for a wide change in mind-set as the perception moves from understanding the biological systems and reading the genetic code towards writing biological programs and design of living cell factories. While the innovation ecosystem in synthetic biology is to a large extent driven by technological advances, mainly the search for non-fossil-based solutions in fuel, chemical and material industries, it is simultaneously tightly coupled in socio-economic context, and connected to societal discussion on values, ethics, politics, and culture. Thus, the emerging ecosystem in synthetic biology is simultaneously a socio-economic transition and a disruptive shift in corporate innovation dynamics. For us, the case provides an exciting and turbulent example of the generation of completely new industrial activities, and the surrounding innovation ecosystem.

We will outline relevant future pathways in synthetic biology that will have potential impacts in the ecosystem development. Our analysis applies a two stage approach: at the first stage we explore the state-of-the-art in the emerging system, and at the second stage we anticipate the alternative future pathways in the system. The first stage (present situation) is based on company and expert interviews, literature review and a patent analysis. The analysis will result in a mapping of the key players and the topics related to synthetic biology. The mapping of topics is especially important, since the field is novel and somewhat incoherent, operating with a diverse terminology. The second stage (future pathways) is built around expert workshops to construct alternative, but plausible, future pathways in synthetic biology. We apply the methods of participatory foresight, and apply alternative technological statements to challenge the existing mind-sets, and for opening up prospective future pathways in synthetic biology. We analyse the changes in the system structure, in the quantity and quality of the interactions between actors, in the system's context and in the outputs the system generates.

As a result, we describe a theoretical framework and a novel methodological approach for analysing emerging innovation ecosystem. This outcome supports the creation of an integrative collaboration forum on industrial prospects and challenges in the bioeconomy, and increases the understanding of the potentially disruptive nature of synthetic biology. Our paper also contributes to the innovation management literature by proposing a novel framework and an approach for exploring analysing emerging innovation ecosystems. The framework supports the sense making in the context of emerging technological trajectories and related innovation ecosystems, and provides an outline for exploration of the alternative futures. It is an approach that both helps in the analysis of the present situation and provides means for future-orientation and anticipatory intelligence. The outcomes will act as a positive driver for developing and managing innovation ecosystems in the novel industries, and related socio-economic regimes. Understanding emerging innovation ecosystems is important for research and technology organisations, for governments, and for both large and

small enterprises, because it helps them to anticipate future developments and major shifts in their strategy and allocate resources accordingly. The conceptual framework supports anticipating and understanding emerging innovation systems, and can be used by foresight practitioners oriented towards innovation activities.

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TIMING, SCALE AND COORDINATION IN POLICY MIXES FOR SUSTAINABLE TRANSITIONS: THE CASE OF SWEDEN

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Keywords: Policy mix; Sustainable transition; Innovation policy; Forest industry; Food industry

EXTENDED ABSTRACT

Over the past decades, a systemic perspective on innovation (Freeman, 1987) has been highly influential not only to study conditions and processes of innovation at the level of regions, nations, industries and technological fields but also to inform policy-making and enable policy-analysis (Smits & Kuhlmann, 2004). In such analysis, most attention has been paid to policy priorities related to economic growth and competitiveness. More recently, a systemic perspective on innovation has also been applied in the field of sustainable transitions, referring to 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). In particular, analyses drawing on the technological innovation system approach have been explicitly focused on identifying systemic inducement and blocking mechanism in the emergence and growth of clean-technology based industries (Bergek et al., 2008; Hekkert et al., 2007). An important aspect and ambition of such analysis has been to identify failures in the innovation system requiring policy intervention for the ‘build-up’ of such industries and the acceleration of sustainability transitions.

An important consequence of a systemic perspective on innovation as well as sustainability transitions is the acknowledgement that there is no single policy instrument that act as a silver bullet to improve the functioning and performance of innovation systems (Borras & Edquist, 2013). Against this light, it is not surprising that the literature on policy-mixes has resonated strongly within the innovation systems community (Flanagan et al., 2011). As Edler et al. (2012) note, “indeed, innovation policy is in fact a mix of policies and is itself a more or less integral part of a broader policy portfolio at various levels” (Edler et al., 2012). In short, the notion of policy mix addresses the extent to which different and complementary *policy instruments* address problems of the innovation system at hand (Borras & Edquist, 2013), as well as the mix of different *policy goals, rationales and processes* of policy making and implementation (Rogge & Reichardt, 2013). In addition, it draws attention to the complex ways in which different policy domains interact and may impact in combined, complimentary but also conflicting ways on innovation. These domains range from science, technology and innovation policies *strictu sensu* to related fields such as climate, energy, environmental and food safety policy.

A broad understanding of policy-mixes fits well to the notion of sustainable transitions. This literature calls attention for the co-evolution of a broad range of innovations, which include not only technological but also social, organisational, and business model novelty. Moreover, it stresses the importance of directionality, resistance and contestation in innovation processes, and thus, policy (Weber & Rohracher, 2012). Compared to IS, it comprises a wider set of institutions and networks of heterogeneous actors including firms, user groups, scientific communities, policy makers, social movements and special interest groups.

A recent contribution of Kivimaa and Kern (2014), has given a first suggestion how a policy mix framework can be applied to the field of sustainability transitions. Notably, following the Schumpeterian notion of creative destruction, this paper acknowledges the need to consider policies that not only respond to the creation of novelty but also to the destabilisation of existing unsustainable practices and structures, conceptualized as regimes. Their framework combines the analysis of key functions of technological innovation systems central for novelty creation in niches around emerging sustainable technologies with an analysis of central processes for the destabilisation of the incumbent regime in transition theory (Kivimaa & Kern, 2014). An integration of both frameworks has been proposed earlier (Markard & Truffer, 2008), but in the analytical framework developed by Kivimaa & Kern the focus is on the role of policy instruments.

This paper seeks to complement this approach by focusing more explicitly on the timing and scale of the policy mix. As acknowledged by the authors these dimensions have been neglected in previous frameworks and analyses. To our mind, this is somewhat paradoxical given the importance that the notion of policy mixes ascribes to coordination and interplay of policies. Therefore, we contend that paying attention to timing and scale of policies will provide useful insights on the extent to which different elements of a policy-mix may actually be effective in accelerating a sustainability transitions.

Our paper has two aims:

(1) We apply a creative destruction policy mix framework on sustainability transitions in two different industries: the pulp and paper industry and the food industry, but in just one country – Sweden.

(2) We test the usefulness of the theoretical framework for a retrospective analysis of the effectiveness of policy instruments in place over the last 10-15 years by explicitly acknowledge timing, scale and coordination of different policies.

Why have we selected these cases? The pulp and paper industry (PPI) is an important industry in Sweden measured in employment (Bergquist & Andersson, 2013:7). PPI is an energy intensive industry, which has contributed worldwide to high levels of pollution and CO₂ emissions. The PPI is subject to a range of climate, energy and environmental policies and regulations, which have facilitated sustainability and competitiveness (Scordato et al., 2013). The food processing industry and food trade on the other side is a leading industry sector in Europe, which poses serious impacts on ecosystems and societies and policy instruments have an important role in driving the implementation of sustainable food processing technologies (Scordato et al., 2014:7f.).

The paper uses data developed in two projects led by the Swedish Agency for Growth Policy Analysis (Tillväxtanalys, 2014a, 2014b). We use mainly results of literature reviews on the development of the two

sectors (Scordato et al., 2013, 2014), document analysis, interviews conducted by the agency and economic studies conducted by our colleagues at Umeå University in Sweden (Bergquist & Andersson, 2013; Lindmark & Bergquist, 2014). We distinguish between sector specific policies, climate and energy policies with relevance for the specific industries, and more generic innovation policies; and we assess the development of the policy mix over time and at different levels, both for niche creation and for regime destabilisation.

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THE INNOVATION IMPACT OF THE POLICY MIX FOR RENEWABLE POWER GENERATION: A SURVEY ANALYSIS OF GERMAN TECHNOLOGY PROVIDERS

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Keywords: innovation, policy mix, consistency, credibility, renewable energies, manufacturing industry

EXTENDED ABSTRACT

The decarbonization of energy systems constitutes one of this century's key challenges for human society in the fight against climate change (van Vuuren et al 2013). In such a transition so-called policy mixes play a crucial role in redirecting and accelerating technological change towards low-carbon solutions (Rogge and Reichardt 2013). Yet precisely how policy mixes affect technological innovation remains poorly understood. Rather, studies so far have focused on the impact of single policy instruments on environmental innovations, and also on their stringency as one of their design features (Kemp and Pontoglio 2011). However, in reality complex policy mixes are at play, implying that studies should focus on the interaction of policy instruments rather than evaluating the innovation impact of single policy instruments (Flanagan et al. 2011). In addition, it also has been pointed out that there is a need to investigate the relevance of overarching characteristics of such policy mixes, such as their consistency or credibility, for environmental technological change (Rogge and Reichardt 2013).

Therefore, in this study we focus on the instrument mix and its consistency, as well as on the credibility of the instrument mix. Regarding the instrument mix we include demand pull and technology push instruments as well as the consistency of the overarching instrument mix. This instrument mix consistency captures whether the instruments reinforce rather than undermine each other in the pursuit of policy objectives. We also include credibility of the policy mix – that is, the extent to which the policy mix is believable and reliable – in our analysis, as credibility has been pointed as being of key importance for stimulating environmental technological change (Rogge and Reichardt 2013). Ultimately, we are interested in the impact of a broad policy mix on environmental innovation or eco-innovation.

As research case we have chosen the transition of the German electricity generation system towards renewable energies – the so-called *Energiewende* – with its ambitious targets of reaching at least a level of 80% electricity generation by renewable energies by 2050. This long-term target is supported through a rich instrument mix which has led to a rapid expansion of the share of renewable in power generation to

approximately 25% (as of 2014). However, here we are not interested in the impact of the policy mix on diffusion, but aim at analyzing the role of the policy mix for firm-level innovation activities in renewable power generation technologies within the German power sector. Since this sector is supplier-driven (Pavitt 1984) we focus on German technology providers, and extend existing qualitative work in the sector (Rogge et al. 2011, Hoppmann et al. 2013) by conducting a survey of companies' innovation activities.

The questionnaire for this survey was designed in line with the Community Innovation Survey, but was adjusted to the context of renewable power generation technologies and extended by questions on companies' perceptions of the policy mix. The survey was conducted by telephone from April 9 until June 22, 2014, with interviews lasting around 30 minutes. In this time period we contacted all German manufacturers and suppliers active in one or more of the renewable power generation technologies, including solar PV, onshore wind, offshore wind, biomass and biogas, geothermal, wave and tidal as well as hydro power. Our sample includes both new entrants but also incumbent players having redirected their activities towards emerging green niche markets. In total we achieved a response rate of approximately 36% (n=390).

In this paper we first present some descriptive statistics on product and process innovations of companies and determinants of companies' innovation activities. We also provide an overview on the perceptions of companies on the policy mix for renewable power generation technologies in Germany, including the perceived credibility of the policy mix, how it differs among technologies and how it has changed over time. We also differentiate between the importance of foreign and domestic demand pull instrument, as well as the relevance of national vs European public R&D funding. This descriptive analysis is followed by an econometric analysis for which we employed a bivariate Tobit model to estimate R&D expenditure equations for the years 2014 and 2015, where the error terms captured possible correlations between R&D expenditures in different years. In this case, the use of univariate Tobit probit models can lead to biased and inconsistent parameter estimations (e.g. Greene, 2012). The simulated maximum likelihood estimations were carried out with STATA 13, relying on Barslund (2009).

Findings of our econometric analysis suggest that R&D expenditures in both years are larger for companies with higher current and expected future turnovers (including export) in the respective renewable power generation technology, which is in line with other studies on the key relevance of domestic and foreign demand pull instruments (Peters et al. 2013). Likewise, higher R&D expenditures are positively related to the amount of subsidies received for R&D from German or EU public funding bodies, thereby confirming the importance of technology push instruments for innovation. Further, future R&D spendings are larger if respondents perceive the current instrument mix to be consistent in its support of renewable energy, and if they perceive a high credibility of the overarching policy mix, as measured by the uniform cross-party support for the expansion of renewables within the German Energiewende. This confirms and extends qualitative findings for offshore wind in Germany pointing to the importance of policy mix consistency and credibility for R&D and adoption activities of emerging renewable power generation technologies (Reichardt and Rogge 2014). Finally, the time a company has been on the market for the respective renewable power technology considered is positively related to the magnitude of innovation expenditures, i.e. more experienced firms invest more in innovation.

Based on our findings we derive recommendations for policy makers on how to tailor policy mixes to support innovation in environmental technologies. These policy implications may not only be relevant in the context of the German Energiewende but also for other countries aiming to promote environmental innovation activities of manufactures and thereby sustainability transitions, such as the transformation of energy systems towards higher shares of renewables. As such, the policy mix under study can be considered as smart. We also point to limitations of our study based on which we derive future research needs.

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UNIVERSITY-INDUSTRY-GOVERNMENT COLLABORATION FOR SUSTAINABILITY INNOVATION: FUNCTIONS AND MECHANISMS OF STAKEHOLDER PLATFORMS ON SMART CITIES

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Keywords: University-industry-government collaboration, Sustainability, Stakeholder platform, Smart city, Social experimentation, Asia

EXTENDED ABSTRACT

Innovation is a critical component of our efforts to tackle sustainability challenges we face today at the global level (Reid, Chen, Goldfarb, Hackmann, Lee, Mokhele, Ostrom, Raivio, Rockstrom, Schellnhuber, and Whyte, 2010). Since the 1980s, when the Bayh-Dole Act was introduced in the United States, many industrialized countries have introduced policies to encourage innovation through technology transfer academia to the private sector, often with exclusive agreements on intellectual property rights (Branscomb, Kodama, and Florida, 1999; Mowery, Nelson, Sampat, and Ziedonis, 2004). While some successful cases have been reported in transforming knowledge created by university researchers into industrial products, the existing models of university-industry-government collaboration tend to focus on narrowly-defined technical issues, mainly targeted to commercial applications (Trencher, Bai, Evans, McCormick, and Yarime, 2014; Trencher, Yarime, McCormick, Doll, and Kraines, 2014). For tackling sustainability challenges, a new approach would be required to promote innovation, involving a wider variety of stakeholders with more diverse knowledge and expertise in scientific and technological fields (Yarime, Trencher, Mino, Scholz, Olsson, Ness, Frantzeskaki, and Rotmans, 2012).

Smart cities and communities are particularly considered to be one of the key areas in which a variety of science and technological knowledge need to be integrated effectively through collaboration among multiple actors. A smart city or community would involve an advanced technological system for efficient electricity supply and applications, incorporating all the behavior of the actors involved, including generators, distributors, technology developers, and consumers, through an intelligent information network. As a smart city integrates a diverse mixture of hardware as well as software in a complex way, different approaches would be possible to introducing and implementing the concept of smart cities and communities in practice, depending on the economic, social, and environmental conditions and purposes, such as energy efficiency, operating cost, environmental impact, resilience to external shocks and disturbances, and accessibility and inclusiveness to end users.

Recently, leading research universities around the world have started to apply their expertise and sources of innovation to the goal of building smart cities and communities. In this paper, we examine approximately 80 cases of the leading initiatives led by universities through stakeholder platforms in Asia, Europe, and North America. A particular focus is placed on smart cities and communities, involving relevant stakeholders in academia, industry, and the public sector. A close examination of the leading initiatives reveals the important functions of university-driven stakeholder platforms in implementing innovation to address societal challenges. These include the creation of future visions based on science, setting of concrete and practical goals and targets, joint scenario making with stakeholders, securing active participation and serious engagement of stakeholders, collection and analysis of data on societal needs and demands, development of new technologies and systems through social experimentation at universities as living laboratories, assessment of impacts with transparency, objectivity, neutrality, legitimation of innovation in society, provision of effective feedback to decision makers, incorporation into institutional design, and contribution to agenda setting at regional, national, and global levels.

On the other hand, remarkable differences are also found with regard to the direction and process of technological development on smart cities and communities between Asia, Europe, and North America. The Asian approach is characterized by a strong focus on sophistication of application technologies for extensive use of home appliances and electric vehicles. In Europe an emphasis is placed on establishing a basic infrastructure in which information about the behavior of all the stakeholders is collected and distributed among the stakeholders appropriately so that the various objectives of the electricity grid are achieved in a more equitable way. In North America a strong interest can be observed in creating and maintaining security through improvement in resilience against physical as well as virtual threats. These asymmetries in conceptualizing and implementing smart cities reflect the differences in how knowledge development, stakeholder networks, and institutional environment interact in dynamic and systemic manners.

The cases highlighted in this paper provide valuable insights into potential ways forward for collaboratively designing and creating knowledge and implementing innovation to tackle sustainability challenges. For follow-up efforts and new projects in the future, however, we still need deal with remaining challenges. These include how to navigate differing motivations and incentives for serious engagement and fruitful collaboration among stakeholders, to promote joint initiatives and networking that contribute to achieving desirable goals and targets and developing complementary skills and capacities, and to identify the factors and conditions required to promote their successful implementation. They will have significant implications for public policies and governance for innovation to make steps towards sustainability.

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LEARNING FROM DEMONSTRATION PROJECTS IN SUSTAINABLE ENERGY AND TRANSPORT

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EXTENDED ABSTRACT

Governmental supported demonstration and trial projects have over more than a century played a central role in the development and dissemination of energy technologies. A well-documented early example from Denmark is Poul la Cour's facility for wind turbines started in the 1890's, that comprised both a experiments with the technology, demonstration of its practical feasibility and also has a strong component of training of practitioners and dissemination of the technology leading to a relative widespread use of electricity producing wind turbines in Denmark two decades later (Arnfred, 1964). The importance of demonstration of the technology also paved the way for the Danish test station for renewable energy technologies (e.g. wind turbines) in the late 1970s and the launch of the Danish development and demonstration programme for renewable energy in the same period.

Also more recently there is a growing interest within both academia and policy in the role of trial and demonstration project in relation to innovation policy and in relation to transitions to sustainable energy and transport. As an indication of the increased interest from policy makers in the role of demonstration projects the governmental expenditures on demonstration projects was in 2003 been added to the original Frascati Manual typology of the IEA/OECD's data collection on R&D indicators. Data from this database shows increased governmental expenditures on 'demonstration'. A similar conclusion is drawn in a recently concluded Scandinavian project (Andersen et al, 2014). Academic research has analysed the experiences of American, European and Japanese demonstration and trial projects for solar photovoltaic and wind technologies (Brown & Hendry, 2009; Harborne & Hendry, 2009; Hendry & Harborne, 2011; Hendry, Harborne, & Brown, 2010).

The reason for this increased interest can be found in the observation that demonstration projects can be seen as attempts "*to shorten the time within which a specific technology makes its way from development and prototype to widespread availability and adoption by industrial and commercial users*" (Lefevre, 1984). As noted by Wene (2000, p28) "*A system that has no output will not learn, meaning, that a technology which is not produced and deployed cannot start ride down the experience curve. Technologies cannot become cost-efficient by laboratory R&D alone*". Market-wide commercialisation and diffusion of a new technology occur after the technology has been successfully tested in large-scale demonstration projects and user feedback has been incorporated.

Ever since the works of Joseph Schumpeter academia has tried to understand the complex processes for development and diffusion of new technologies. This paper takes a theoretical departure from the innovation systems approach that first emerged as a national innovation system that was concerned with building a national knowledge infrastructure for economic development (Freeman, 1987; Lundvall, 1992; Nelson & Rosenberg, 1993). The framework has developed in different directions that include different levels and dimensions, such as technology-specific innovation systems (Bergek, Hekkert, & Jacobsson, 2008; Carlsson & Stankiewicz, 1995).

The innovation systems approach focuses on the flow of information and knowledge between actors, in contrast to other analytical approaches that focus on the flow of money or goods. As stated by Freeman, *'Numerous case studies of innovation brought out the importance of flows of information and knowledge between firms as well as within firms. Moreover, the results of the empirical research pointed to the importance both of flows to and from sources of scientific and technical knowledge and of flows to and from users of products and processes'* (Freeman, 1996). Hence, the importance of learning from the user–producer interaction is emphasised. This also includes the interactions of the knowledge producers and users. Another core element in the innovation systems approach is that learning is the most central activity in an innovation system, and that learning is mainly interactive (Johnson, 1992). The explicit introduction of interactive learning to innovation studies came in the form of user–producer interactions (Lundvall, 1985). Lundvall argues that innovation emerges from confronting user needs with technological opportunities. This raises a challenge for new technologies with a limited market presence and, consequently, few opportunities for user-producer interactions. Furthermore, demonstration projects have been defined as a decisive phase of the development of new technologies, designed to promote various forms of learning (Raven 2005). This is among the key rationales for governmental support for demonstration and trail projects. Based on the concept of the technological innovation system (Carlsson & Stankiewicz 1991) Hellmark (2011) identifies a number of roles for demonstration projects including the formation of knowledge networks and facilitating learning.

This leads to the research problem behind this paper. There exists a very large literature and conceptual development on learning's role in innovation and in innovation systems. This comprises concepts such as learning-by-doing, learning-by-using, learning-by-searching, learning by interacting, policy learning etc. The paper will contain a brief overview of this literature. Also there is a large literature on demonstration and trail projects in sustainable energy and transport. However there is only few empirical studies of the learning from demonstration and trail projects in sustainable energy and transport, the studies carried out at Cass Business School being one of the exceptions (Brown & Hendry, 2009; Harborne & Hendry, 2009; Hendry & Harborne, 2011; Hendry, Harborne, & Brown, 2010). This paper aims to contribute to this research gap with solid empirical foundation. The overall research question of the paper is: Can the empirical data on learning from demonstration and trail projects in sustainable energy and transport confirm what conceptual studies suggest? The paper will focus on a range of more detailed questions, e.g.:

- What types of learning (using, doing, interacting, policy learning, etc.) appears in the projects
- Are there any differences between planned learning and the realised learning in the projects.

- Which types of actors are learning throughout the projects?

Empirical data

The paper reports from a part of the project Role of demonstration projects in innovation: transition to sustainable energy and transport (InnoDemo) funded by the Research Council of Norway. This project aimed at providing insights on the roles that trial and demonstration projects and programmes can play in innovation systems with a focus on the domain of sustainable transport and energy in Denmark, Norway and Sweden. The paper is based on three sources of empirical data. First, through a desk-study and explorative interview with programme officials in the three counties, a total of 433 demonstration projects started in the period 2002-2012 was identified across Denmark (224 projects), Norway (107 projects) and Sweden (102 projects). 97 (22%) of these projects were concerned with transportation. Second, an online survey was mailed to 370 project leaders of which 80 responded (a response rate of 22%). Among the questions in the survey were specific questions on learning. Third, 26 in-depth interviews were carried out with project managers and project participants. A large part of the interviews focussed learning processes during the projects. The in-depth interviews covered 17 projects out of the 433 projects. Together, this gives a unique empirical material for our research. The data behind the analysis of Cass Business School comprised projects in Europe, Japan and USA within wind power, solar photovoltaics and fuel cells from the 1970s to today. Our data comprise a comparable number of projects, but over a wider range of technologies, over a shorter period (10 years), and in fewer countries (3).

Expected results

The paper reflects a work in progress. Even though the InnoDemo project is finalised and all empirical data exists the analyses of these data are not yet finalised. However, the paper intent to present the analyses in relation of the research question for this part of the project. Among the preliminary findings is that learning in the projects most frequent related to technical feasibility, appearing in 58% of all projects. Other frequent areas of learning was related to reducing building, operating and maintenance cost (33%); prove feasibility in commercial applications (33%) and facilitate learning (31%). Another outcome of the preliminary analysis is a variation in the objectives across the countries. Objectives related to cost reduction (building, operating and maintenance cost) were relatively frequent in Danish projects but less frequent Swedish. Whereas, objectives related to facilitate learning were less frequent in Danish projects but the second most frequent (57%) objective in the Swedish projects. The final paper will conclude on the implications for innovation policy and suggest issues for future research.

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A ROADMAP FOR EU-LAC COLLABORATION ON NANOTECHNOLOGIES FOR MEETING WATER SUSTAINABILITY CHALLENGES

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EXTENDED ABSTRACT

Until 2050, the global water resources will have to support food and beverage production for an additional 2.7 billion people. According to the United Nations, water withdrawals have already tripled over the last 50 years mainly due to rapid population growth. In Latin American (LA) countries, the population growth forecast +7%, exceeds well that of Europe (+1%) and North America (+4%), and will increase the pressure on good water resource similarly. Climate change and rising temperature will cause additional pressure on the fresh water resources. Increasing temperature leads to higher water demand for irrigation, hydration and cooling needs and also higher treatment requirements due to higher risk for water-borne pathogens. Many large cities in the Andes and irrigation systems depend almost entirely on high-altitude glacier water stocks to complement rainfall during the dry season. As these water-resource buffers shrink further alternative water supplies may become very expensive. Less water intensive agricultural practices will need to be installed and solutions for water recycling developed.

Given that LA is currently in principal abundant with water, there are still 38 million people – nearly 7% of the population –without access to safe water. Water resources are not equally distributed and areas with high population and industry are facing problems. Altogether, 40% of the population live in areas containing only 10% of the region's water resources. These are also key industrial regions with some of the most water intensive industrial sectors.

The scientific community has generated evidence that the use of nanomaterials in water treatment is a new and promising application. Nanotechnology-derived materials, such as nanoadsorbents, catalytic material, nanostructured and reactive membranes as well as bioactive nanoparticles have been applied to water treatment. These materials are of interest due to their large surface area, efficiency in removing a contaminant even at low concentrations, enhanced affinity for specific contaminant removal, catalytic potential, and high reactivity. Below is a list of applications demonstrating the general potential applications of nanomaterials in water technologies (Table 1):

Table 1 Nanotechnologies for Water Applications

Application	Current technologies	Current Challenges	Enabled by nanomaterials
Drinking water production Desalination	Membrane filtration (reverse osmosis)	<ul style="list-style-type: none"> • High energy consumption implies high operational costs • Membrane fouling leading to high energy consumption and lower throughput because of increased need for membrane cleaning and backflushing 	<ul style="list-style-type: none"> • Incorporation of nanoparticles can give the membrane material antifouling mechanisms • Lower energy consumption
Drinking water production Disinfection	<ul style="list-style-type: none"> • Chlorination • Advanced oxidation 	<ul style="list-style-type: none"> • Efficiency, • Chemical consumption • Generation of toxic by-products such as organic chlorides • Resistant microbes, viruses 	<ul style="list-style-type: none"> • Catalytic breakdown, • No by-products • Degradation of viruses and microbes through various pathways
Drinking water production Pollutant removal (heavy metals, arsenic pesticides etc)	<ul style="list-style-type: none"> • Precipitation through addition of chemicals • Filtration 	<ul style="list-style-type: none"> • Efficiency towards low concentration, • Generation of toxic by-products • Resistant microbes, viruses 	<ul style="list-style-type: none"> • Catalytic breakdown, • No harmful by-products • Degradation of viruses and microbes
Waste water treatment	<ul style="list-style-type: none"> • Chemical flocculation • Biological degradation 	<ul style="list-style-type: none"> • Long residential time • Inadequate removal of recalcitrant micropollutants • No possibility for recovery 	<ul style="list-style-type: none"> • Engineered nanoparticles can show very high selectivity towards targeted pollutants • Recovery /valorisation
Irrigation	<ul style="list-style-type: none"> • Little control and management, overuse, leakages 	Controlled water delivery according to need, price of sensor networks	<ul style="list-style-type: none"> • Monitoring for precision use of irrigation • Wireless new affordable sensors • Soil amendment

However, to become a reliable water treatment technique, a few challenges need to be met. So far, the environmental impact and toxicity of nanomaterials are not well known; therefore, the key challenge may be to take initial steps in LA towards Responsible Research and Innovation (RRI) in nanotechnologies. This would include, amongst others, more dedicated funding for risk assessment, introduction of regulatory frameworks and awareness raising campaigns targeting the general public and policy makers in order to raise acceptance for using nanomaterials in water purification. Other important issues to face are how to integrate nanomaterials into existing water purification systems and how to guarantee the availability of suppliers who can provide large quantities of nanomaterials at economically feasible prices. Although cost efficiency in production of nanomaterial is improving, one barrier to the application of nano-based solutions for societal challenges is considered to be the high cost of the nanomaterials. Further investigation for lower cost solutions is needed. When moving from basic research towards applications of nanotechnologies, these should be aligned closely to solve concrete problems in LA and prove their effectiveness through real socio-economic impact.

Demonstration project to show the applicability of new innovations is crucial to enhance the deployment of new inventions. These demonstrations are to be installed in nationally relevant environments, such as drinking water production sites and mining water remediation.

Still the performance-against-cost factor of the water purification technology will play an important role in determining the acceptance of the technology at grassroots level. Thus, the affordability of the water purification technology, robustness and the durability of the material used for water purification are crucial factors for successful commercial adoption of water purification technology.

A bibliometric study indicated that research in nanotechnologies for water is in a quite nascent stage in LA. On the topic water potabilization the first publications in the region appeared during the 1990s, and on the topic of water remediation, the first articles were published in the 2000s. Since then, the number of publications on nanotechnological approaches to water treatment and monitoring has increased remarkably. However, the overall number of publications is still low.

Based on co-authorship analysis interestingly, Brazil, with highest research output in the area, has developed stronger research cooperation with European institutes than with other LA countries compared to other LA countries. As the number of nano-related publications is currently about 10 times higher in the European Research Area than in LA, research cooperation and co-publishing with Europe may demonstrate an opportunity for LA to catch-up on certain topics or to gain more visibility for region-specific challenges.

Currently, scientific sources of information have generally relatively little impact on firm innovation efforts, illustrating a quite weak linkage that characterize national innovation systems in LA countries (IDB, 2010). However, it has been shown that firms investing in knowledge are more able to introduce new technological advances, and those that innovate have greater labour productivity than those that do not. Wider international collaboration can increase the companies' interest in scientific results and promote innovation uptake.

With pioneer legislative standards, acknowledged water service companies and front-running technology providers, Europe has a strong position in the global water sector. Consequently, Europe should take the responsibility to take lead in fostering collaboration with developing countries and jointly promote innovative solutions to tackle water challenges on a local and global level. This will also position Europe in the future to seize new market opportunities in the area. As nanotechnologies for water seem to be a nascent sector for innovation in the LA countries with less established cooperation, targeted support for collaboration to enhance these countries possibilities to evolve in the sector would form a fruitful collaboration base for future deployment.

Currently LA is not well represented in international networks on nanotechnology and water, such as the IWA specialist group on Nano and Water¹. A stronger network between LA countries to solve common problems, e.g. arsenic contamination, would empower the scientific and technological input compared to the

¹ <http://www.iwa-network.org/specialist/nano-and-water-application-of-nanoparticles-nanoengineered-materials-and-nanotechnology>

current situation with the comparatively scarce and fragmented research resources Life cycle models for nanomaterials are needed to determine the fate of nanoparticles during their life cycle, and their impact in the environment. Further, technological networks should be established and social actions undertaken to engage the local population and companies.

Among LA countries largest water innovation investments are made in Brazil, From the European side, several European engineering companies are indeed interested in the Brazilian water market. There can be more opportunities for introducing innovative solutions because the existing technologies are not as standardised as in Europe. It is important to target solutions to the national and regional regulations and organisation of the water sector. The zero draft of the new UN Sustainable Development Goals² includes ensuring availability and sustainable management of water and sanitation for all (goal 6). Nanotechnology may contribute to several subgoals by 2030: access to safe and affordable drinking water for all, reducing pollution and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater, and increasing recycling and safe reuse and expand international cooperation and capacity-building support to developing countries in water and sanitation related activities and programmes.³

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TOWARDS A ROADMAP FOR DEPLOYMENT OF NANOTECHNOLOGY IN ENERGY FOR LATIN AMERICA¹

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EXTENDED ABSTRACT

Ongoing worldwide discussion on energy matters turns around the “energy trilemma” of energy security, energy equity and environmental sustainability (WEC, 2013). Energy security, which is related to its long-term supply and reliability, is of utmost importance for economic growth; energy equity, which is related to its accessibility and affordability, is of utmost importance for social development; environmental sustainability, which is related to the use of low-carbon energy sources, is of utmost importance to combat climate change (Tol, 2013) and preserve public health by reducing greenhouse gas emissions (Haines et al., 2009).

The use of alternative energy sources, such as solar, wind, biomass, geothermal, hydropower and ocean energy, supported by regional cooperation may contribute to tackle the energy trilemma (Panwar et al. 2011). The issue of energy equity is specially sensible in the Latin America and the Caribbean (LAC) region since 29 million people still lacked access to electricity as of 2010, and under the most optimistic scenario, the region will have universal access to electricity by 2030 (OECD/IEA, 2012). However, other reports indicate that 3 million people may still lack electricity in the region by the same year (WEC, 2013).

Developing countries of LAC represent approximately 9% of the world’s population, 6.5% of the worldwide Gross Domestic Product (GDP), 6% of the global energy consumption and 5% of the worldwide energy-related CO₂ emissions. Although the contribution of the LAC region to worldwide energy-related CO₂ emissions is low, it is important to understand the energy trends in the region in order to implement a low-carbon future for the region while meeting the energy needs for poverty reduction as suggested by Sheinbaum-Pardo and Ruiz (2012).

The role that modern energy services can have for the LAC region with regard to accomplishing the United Nation’s Millennium Development Goals (UN MDGs) (UN, 2000) has been documented in two reports (ECLAC, 2010; OECD/IEA, 2010). Those reports conclude that: i) a new technological framework is

¹ The Roadmap is prepared under the framework of NMP-DeLA project (Nanosciences, Nanotechnologies, Materials and New Production Technologies - Deployment in Latin American Countries), funded by European Commission 7th Framework Program.

required in order to dramatically scale up the access to modern energy services at the local and regional levels, ii) capacity building activities are required in order to incorporate highly trained and motivated technicians into national planning bodies and agencies, iii) it is important to incorporate integrated planning practices in order to set goals, specify energy sources and technologies to be used and iv) it is necessary to provide funding for research and development (R&D) agencies responsible for new technologies and to supervise results at the design, prototype, test, manufacture stage and actual use by the poor population.

This paper presents a roadmap for the deployment of nanotechnologies for sustainable energy, especially focusing on renewable sources, and science, technology and innovation (STI) cooperation between Europe and LA. The roadmap follows a study on the scientific cooperation in nanotechnology for energy between the regions and the mapping of existing capabilities (key scientists, supporting policies and funding) of selected countries in LA (Brazil, Mexico, Argentina, Colombia, Chile and Uruguay). The roadmap has a time span to 2025 and focus on technologies listed in Table 1.

Table 1. Literature-Based Examples of Nanotechnology for Energy Applications

Type of technology	Subcategories	Nanotechnologies applications
Solar Energy	Silicon solar cells (SSC)	Use of Si nanowires to increase sunlight absorption.
	Thin film solar cells (TFSC)	Use of nanorods, nanoprisms, nanoplates or nanocrystals to optimize the cell structure.
	Multijunction solar cells (MJSC)	Use nanoscale fabrication methods based on printing techniques for cell stacking.
	Dye sensitized solar cells (DSSC)	Use of highly efficient dyes TiO ₂ and nanocrystalline film to improve efficiency.
	Quantum dot solar cells (QDSC)	Use of CdS and CdSe quantum dot sensitized TiO ₂ nanocrystalline film to improve efficiency.
	Organic solar cells (OSC)	Develop nanoscale experimental techniques to optimize the charge transport properties of the devices.
	Photocatalytic and photoelectrochemical hydrogen production (Photo H ₂)	Use of Mo-based nanowires as catalysts with improved durability.
Electrochemical Energy Storage	Lithium-ion Batteries (Li-ion)	Use of Si-C nanocomposites to improve cyclability.
	Redox Flow Batteries (RFB)	Use of carbon nanotubes to increase the reaction kinetics of the redox reactions.
	Supercapacitors (SCAP)	Use carbon aerogels to improve capacitance and cyclability.
Hydrogen Energy	Solid Hydrogen Storage (SH ₂)	Use of carbon nanotubes and graphitic fibers for improved H ₂ storage.
	Polymer Electrolyte Membrane Fuel Cells (PEMFC)	Introduce nanoclays in traditional membranes to decrease methanol crossover.
	Solid Oxide Fuel Cells (SOFC)	Use of Y ₂ O ₃ -doped ZrO ₂ nanofilms for improved ionic conductivity in the electrolyte.
Fossil Fuels	Enhanced oil recovery (EOR)	Use of nanofluids (i.e. liquid with polystyrene) nanoparticles for enhanced oil recovery.
	Carbon capture, storage and utilization (CCSU)	Use of carbon nanotubes for low pressure carbon capture.
Biomass	Biofuels	Use of Au nanoparticles supported on CaO for improved alcohol production from petroleum residues.

Considering the applications identified they were matched against the findings of the mapping exercise on the deployment of nanotechnologies, according to the following categories: key scientists (by number of publications), research groups and focus of research. Results of the mapping show that nanotechnology can be successfully used to improve the efficiency and reliability of different energy technologies that could contribute to address the energy trilemma in the LAC region.

The matching exercise highlights the following related to activities in nanotechnology research:

1) Almost 40% of the key scientists of LA are focused on the development of nanomaterials for energy applications;

2) The critical mass of key scientists of the LA is concentrated in the following subcategories: PEMFC (27%), DSSC (15%), SH2 (9%), QDSC (9%) and Li-ion batteries (3%);

3) Almost 80% of the key scientists of LA are concentrated in Brazil and Mexico.

Results of qualitative research confirm the four statements presented by ECLAC (2010) and OECD/IEA (2010) and go a step further by adding the perspective of LA researchers and other interest groups to the relevance of these factors for nanotechnology deployment for societal challenges in the energy sector. Education and training - in the widest sense - were considered key elements for professionalizing this sector in LA. The roadmap presents recommendations for nanotechnology capacity building in LA. The technological framework (mentioned under (i)) would be complemented, according to our research, by introducing binding national regulatory frameworks for nanotechnology which are sorely missed by LA researchers at current stand. The roadmap gives suggestions of how such frameworks could be developed and what would be essential for their acceptance. In addition we recommend that national strategies for nanoenergy should be developed in trans-disciplinary and cross-stakeholder group processes. For all of this, additional committed funding will of course be a pre-condition.

International cooperation may support all of the above mentioned challenges in special fields of strength. According to a bibliometric study done in the NMP DeLA project, co-publications in the field of nanotechnology (and also specifically nanoenergy) between EU and LA are constantly rising, although Europe is currently producing approximately ten times more scientific output in nanotechnology than LA and these output numbers are very uneven between countries. Especially for countries with weak STI infrastructures in LA, international cooperation presents a big chance for conquering niche sectors.

In order to generate a new energy technology framework and build technical capacity, it is necessary to use suitable tools to identify the alternative energy technologies to be deployed in the LA region. The last is especially true for advanced energy technologies with a mid-term implementation time scale. In this way, analysing the potentialities of nanotechnology for alternative energy applications and developing a technology roadmap could be useful for defining action plans in the matter as well as to define priorities for interregional (e.g. between the European Union and LA) and intraregional cooperation.

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DIMENSIONS OF SOCIAL INNOVATION AND THE PROMOTION OF LOCAL ECONOMIC DEVELOPMENT IN THE BRAZILIAN SEMIARID.

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Keywords: Social Innovation; Semi-arid; Emerging variables

EXTENDED ABSTRACT

Introduction

This study proposes, holding as reference the table presented by Tardif and Harrison (2005), to identify the existing and emerging dimensions for social innovation by studying the *Agência de Desenvolvimento Local* (ADEL – Agency of Local Development in Portuguese) and its main programs.

The table was chosen as a tool to investigate the dimensions of social innovation due to its analytical reach regarding many previous studies, and once the work comes from the *Centre de Recherche sur Les Innovations sociales* (CRISES), a Canadian institution renowned worldwide for its efforts on social innovation. Besides that, from the defined reference it was possible to visualize emerging dimensions coming from a very different context.

We used the case study as research strategy, through in-field data collection and using other sources in order to corroborate with the information obtained. Finally, data was treated by the content analysis technique employing resources from the Nvivo 10 software for qualitative research.

Social Innovation

Social innovation, whether it be a policy, product or process might be situated in different realms of society. Innovating social relations does not exclude the existence of market-related relationships, but it has the objective to regulate and oversee such relationships to satisfy social needs and not only to develop commercial capital. Thus, it is in social innovation, and in its relationship with different forms of capital, where there is wealth expansion (Hillier, Moulaert & Nussbaumer, 2004).

Moulaert et al. (2013) understand that social innovations are presented as progressive acceptable solutions to problems related to exclusion, deprivation, alienation, lack of welfare and to actions that contribute positively and meaningfully for human progress.

To CRISES (2012), social innovation is a process initiated by actors driven to respond to a social aspiration, to fulfil a need, to offer a solution or to seize an opportunity to change social relations, transforming a scenario or providing new cultural guidance for improving well-being and life conditions for communities.

Dimensions of analysis for Social Innovation

To reach our objectives, the classification presented by Tardif and Harrisson (2005) was highlighted, which was produced based on the selection of 49 articles published by CRISES' members. Amid the investigations carried out, Tardif and Harrisson (2005) presented the table named "CRISES' Conceptual Encyclopaedia of Social Innovation" in which they defined five analytical dimensions for identifying social innovations. The main categories were Transformations, Innovative Character, Innovation, Actors and Processes that have also been determined by Maurer (2011) as dimensions enabling the analysis of other social innovations.

Hence, the dimensions presented contemplate the social innovation process since its inception from an enabling context, until the assessment of implemented actions, a stage seeking the improvement of practices adopted to enhance the reach of intended objectives.

Methodological procedures

This study is being exploratory and descriptive. Furthermore, our research is qualitative and it adopted the case study as investigation strategy. Specific methods of data collection were utilized such as direct observation, documental research and semi-structured interviews. Besides the interviews; photographs, promotional NGO images, institutional videos, textual material available online and TV-related material about ADEL were analysed as well.

Eight interviews were carried out: five with members from the *Agência de Desenvolvimento Econômico Local* (ADEL), in charge for activities' direction, organization, coordination and execution; two with benefitted youngsters, and one with a family farmer who was a beneficiary in one of the programs developed by the organization.

The data codification was operationalized via the software Nvivo 10 for qualitative analysis. Each dimension in table was analysed based on the collected sources. Through the relationships established between data collected and nodes created, it was possible to bring together codified references from the sources. From the categorization of nodes, sources were analysed. Aiming at the best adjustment for such distribution, the content analysis technique was conducted, following the directions available in Bardin (2006).

In order to deepen the composition of variables listed for each dimension, the sources explored in this study were analysed seeking specific elements, identified within the cases studied, so they would sum to the existing variables, contributing theoretically with the emergence of a new revisited table.

ADEL

The *Agência Desenvolvimento Econômico Local* (ADEL – Agency of Local Development in Portuguese), founded in 2007, located in the city of Pentecoste – Ceará is a non-governmental organization (NGO) that works with family agriculture and youth entrepreneurship, operating in communities and territories in the state.

The initiative is a result of joint interests from local actors to change the paths of development in the state semiarid. After graduating from university, ADEL's founders, started talking about the semiarid region particularities and questioning how they could contribute through an action that had greater impact on

the lives of people living in the communities they had been born. From the ideas and restlessness shared with representatives of social movements as well as other organizations working with local development, they decided to return to their communities and found the NGO, with the objective to socialize knowledge in order to fulfil regional demands.

ADEL's activities were based on structured actions and programs: *Programa Jovem Empreendedor Rural* (PJER – Young Rural Entrepreneur in English), which targets the social and economic inclusion of youngsters inhabiting rural communities, awakening entrepreneurial capacities to encourage them to stay in their communities. In addition to PJER, the *Programa Soluções Rurais* (Rural Solutions Program in Portuguese, formerly known as Josué de Castro Program for Local Development), has the goal of organizing family farmers to aggregate value to their activities and to the productive chains they belong, besides developing their rural enterprises, increasing profitability and productivity.

5 Result Analysis

After the identification of the three distinct social innovations (ADEL, the Rural Solutions Program and PJER) as components of the greater case studied, it was sought to track a similar path to the one covered by Tardif and Harrison (2005).

Considering the components housed within the *Transformation* dimension, it was verified the appearance of “**Climatic conditions**” as an emerging variable. Another emerging Variable in the same dimension is linked with the “Social” subcategory and it was entitled “**Discovery**”.

Inside the *Innovative Character* dimension, among the variables comprised in the analytical angle Social Action, it was understood as necessary the inclusion of the term “**Formation of networks**”.

In regards to the analytical angle Purpose, presented in the *Innovation* dimension, the analysis disclosed that “**Local Development**” appears as key factor in the context explored.

Considering the *Actors* dimension, among the variables in the Social subcategory, the term “**Family Units**” was inserted.

The second term included in the dimension related to the Organizational subcategory and it is “**University**”.

The last variable added to this dimension was inserted within the Institutional actors and is related to “**Flaws**”, especially the ones connected with State actions. Interviewees frequently mentioned these flaws and, in the scenarios exhibited in the videos where the climatic issue was stressed, reports told about governmental negligence or flaws regarding the struggle against droughts and other restraining regional factors.

In the *Process* dimension, two more variables were inserted in the subcategory Modes of coordination; they are “**Mediation**” and “**Search for recognition**”.

Concluding Remarks

We intended, along this article, to disclose the social importance, especially in the semiarid of Ceará, of efforts carried out by ADEL. We verified, by analysing the codifications, that the dimensions of social innovation proposed by Tardif and Harrison (2005) were perfectly applicable to the study. The

identifications performed also permitted the emergence of specific variables linked with the context explored.

This research intends to contribute with the academic production in the innovation field by presenting initiatives that promote life quality improvements in social and economic contexts impaired by several factors. In addition, we intend to foster in the field other case studies presenting initiatives to apply the CRISES' table, making possible the emergence of variables from different contexts not only in Brazil, but also over the world.

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REFLECTIONS ON THE DEMOCRATIZATION OF KNOWLEDGE GENERATION IN RESEARCH PARTNERSHIPS FOR SUSTAINABLE DEVELOPMENT

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Keywords: Sustainability science; transdisciplinarity; case study; research partnership; North–South

EXTENDED ABSTRACT

The paradigm of delivering aid and sharing benefits that economic development generates in rich countries has long been guiding poverty alleviation policies, practice, and research. Correspondingly, a North-to-South transfer of goods, knowledge, and technologies still dominates development cooperation. However, such conventional approaches run the risk of justifying philanthropic sharing by the rich with the poor as an adequate and sufficient means to achieve a better world. Neglecting structural causes for disparities in access to resources, power, and decision-making, such propositions perpetuate inequality, poverty, and dependency.

Sustainable development, by contrast, is an emancipatory concept. Framed when economic shocks in the 1970s revealed the limits of economic growth and social and ecological crisis became manifest on a global scale, it builds on the premises of intra- and intergenerational equity and justice to address poverty disparities. From this perspective, all members of human society are entitled to both a just share of resources and an equal voice in shaping a sustainable future. Based on a new social contract, science and society face the challenge of jointly organizing a sustainability transformation that secures development and well-being now and in the future (Lubchenco, 1998; WBGU, 2012). Since the turn of the millennium, an emerging sustainability science has begun to organize a corresponding transformation of science (Biermann, et al., 2009). Working out of niches, sustainability scholars are establishing networks and institutions that transcend disciplinary boundaries. Contesting the global North's monopoly on scientific knowledge production and technology transfer, they propose transdisciplinary modes of exchange that accommodate diverse values, norms, stakes, perceptions, and knowledge systems. A strategic goal framed by UNESCO (2005) is the development of knowledge societies by means of more democratized knowledge and knowledge production for equal self-representation, and self-determination in decision-making processes regarding sustainable development.

Yet, despite its failure, the previous paradigm of growth is persisting due to its institutional strength and the sustainability paradigm's apparent failure to establish itself as a robust alternative. The global community is struggling to organize more equitable, just, and inclusive development. Hundreds of multi- and bilateral agreements, programmes, and institutions have failed to establish coherence in local to global

governance structures. Conceptual and practical implications of sustainable development are still elusive and transdisciplinary knowledge production – a new mode of interaction between science and society – remains experimental. More specifically, burning questions are how to properly frame research policies and (re)organize and implement research for sustainable development (Wiesmann, et al., 2011). While carrying on with business as usual, we are on the verge of overstepping planetary boundaries. No doubt, there is urgent need for a sustainability transformation. This paper explores how science and research can contribute.

Methodologically, I start from the basic assumption that sustainability science, with transdisciplinarity as its explicit method, is suited and needed for meeting today's complex global challenges (Hirsch Hadorn, et al., 2008). My key question is how the scientific community can best organize research to operationalize the democratization of knowledge and knowledge generation. In accordance with sustainable development's experimental nature, we need to embrace diversity and plurality in transdisciplinary research approaches. But to effectively harness its transformative power, we need also to find common ground. One way of doing this is focusing on transdisciplinary research practice and building on what has worked in the past. I proceed as follows: (1) I reflect on current science–society interaction for sustainable development in the two spheres of global approaches to environmental governance and an emerging sustainability science, as these delineate the 'playing field' and provide guidance on how to organize research for sustainable development. (2) I zoom in on a long-term North–South partnership programme, analysing its foundations and its practical approaches that proved to be supportive of equity-based knowledge production and institutional development. (3) I zoom back out on the larger playing field to reflect on the programme's performance from a broader perspective in terms of time, space, and scale.

Major results include the following: (1) State-of-the-art sustainability practice and discourses reveal significant missing links. While current global practices of environmental governance have turned into major experimental fields for science–society interaction, the traditional roles ascribed to scientists, the public, and policymakers remain largely unchanged. Scientists primarily provide synthesized quantitative knowledge for complex modelling of coupled human–nature systems, and the integration of the public remains experimental. Resulting policies do not take adequate account of varying conditions at the national and local levels, and in particular they disregard the voices and agency of countries in the global South. While we have access to an enormous amount of synthesized scientific knowledge on how to mitigate and adapt to global and climate change, power imbalance and conflicting interests limit action and coherent governance structures. Moreover, sustainability science is a fairly young field and struggles with the unfavourable institutional fabric of established science and funding schemes. Transdisciplinary practice remains experimental and isolated. Sustainability scholars make headway on transdisciplinary concepts and practice by synthesizing and theorizing mainly qualitative field data on a meta level. Yet, experience in long-term transdisciplinary science–society interaction is rare, especially at regional levels. (2) The *Eastern and Southern Africa Partnership Programme* (1999–2014) is a unique example of a completed long-term transdisciplinary research programme and provides a wealth of experience. As a research network linking Switzerland, Kenya, Ethiopia, Tanzania, Madagascar, Mozambique and Eritrea, it aimed at generating knowledge on sustainable land management and sustainable regional development. In my analysis I found

four programme features that were especially conducive to the democratization of knowledge and knowledge generation: The *foundations* of ESAPP as a transdisciplinary research partnership for sustainable development were oriented towards equity in all programme aspects; (b) A consistent but *adaptive management approach* made it possible to integrate all partners' claims and research needs and jointly steer the programme; partners used places of exchange strategically to foster equity and integration, and gradually developed an appropriate monitoring and evaluation system. The programme's *dual structure approach* combined action research with basic research and capacity development: ESAPP's action research component comprised over 200 diverse Priority Action Projects driven by local development priorities, while a small basic mandate secured coherence and consistency by strengthening the scientific foundations, reflecting on programme steering, providing education and training, and developing adequate management and research tools and databases. A *contextuality approach* focused on keeping the programme's research and solutions consistent with the conditionality at local to global levels.

My case study confirms that these features have been indispensable in democratizing ESAPP's research. Partners jointly developed comprehensive contextualized knowledge databases on sustainable land management and sustainable regional development, strengthened capacity and institutions in the South, and fostered rural governance that matches local, national, and regional conditionality. Nevertheless, such a conventional view falls short of grasping the programme's effects and effectiveness and does not adequately detect driving forces and agency in the participating countries. (3) I therefore reflect on the entire fabric of global to local governance structures, science–society practices, and development discourses as the programme's 'playing field'. Situating ESAPP in time, space, and scale provides a better understanding of its role and contribution to a sustainability transformation. It offers insight into the vital impacts of ESAPP beyond its lifetime: First, ESAPP strengthened the capacities of national governments to step in and fill the gap of the missing link between the global and local levels. ESAPP's knowledge hubs are experienced, active, and acknowledged in the entire region. This secures a firm internalization of sustainability concepts, promotes more coherent and legitimized development strategies, and reduces the danger of persistent dependency on (financial) input from the global North. Second, positioned at the transnational regional level and conducting long-term transdisciplinary research, ESAPP has been bridging local to global levels as well as sustainability theory and practice. It has accumulated a wealth of experience in organizing research programmes for sustainable development: its epistemological foundations are suited to support a re-conceptualization of research and the operationalization of transdisciplinarity by means of equity-oriented structural and procedural approaches. It further made available an adequate set of tools, databases, and a methodology for scaling up innovative pilot projects ready for uptake.

Finally, I argue that time is most conducive in transdisciplinary research, which is resource-intensive and often intangible and conflictive. ESAPP was able to build on the legacy of predecessor programmes, including the corresponding close personal ties. Long-term interpersonal ties also bind the programme to the financing institutions, national governments, research institutions and NGOs. Due to four decades of relationships, partners in the South already had a strong voice in designing ESAPP, thereby lending ESAPP legitimacy to address conflictive and sensitive issues. It thus might be appropriate to conceive of a North–

South research partnership as a co-evolutional process between countries. Presumably there is no alternative – especially in light of Africa’s current rapid economic growth, which increases pressure on ecosystems, threatens rural livelihoods, and may result in greater disparities. I conclude that – despite what seems a Babylonian confusion in sustainability discourses and practices – the normativity in the context of sustainable development is indeed very powerful in guiding development-oriented research and collaboration today.

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FUNDING AND OWNERSHIP OF ACADEMIC INVENTIONS: EVIDENCE FROM A PATENT-LEVEL SURVEY

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EXTENDED ABSTRACT

How to bring academic inventions to market? The question has been haunting university administrators and policy makers for more than two decades now. One important step to ‘turn science into business’, it has been frequently argued, is the institutionalization and professionalization of technology transfer activities at academic institutions (OECD 2003). Following the example set by the United States, with the approval of the Bayh-Dole Act in 1980, many countries have also pushed their academic institutions to retain title of their faculty’s inventions, whenever obtained as a result of public funded research (Mowery and Sampat 2005).

In some European countries, such as Austria, Finland, Germany and Denmark, this move required the abolition of the so-called professors’ privilege, which assigned the IP rights over academics’ inventions to the employees (the academics themselves) instead of their employers (their universities; von Proff *et al* 2012; Lissoni *et al.* 2009). Even in countries with no such norm, universities lacked the legal and financial means both to make sure that the faculty would disclose their inventions and to manage actively the related patents. As a result, in most research contracts or collaboration agreements with business partners, some of which were signed in order to develop research results from public funded research, the IP ended up being assigned to industrial partners. Overall, this implies that, historically, the vast majority of patents filed over academic inventions in most European countries belonged to business companies. Methodologically, such patents can be associated to universities only by identifying their inventors as academic researchers (Lissoni 2012).

Spain, which is the focus of the present study, is no exception (Garcia and Sanz-Menendez 2003). Despite the fact that most Spanish academics are civil servants, recent efforts to reclassify patents according to the institutional affiliation of their inventors have confirmed that a large share of all patents invented by Spanish academic inventors is in fact owned by industry, where the term academic comprises both universities and public research centers (Maraut and Martinez 2014).

Early studies on technology transfer have shown this to be a complex activity, which is explained not only by the universities' efforts to patent and license their research results, but also by the importance of previously existing links between industry and academia (Thursby and Thursby 2002; Colyvas 2002). Most of these early studies, however, were based on data and experiences from the United States, where the large majority of academic patents are owned by universities. More recently, a number of studies have started to look at the issue of ownership and patent importance using novel data on academic patents from different European countries which allow for industry ownership.¹ The growing, albeit scattered evidence suggests that academic patents owned by academic institutions are less cited on average than academic patents owned by industry, which may imply a lower commercial value of the former. However, the difference seems to disappear over time, which indicates that university-owned academic patents are more fundamental by nature. A common limitation of most of the European studies available is that they solely rely on publicly available information about patents, and they lack information on the underlying details of the funding and patent filing process. Exceptions such as Gulbrandsen *et al* (2006) and Baldini *et al* (2007) concentrate on incentives to patent and patenting obstacles in academic contexts. The PatVal survey is also addressed to inventors (Giuri *et al* 2007), but its focus is on the value of business patents, as estimated by their inventors.

The present paper draws from the results of a patent-level survey of Spanish academic inventors, carried out by the authors in 2014. Data on funding sources, ownership, commercialization and inventors' personal characteristics have been collected for almost 600 academic patents. The target population of the survey consisted on the 3,142 academic inventors (with about 2 patents each, but a few having more than 100) who had been previously identified by matching academic authors of scientific papers from Spain (as listed on 2003-2008 Scopus publications) to inventors from Spain (as listed on EPO patent applications filed in 1978-2009), following the methodology described in Maraut and Martinez (2014). An invitation to fill out a web based questionnaire was sent to those inventors for whom a valid email address was available, a total of 2,511. Amongst the recipients of the questionnaire, 472 responded about one or more patents, which represent a valid response rate of almost 19% of our population.

Questions at the patent level were divided into eight different themes: i) types of funding; ii) timing of the decision to patent; iii) timing of the decision about patent ownership; iv) commercialization; v) role of the university administration at the research funding phase; vi) role of the university administration at the patenting phase; vii) publication of related results; and viii) occupation of co-inventors at the time of patenting. Each inventor responded to patent-specific questions only for a maximum of three patents², in addition to some academic career and personal questions. See Table 1 below for some preliminary descriptive statistics of the responses (Likert type scale).

Our purpose is to use the unique and novel information provided by the survey to build a typology of academic patents based on the characteristics of their inventing and patenting process (in particular, as regards funding and ownership), based on factor analysis. We will then assess, by means of an econometric model, which types are more likely to be considered commercially valuable and technologically important.

¹ See <http://www.esf-ape-inv.eu/> for literature review and recent initiatives.

² We imposed a maximum of three patents for each inventor's questionnaire (the most cited and most recent ones), so that the most prolific inventors were not discouraged.

Information on commercial values will come both from our own survey (see “Commercialization” section in table 1) and from public available information (granting, change of ownership and renewal status, as from PatStat). Information on technological importance will be based on public information on citation patterns (also derived from PatStat), in accordance with the existing literature (survey by: Van Zeebroeck 2011). All the analysis will be contextualized with regards to the changing institutional framework of the Spanish academic system over time.

Table 1. Descriptive statistics at the patent level

	N	Mean	SD
Funding sources:			
(values: from 1 (not at all) to 5 (entirely))			
<i>National Public Funding</i>	544	2,99	1,56
<i>International Public Funding</i>	526	1,84	1,34
<i>Research Joint Venture with Industry</i>	512	1,87	1,37
<i>Contract Research with Industry</i>	521	2,49	1,69
<i>Measuring, testing and quality</i>	495	1,25	0,81
<i>Personal consulting</i>	493	1,35	0,94
Timing of decisions:			
(values: from 1 (at the beginning) to 5 (at the end):			
<i>Patenting</i>	548	3,12	1,26
<i>Patent ownership</i>	516	2,97	1,47
Commercialisation:			
(values: from 1 (definitely no) to 5 (definitely yes))			
<i>Exploited by the assignee</i>	546	2,60	1,47
<i>Sold to a new assignee</i>	546	1,81	1,10
<i>Licensed</i>	546	2,66	1,50
<i>Entrepreneur inventor</i>	546	1,34	0,90
Role of the TTO or administration:			
(values: from 1 (not at all) to 5 (definitely yes))			
<i>Finding right source of public funds</i>	506	1,81	1,23
<i>Finding one or more private research sponsors</i>	504	1,56	1,03
<i>Bureaucratic procedures to secure public funds</i>	506	2,19	1,43
<i>Drawing contracts with funders or partners</i>	498	2,32	1,54
<i>Suggestion to file a patent</i>	510	1,44	0,98
<i>Negotiation over patent assignment</i>	503	2,03	1,40
<i>Patent filing procedure</i>	505	2,47	1,55
<i>Marketing the patent</i>	494	1,61	1,16

Note: Taking mean values for multiple responses and excluding n/a replies. Statistics of the responses to the question about publication of the invention or related results have been excluded from the table because they are not of a Likert-type scale.

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EVALUATING THE ABOLISHMENT OF THE FINNISH PROFESSOR'S PRIVILEGE

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EXTENDED ABSTRACT

Many case studies and plenty of quantitative work show that academia has an important role in contributing to invention and innovative activities. In particular, academics help by “translating” research into commercial products (Stokes (1997)). This is because much tacit knowledge about inventions cannot fully be understood from e.g. patent documents and rather than just “transferring knowledge”, academics’ involvement in commercialization is often necessary (Zucker, Darby and Brewer (1998)). Moreover, an emerging body of research shows that individuals who engage in commercialization activities also become more productive as researchers (Azoulay, Ding and Stuart (2009); Buenstorf (2009)). If these results can be generalized and no open-access dilemma exists, research policy should direct attention to how to stimulate university researchers to engage in commercialization.

Traditionally, academia in Europe has often followed a “hands-off” approach to regulating researchers’ involvement in commercialization, although this has always varied with the institutional setup. Usually, the institute sector (small in e.g. Sweden and Switzerland, more important in e.g. Finland and Germany) has held ownership to inventions, whereas academia has followed the German model of a professor’s privilege, where inventors retain rights to their inventions. This has changed, especially over the last fifteen years in many European countries that have abandoned this position, favoring a transition to university ownership (UO) following the model of the US Bayh Dole act of 1980. This trend has also come to the Nordic countries with Denmark switching to UO in 2000, Norway in 2002 and Finland in 2007. Yet, the effects of these switches are far from obvious. In fact, most academics are quite skeptical to the idea that moving to university ownership would facilitate smooth transfer of inventions, the basic reason being higher transaction or negotiation costs of inventions for researchers, not being outweighed by higher levels of efficiency (Lissoni (2013); Lissoni, Lotz, Schovsbo and Treccani (2009); Mowery, Nelson, Sampat and Ziedonis (2001); Mowery and Sampat (2005); Verspagen (2006)). A few interesting studies indeed suggest that switching in fact may have the opposite effect (Kenney and Patton (2009); Kenney and Patton (2011)). Yet, large-scale quantitative evidence is scarce. A recent exception is the working paper by Czarnitzki et al. ((2015)) who compare German researchers at universities with researchers at institutes before and after the switch that took place in Germany using a difference-in-difference approach. They find a strong decline among university researchers in patenting.

Still, this result may be specific to the German case; possibly technology transfer offices may have worked better in Finland.¹ Thus, whether switching to university ownership generally leads to fewer inventions patented by university researchers remain an open question. This paper studies the case of Finland, with the help of a new unique database on Finnish inventors to be compiled in the project. Finnish policymakers will get an insight into the effects of the abolition, and whether it has lowered patenting by academia or even had positive effects, something which has not been studied before.

For the paper, a database on inventors in Finland is to be created where Finnish inventors in the European Patent Office (EPO) databases will be linked with Statistics Finland (StatFi) databases. These registers enable us to access important demographic control variables, and importantly information on whether individuals work at universities or institutes. We choose EPO because it contains full address records of inventors, which makes identification much easier than e.g. USPTO records, and in order to compare results with studies from Europe.

The basic method follows that of Czarnitzki et al. ((2015)), i.e. comparing inventive productivity before and after the reform among university researchers with patenting by Finnish institute researchers. Basically, we will compare inventive activity of Finnish researchers before and after the legislative change. However, change in inventive activity can differ due to innate changes over time in patentability. For this purpose, two benchmark cases will be created. The difference in patentability for an individual compared to a benchmark person gives rise to the difference-in-difference method. That is for each person affected in the Finnish system, we need to find a control person with similar characteristics such as age, gender, technology and/or scientific field of work.

The first benchmark case is the Finnish institute sector which never had a PP. This benchmark controls for Finnish-specific traits in the system. The second case is the Swedish university sector, which always had the PP (Ejermo (2012)). This has the advantage of controlling for any trends in patenting by researchers that is due to being employed in academia and is not fully captured by age or cohort covariates. However, Finnish and Swedish university inventor data cannot be combined in one single database (thus allowing for a full difference-in-difference estimation of these groups). That analysis therefore has to be based on comparative descriptive statistics. The use of two types of benchmarks allows us to draw more robust conclusions. Also, the comparison with Swedish university patenting is interesting in itself.²

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¹ See http://ec.europa.eu/invest-in-research/pdf/download_en/monitoring_and_analysis_of_technology_transfer_and_intellectual_property_regimes_and_their_use.pdf for an overview of the professor's privilege in Europe, specifically p. 56 regarding Finland for the distinction between "contract" and "open" research.

² The team of authors is divided in its prediction of the outcome, but currently Finland leads over Sweden 2-1. ☺

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A MARKET FOR GREEN PATENTS? ANALYSIS OF OWNERSHIP CHANGES IN ENVIRONMENTAL TECHNOLOGIES FROM SPAIN

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Keywords: environmental patents; sustainability; technological change; technology transfer

EXTENDED ABSTRACT

The aim of this paper is to analyze the current situation of environmental innovation and the market for environmental technologies in Spain, by using data on filings and registered changes of ownership of "green patents" requested from Spain, between 1979 and 2013, at the European Patent Office. Strategic transactions for companies and then, information on technology transfer agreements, are usually done through bilateral private contracts whose details are not available. This is why information about registered changes of ownership represent a very valuable source of information, even though they are not exhaustive (not all changes of ownership are registered) and only represent a small share of what is transferred (not all inventions seek patent protection). Previous studies using this kind of data include Serrano (2006; 2010) using USPTO patent reassignments and Meniere et al (2012) on French reassignments. To our knowledge patent registers have not been used to assess to what extent environmental technologies of different types have changed hands in a country, like Spain, characterised by a very favourable environmental policy to the generation and transfer of environmental technologies in recent years, especially as regards renewables. This generous policy towards renewables has been reflected in the growth of patenting in related areas from Spain (Casado et al 2010), but have those patents remained in the hands of their original inventors? Can we find evidence of patent sales and mergers and acquisitions of patent owners leading to changes of ownership of those patents and thus, a form of technology transfer?

We explore evidence on patenting and changes of ownership of patents registered in patent offices to assess whether there exists a market for green technologies originating from Spain and, see what kind of technologies are transferred and what companies are more likely to participate. So far, most of the studies on the transfer of environmental technologies have focused on exploring technology transfer internationally, especially in those developing countries (Barton, 2007; Pueyo et al, 2011; de la Tour et al., 2011 among others). Less attention has been paid to ownership changes of environmental technologies within the national context in developed countries. The dynamics of the creation of environmental innovations has recently become a key issue in the literature due to the identification of these new technologies as a mean to restore competitiveness in advanced countries (Ghisetti and Quatraro, 2013). In fact, there is a prevailing belief

among OECD countries in that innovation involves economic growth, and specifically, environmental innovation can play an important role in achieving, environmental sustainability, economic performance and competitiveness (Boons et al., 2013).

The use of patent data in the empirical literature on the analysis of innovation and diffusion of environmental technologies has increased in recent years. Examples include investigations such as Dechezlepretre et al. (2011) where, using data from PATSTAT, the authors analyze the inventions patented in 13 different technologies with potential for reducing GHG emissions worldwide and its international transfer between 1978 and 2005; and Dechezlepretre et al. (2015), which addresses the diffusion of new technology based on patent data in the automotive sector. Albino et al. (2014), analyze the eco-innovation in low-carbon energy technologies using information about patented technology; Sun et al. (2008) investigated the capacity for innovation in environmental technologies in China using patents; or Popp (2006), using the same kind of data, for Japan, the US and Germany studied the innovation and diffusion of equipment for pollution control plants generating electricity from coal.

Technology transfer, while subject to different meanings depending on the context in which it is used, refers to the transmission of information about technology or the technology itself between the holder and a third that requires it. Therefore, environmental technology transfer is the transfer of information or technology with potential for improving the environment. To perform the analysis of patent applications included in the sample of this study, first we must define what is meant by commercial transfer of technology and by administrative transfer of the patent. In this research commercial transfer is defined as the transfer of patent rights, either through the sale of the intellectual property itself or as a result of a merger or acquisition between independent companies. By contrast, those changes registered in patent documents that refer to administrative or corporate name changes, technology transfer between companies in the same group (parent-subsidiary relationships), transfers between applicants of the same patent or changes from the applicant to the company for which they work, will not be considered commercial property changes, but administrative.

To analyze the current situation of patented environmental technologies in Spain, we follow these steps:

1. Analysis of the number of requests for environmental patents filed by Spanish applicants at the European Patent Office between 1979 and 2013.
2. Analysis of all property changes recorded in the database of the European Patent Office on applications for environmental patents of Spanish origin.
3. Development of a typology of property changes registered, using information from the corporate information database BvD SABI on Spanish firms, corporate annual reports and internet searches; and a classification of different environmental technology areas in which they occur.
4. Analysis of the type of environmental patent applicants in Spain: companies with greater environmental innovation activity and scope in which they develop their activity.

Data used in this research have been extracted from the PATSTAT database (version April 2014) and corresponds to all patent applications filed from Spain (country of residence of the applicant) that are related to the environment as defined by the OECD, also called "green" patents. The resulting dataset contains 1276 environmental EPO patent applications filed from Spain between 1979 and 2013.

We find that 52% of all EPO green patent applications filed from Spain are related to the generation of electricity from renewable energy sources or fossil fuels patents, and more than 25% are patents in the field of wind energy. Technologies related to energy generation with renewable resources and non-fossil fuels are thus the most patented in Spain. These figures show the intensity of innovation in this field in the last decades induced by the dynamism of a renewable market in Spain and Europe, mainly as a consequence of the introduction of generous policies to promote renewable energy.

Of the 1276 environmental patents only 172 have recorded changes of ownership, 13%. However, not all these changes are technology transfers understood as 'commercial transactions'. Most of them correspond to administrative changes, such as transfers between co-applicants (13%) and changes of ownership between companies belonging to the same group (37%). Patent sales and transfers corresponding to mergers and acquisitions represent a smaller share, only 27% of registered changes. The latter would be the only ones that correspond to real market transactions. Although in absolute terms patents in wind energy have registered the greatest number of real changes, in relative terms technologies for improving internal combustion engines are more dynamic. Innovation is highly fragmented, with regard to the type of applicant but private companies are predominant, both among the original applicants and new owners.

We conclude that the policy support to technology diffusion experienced in Spain in recent years has led to higher rates of patenting at the European Patent Office in certain areas. We observe that the changes of ownership of those patents, which can be taken as a rough indicator of technology transfer otherwise difficult to observe, have been mainly related to intra-group operations. Nevertheless, the few market transactions we find (related to patent sales and mergers and acquisitions) provide evidence of the existence of a small market for environmental technologies from Spain that is worth monitoring and study how it is affected by changes in innovation and environmental policy at the national and international level.

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UNIVERSITY OF SAO PAULO INNOVATION ACTIVITIES WITH SOCIAL RESPONSIBILITY: WHEN OPPORTUNITY MEETS SOCIAL NEEDS

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EXTENDED ABSTRACT

According to André & Abreu (2006), innovation was almost exclusively associated with the technological domain. The concept of social innovation gained increasing recognition since the end of 60's, and is currently applied in a variety of contexts, connecting innovation with societal problems and needs. Phillips et. al (2008) presented a concept of Social Innovation where a novel solution to a social problem is created, presenting a more effective, efficient or sustainable result than existing solutions, and adding value to society as a whole rather than private individuals. It can be presented as a product, production process, technology, a concept, an idea, a piece of legislation, a social movement, a social intervention, or some combination of them.

Social Innovations come from different sectors like, non-governmental organization (NGO), governments, universities and companies. A great effort is necessary to mobilize these different actors to identify and develop innovations that meet the society's needs. Recently, policy makers are making efforts to create new organizational models for companies more focused on social innovation like the Community interest companies (CIC) in United Kingdom (Nicholls, 2010).), as well to create funds to support the creation of public policies.

Universities have important roles educating and researching. The idea of the "Third mission", based in the university's extension activities or, relations with the surrounding society (Molas-Gallart, 2002) are being stimulated in Brazilian research universities, once they are very dependent on public resources (provided by State and Federal Research Agencies). In the scenario where, Cunha & Benneworth (2013) identifies the need that of societal support for their maintenance and growth, fit well with the idea of a societal compact between universities and society. Besides the partnerships with the private sector were encouraged and advanced are in the agenda of many Universities, not all of them have succeed in topics with high social relevance like the promotion of the quality in services like education, health, employment, housing and safety.

As the largest Public University in Brazil, USP has been focusing its performance in the open innovation environment. The Brazilian Innovation Act, Law nº 10.973/2004 (Brazil, 2004) fosters research and development of novel processes and products in private enterprise, through integration of efforts made by universities, research institutions, and technology-based companies. Such integration has been quite difficult due to the lack of statutory regulation, but the act is increasing the links and partnerships between Academia, Companies and Governments.

Supported by Federal and State Agencies USP organized the National Institutes of Science and Technology and the Research, Innovation and Dissemination Centers. These centers and institutes have a thematic purpose and has been working in projects with social appeal.

This paper will exemplify some results in the creation of social innovation in three different cases following the idea of Perez & Botero (2011) where “the community is a natural recipient of knowledge, with the same status that the State and companies have in Triple Helix Model, and that public procurement is another mechanism by which social innovation can be encouraged, guiding the transfer in terms of the problems of social context and values such as quality of life, should be another challenge for universities to even generate an economic return”.

The first case is related to the National Institute for Optics and Photonics (INOF) and Optics and Photonics Research Center (CEPOF), where developed a program dedicated to promote the diagnostic and treatment of skin cancer that remains the most frequent cancer type in Brazil. For 2015, 182,000 new cases are expected, which corresponds to 25% of all malignant tumors registered in the country (INCA, 2014). This project resulted in four new products launched in the market, a spin-out company specialized in Photo-drugs was started, and a National Program with 100 centers of diagnosis and treatment distributed over the Brazilian territory were established and the expansion to Latin America is on progress. These innovation centers are helping to evaluate the technology and to define the demand, originally not existent for this technology.

The second case is related to the need for experimental science equipment for school classes. A group of scientists developed kits, e.g. Biology, Chemistry, Optics, Math and Astronomy, to motivate the learning of science concepts. . These kits were licensed for two small companies (SMEs) that developed new products in partnership with Universities. In the current phase, the project involves a consortium of more than 20 companies that sells their products for Brazilian and Latin America governments and schools.

The last case refers a project with the Brazilian Textile and Apparel Industry Association. Brazilian textile and apparel companies lost their competitiveness in domestic and foreign markets due to their inability to compete with Asian companies, mainly due to high labor costs, and European and North American brands that are already established internationally. Together with the University of São Paulo, the textile sector’s companies have launched a program for the modernization of the sector, including the identification of new technologies and strategies to optimize the production and increase its competitiveness.

In conclusion, exemplifying these cases where the social needs demanded the creation of new partnerships, solutions, as well the establishment of new ventures we agree that in developing economies such a model of identification of social demands as well organization of partnerships between government,

universities and entrepreneurs can increase the interactions inside the innovation ecosystem as well the promotion of new solutions for society needs; ie, we present cases where the social necessity creates a opportunities for generation of new technologies, establishment of business.

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THE GRAND CHALLENGES: A POTENTIAL BOOST FOR A RESPONSIBLE RESEARCH AND INNOVATION

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Keywords: Responsible Research and Innovation; Innovation policy; Grand Challenges

EXTENDED ABSTRACT

The European Union is addressing the issue of *Responsible Research and Innovation* (RRI) with a growing attention. On the other hand, the *responsibility* criterion is deeply embedded in Horizon 2020, where *smartness*, *cohesion* and *sustainability* values are viewed as essential components of the economic and social development.

The concept of *responsibility* has been extensively challenged in the last century, remarkably in relation to the huge power of technology and the imperative for advanced societies and primarily the research sectors to be *aware* of and *accountable* for the consequences that an irresponsible use of technology can produce (Jonas, 1979).

Today more than ever, human communities are facing the urgent need to transform social and economic processes in order to ensure at the same time environmental sustainability and social prosperity. The scientific community must be conscious of the fundamental role it can play in such a global challenge and humble enough to recognise that all the dimensions of society have to become essential actors of these transformations.

The paper puts forward some new remarks and proposals about the principles of a *Responsible Research and Innovation* (RRI) discussed in basic articles (Stilgoe, et al., 2013); (Pandsa, et al., 2013) and in some EU documents (EC, 2013). The premise considers how the *intentionality* of a potential innovation may confine the needed actions to *responsibility* criteria. On this basis, the paper focuses on the central argument, namely on how RRI *principles*, *policies* and *governance* can be fruitfully explored and consolidated in the area of grand challenges.

Within the complex relation arising between fundamental and applied research, the *objectives* of a technological intervention can be read on the background of the RRI aims. In this exercise, it is apparent that whenever a technologic advance is used to understand the nature of the matter (e.g. sub-atomic laws) or the essence of a process (e.g. the stability conditions of a micro climate), the *responsibility* for such an action cannot be substantially questioned. Here in fact, the *intentionality* of the technology-supported research is to understand the phenomenon and possibly to bridle its behaviour in a formal representation. The relevant research action is far from offering some application evidence, hence, not only the claim to *predict* its *consequences* is unrealistic, but applying a rigid scrutiny to the action may threaten the research freedom and autonomy and raise the risk of narrowing its potential benefits. In this case, a responsible attitude should

foster a *public dialogue* around the research object and a prompt *contamination* at the level of (higher) *education*, where the new issues and discoveries could be viewed on the watermark of the consolidated disciplines.

Conversely, whenever the technology is used to *manipulate* either the natural matter or pre-existing processes, the innovation action and the *social consequences* become more interdependent. And the need to choose the appropriate action according to *ethical* criteria more evident. If the innovation action is more *responsive* to a *responsibility-driven* scrutiny, at the same time it is significantly dragged by market and business opportunities which are very seldom *ethically* inspired. In any case, this kind of innovation discontinuity is the one where a RRI-based policy should be more strongly pursued. Such a policy should address *awareness*, *engagement* and *collective responsibility* by pursuing a diffuse understanding of the needs the innovation is expected to fulfil and a transparent evaluation of the potential impacts (*integration* of scientific, economic, social cultures).

On the other hand, the evaluation of the impacts and risks of a given innovation discontinuity is very hard to *verify* because of the delay that inevitably elapses from the innovation design phase to the point when its effects can be measured. Moreover the innovation action is modifying a *complex* process, subject to random conditioning factors and this makes, if possible, the impact even more unpredictable. The problem can be tackled by assuming a future oriented or *anticipatory* approach (Stilgoe, et al., 2013); (Rosen, 1985) that is supported by the existence of common and transparent objectives reflecting the societal *expectation* about the issue the innovation action is tackling. As requested by the *participatory* character of democracy, all the social dynamics (scientific and social research, business, politics) are assumed to participate to the design of such *expectation* (Leydesdorf, 2006).

In a way, this approach *embeds* the unfeasibility of prediction into the *collective* character of *responsibility*. If considered in conjunction with the *expectation* that inspires *backwards* the innovation choices, this approach means to shape a desirable future (*anticipation*) through a *responsible* innovation rather than trying to *predict* the effects of a loosely directed innovation act.

The *anticipatory* approach is particularly suited to deal with the innovation aspects applied to the so called *grand challenges* (Horizon, 2014) and this leads the discussion to the central argument of the paper.

The grand challenges address the variety of issues emerging along the society's development path. Problems like *global warming*, *health and demographic changes*, *energy sustainability*, *water shortages*, *waste production and disposal cycles*, *mobility of humans and goods*, will inevitably generate radical changes of the relevant systems.

Now, the social character of these processes, is directly implying that the expected transformations would simply *not be possible* if a new level of social involvement (*engagement*, *responsiveness*) and a profound *identification* with the common aims are not affirmed. This very pragmatic need is conveying the transformation efforts in the same direction addressed by a *responsible* R&I: an unexpected *enforcement* of the relevant policies.

The need to involve the social forces and cultures to guarantee the success of socially-sensitive innovation action, is particularly evident in the cases of new care and health models (e.g. prevention and de-

hospitalisation) and in the changes arising in the energy paradigms tied to sustainability (e.g. energy communities).

So, the *grand challenges* can create favourable conditions to *experiment* and *consolidate* a *responsible* attitude in the phase when the *direction* of the innovation action is established. It is apparent that any innovation facing a *grand challenge* is naturally looking at a background of potentially *negative circumstances* the action is expected to prevent (e.g. global warming, drop of welfare, corruption of the environment). It can be said that these circumstance will occur with a *high level of confidence* if present processes and behavioural habits are not discontinued. The knowledge of the *negative circumstances* and their *likelihood* support the *need* for an action and offer some criteria to choose *ex-ante* the most appropriate action among the many possible.

The above considerations put forward the idea that grand challenges offer favourable conditions to define responsible R&I projects. The EU research plans of Horizon 2020 as well as the Regional plans based on structural and cohesion funds are considering the *social benefit* among the objectives to be achieved by the candidate projects and frequently require that *social bodies* and *social disciplines* are involved. Indubitably these requirements encourage a responsible attitude of the participating bodies, but they are still too feeble signals for the affirmation of a responsible R&I. In the EU and Regional projects dealing with the grand challenges, a more responsive attitude could be fostered through some practical governance rules.

Firstly, the active participation of social bodies and social disciplines should be allocated *from the very beginning* of the project. This would guarantee an appropriate weight of the social values in defining the innovation action and the *responsibility* of each actor about the effects of the innovation step and the potential re-directing initiatives.

Each partner of the project should be *aware* of the *perspective* driving the innovation action and should identify its work as a contribution to a *collective aim*. This attitude requires that the project *governance* is able to stress the benefit that a *collective effort* can generate for all the parties in case the project is successful. The leverage lies in the *completeness* of the innovation effects, which is guaranteed when the project requires that *new models* are explored on the *business, social behaviour* and *educational* dimensions.

The above cases can support a RRI approach just if the project is *well formed* in terms of *complementarity* of partners, *shared intentionality* and clear guarantees of *continuity* and *consolidation* in case of success. The pre-commercial procurement of innovation offers (only) some of these requirements.

Finally, it is important to recognise that higher and professional education can become an *acceleration* and *anticipatory* factor for RRI. To achieve this, the education forces (academia, research centres) taking part in an innovation project should allow that the new speculative issues the project is tackling permeate and possibly re-direct the *pedagogic schemes* they are usually conforming to. In this way, a *well-formed* and *well-governed* project conveys at the education level the *responsibility* character and the *consciousness* of the coming innovation when it is still in the pre-market phase.

Summarising, the *grand challenges* seem to offer interesting hints to face the RRI dilemma. In fact the innovation projects they are urging embed *societal needs* in a natural way and stimulate the adoption of a *collective responsibility* through an *anticipatory* approach.

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WELFARE TRANSITION EXPERIMENTS IN KOREA: LEARNING AND POLICY CHALLENGES AHEAD

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EXTENDED ABSTRACT

Since, system-transitions have been brought out as important issues for the sustainable development over the last few years, national R&D in South Korea are faced to big challenge. Especially innovation policies aimed at solving social problems are beginning to take a more concrete form in Korea. For example, science and technology-based programs to tackle major societal challenges, including climate change, energy and the environment, healthcare and welfare, and safety, have been planned and implemented at the government level. These efforts are expected to provide an initial impetus for the direction of innovation policies to gradually change from ‘technology-acquisition/supplier-oriented’ to ‘problem-solving/user-oriented’. Social enterprises, whose main purpose are to create and expand social innovation for grappling with and solving social problems, would also be able to improve and upgrade their activities by utilizing these new technological resources.

National R&D in South Korea has been conducted with a picking-winners method that is suitable to get outputs in a short period by select and concentration strategy. With the picking-winners method that emphasizes on goals and outputs of R&D programs, South Korea’s R&D could be advanced a lot in the quantity side drastically.

However, it takes some time before new types of policies and activities are socially accepted and begin to take root in society. First of all, existing institutional framework and ways of doing things exert a dominating influence and innovation policies are still very much ‘technology acquisition/supplier-oriented’. Moreover, infrastructure, human and financial resources, and knowledge base which are badly needed to support ‘problem-solving/user-oriented’ innovation policies leave very much to be desired.

To cope with these institutional and structural problems, we need a new framework that would be able to guide innovation policies and activities for tackling social problems. This study attempts, from the perspective of ‘socio-technical system transition’, to propose preliminarily a new direction and ways of doing things for innovation policies and activities to tackle social problems. South Korea government starts

to concentrate on qualitative outcomes of R&D such as social justice, inclusive development, quality of life, public welfare as well as quantitative growth so that planning, budget allocation, evaluation of R&D are kept up with this change.

In socio-technical system transition, ‘participation’ and ‘transition’ are two key elements. In system transition, not only technology suppliers but also civil society actors and relevant stakeholders as technology users in specific context of social problems in the field work together and participate in the process of making a transition vision towards a new socio-technical system and carry out innovation activities to realize the transition vision. Seen from the system transition perspective, R&D programs and social innovation activities focused on solving a specific technical or social problem take on a new meaning as transition projects enabling or contributing to system transition. The new meaning is not given by technology suppliers, but socially constructed through the deliberation of stakeholders including technology users.

This study is an attempt to evaluate, from the perspective of user participation and transition, both current R&D programs of the Korean government and innovation activities of social economy organizations to find the solution to social problems, and based on this, to suggest ways to improve these novel efforts. This could be of help in coping with the inertia of the current paradigm of innovation policies and R&D programs and searching for and establishing a distinctive identity for innovation policies to tackle social problems.

To be specific, we evaluate the public welfare R&D programs initiated by the Korean government with a system-transitions perspective. Goals of the public welfare R&D programs are the improvement of vulnerable social group’s welfare and life quality unlike those of the innovation system such like developing cutting-edge technology. In terms of pursuing the social value considering the life of quality development for the elderly and the disabled, goals of the public welfare R&D programs support inclusive-innovation. These R&D programs are quite innovative in respect of suggesting public welfare as a goal, but have limits for implementing system transition within current system.

There are 25 programs which are related to vulnerable social group’s welfare in South Korea and we choose three R&D programs specialized for it as subjects of evaluation for this study; *Public Welfare and Safety Research Program by Ministry of Science, ICT and Future Planning*, *R&D for Improving Quality of Life by Ministry of Trade, Industry and Energy*, *Rehabilitation R&D for the Disabled by Ministry of Health and Welfare*.

We brought two research questions for this study. First of all, have these three R&D programs represented government’s welfare policy? Government’s welfare policy for vulnerable social group presents to provide not only promotion of health, treatment and rehabilitation but also quality of life and happiness such like cultural activities and leisure. Second of all, have three R&D programs been carried out appropriately in terms of systems transitions? We would look through how these programs reflect user’s opinion in order to create demand and how submitted outputs are adequacy.

Bibliometric analysis and in-depth interview methods are used to evaluate environmental analysis, goals of program, relative policy and statistical analysis of submitted outputs. The reports related to

government policy, program proposals which each ministry submitted, quantitative data of programs' outputs and results of in-depth interview would be used as data for the analysis.

Analysed results are as below. We have looked through the direction of welfare policy what government might proceed prior to analysing the adequacy of these three R&D program with government policy. As a result, the direction of vulnerable social group's welfare policy is divided into 6 categories; Education and Cultural Activities, Transportation, Broadcasting and Telecommunication, Healthcare, Residential Environment, and Amenity.

Table 1 The Direction of Vulnerable Social Group's Welfare Policy

Goals		Contents
Education and Cultural Activities	Improvement Education Environment	Learning Program Development for the Disabled
	Support Cultural Activities	Use of New Technologies for the Cultural Activities Environment
Transportation	Improvement Transportation Convenience	Technology Development for Improvement Inconvenience Factor of the Social Infrastructure
Broadcasting and Telecommunication	Improvement Information Accessibility	Alleviation Imbalance of Accessibility to Information
Health	Promotion of Health and a Medical Examination	Development Smart Health Management Platform for Health Promotion
		Supply Healthcare Network
		Technology Development for Improve Inconvenience Factors of Social Infrastructure
	Treatment and Rehabilitation	Supply Rehabilitation System for Senile Disease
		Supply Individual Customized Healthcare Service
Residential Environment	Improvement Residential Environment	Technology Development to Remove of Danger and Inconvenience Factors in Residential Environment
Amenity	Improvement Convenience	Technology Development to Improve Inconvenience Factors of Social Infrastructure
	Establishing Standards	Fundamental Research to Improve Inconvenience Factors of Social Infrastructure

As a result of analysis for adequacy of government policy, most of policy directions are forwarded to programs concretely but programs and investments have mainly been targeted to healthcare and rehabilitation. Programs of cultural activities and leisure for vulnerable social group have not been established. With regard to the second research question, all three R&D programs have tried to researched

user's opinion in the planning stage but have not represented in the middle of carrying out programs. This is not the only problem applied to three R&D programs but most of other programs in current system. In addition, goals of programs have been changed to improvement of life quality and happiness for vulnerable social group from economic development and results creation. However, submitted outputs are almost related to general required results for R&D programs in current system such as a number of SCI papers, patents and so on.

This study has been done for collecting data and analysing adequacy government policy and in-depth interview and additional analysis in respect of the second research question are in progress. We would like to have possibilities and challenges with system transition perspective for the sustainable development by evaluating these programs in this study.

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ADDRESSING ORIENTATION FAILURE: CONCEPTUAL THOUGHTS ON HOW TO INTEGRATE DIRECTIONALITY IN THE SYSTEMS OF INNOVATION HEURISTIC

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Keywords: Innovation Systems; Grand Challenges; RRI; Directionality

EXTENDED ABSTRACT

Since about 15 years, science, technology and innovation (STI) policies are increasingly geared towards addressing objectives reaching beyond an immediate economic focus on growth and competitiveness. This “normative turn” (Daimer et al., 2012) is expressed in the strategic reorientation of national and supranational STI policies to address the so-called Grand Challenges. Well known examples for this ongoing paradigm shift are the European Union’s Europe 2020 strategy, the US Strategy for American Innovation or Germany’s Hightech Strategy. What is more, the quest to address grand challenges such as health, demographic change, wellbeing and sustainability by the means of innovation is complemented and developed further by the emerging discourse on responsible research and innovation (RRI). In essence, RRI aims at improving the alignment of the impacts of technology and innovation with societal demands and values as far as possible. The concept is inherently characterised by a high degree of normativity in order to provide necessary guidance as to what constitutes desired or “responsible” research and innovation (Randles et al., 2014). The prominent position of RRI in Horizon 2020 and the endorsement of the “Rome Declaration on RRI in Europe” by the European Council in December 2014 indicate that RRI is increasingly developing relevance for policy, research funding and scientific communities.

The growing importance of normative directions of research, technology development and innovation pose significant challenges for the substance, procedural design and coordination of STI policies as the dominant rationale for STI policy remains to be primarily focused on fostering economic growth and competitiveness. Established practises, institutions and infrastructures continue to operate with the chief aim of improving innovation capacities. How to cope with issues of directionality, normativity and questions which innovations are desirable from a societal perspective is still not adequately addressed.

Arguably, since the late 1990s, the systems of innovation approach has established itself as the most influential paradigm within the international innovation policy community. The systems of innovation perspective does not only frame the scientific debates dealing with innovation, it also provides conceptual orientation for many governments and international and supranational organisations such as the OECD and the European Union (Fagerberg & Verspagen, 2009; Lindner, 2012). However, in view of the observed

normative turn in STI policy, the innovation system heuristic is increasingly being criticised for its inability to incorporate the dimension of normative direction and/or the lack of openness to address objectives beyond systemic imperfections (Daimler et al., 2012, Weber & Rohracher, 2012). The IS has mainly focused on the explanation of the economic performance of national/technological/sectoral systems by factors outside of the classical neoclassical framework (Sharif, 2006). Hence, the predominant policy rationale concept of market failure has been enriched by the system failure concept, which takes into account weaknesses such as infrastructural failures, capability and learning failures, transition failures, network failures (weak and strong) or institutional failures (Woolthuis et al., 2005; Chaminade & Edquist, 2006). Consequently the IS approach has usually been employed to tackle generic questions of innovation and its role for economic growth and employment. In contrast, it didn't focus on understanding how policy might steer innovation in a particular direction towards other socio-economic goals (Quitow, 2011; Bajmócy & Gébert, 2014).

Despite the fact that the systems of innovation approach and its numerous variants have frequently been criticised for, among many other weaknesses, their one-dimensional focus on economic development, the tendency to overemphasise technological innovation and the implicit notions of linearity (Soete et al. 2010; Dodgson et al., 2011, Mahroum, 2012), the heuristic itself continues to provide useful analytical lenses and constitutes a valuable conceptual frame of reference for the design of STI policy. Most notably and well established within the STI community, the emphasis of the systems of innovation approach on interactivity and interdependence between different actors, the understanding of innovation as a collective endeavour which is influenced by complex framework conditions, the sources of innovation (e.g. non-R&D activities) and the prominent position of reciprocal learning processes as chief drivers of innovation remain important guideposts (Soete et al., 2010)

This brief problematization raises the question how the systems of innovation approach can be revised and developed further in order to respond to the challenges of directionality and normative orientation. The proposed paper will present preliminary conceptual considerations, which are currently being developed in an on-going research project, on how to tackle this challenge.

Our points of departure are (1) the observation of a conceptual "blind spot" in the established systems of innovation heuristic. While the systems of innovation approach primarily serves to identify relevant system elements and supports the analysis of the interplay of interaction and knowledge exchange, it fails to provide conceptual underpinnings on how to identify, assess and ultimately guide innovation towards desired directions. This deficit might also be termed as the "governance gap" of the systems of innovation approach. (2) Contemporary literature on the governance of technology and innovation provides a rich reservoir of approaches, instruments and mechanisms on how to steer, influence or "nudge" actors and institutions with the specific aim of modulating and orchestrating innovation trajectories according to desired ends. Hence, we propose to systematically integrate a governance perspective into the systems of innovation heuristic in order to address the identified orientation failure. (3) The rise of the analytical term "governance" is without doubt a reaction to the growing interdependence between societal subsystems such as different policy subsystems or different functional areas. We understand governance therefore as a mechanism to deal with interdependencies. As growing interdependencies in general mean an increase in complexity of policy and

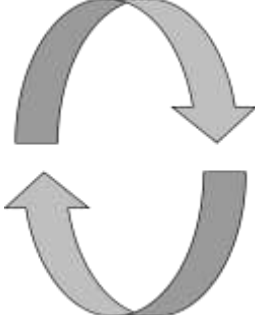
politics, this implies at the same time that cooperation and coordination between different actors become increasingly important.

At this point, a number of promising conceptual building blocks were identified in the project. These include the numerous elements of strategic intelligence (technology assessment, evaluation studies, foresight) as well as primarily procedural approaches aiming to improve deliberation and participation.

Following up these thoughts, we think that reflexivity or discourse capabilities should be major criteria of the quality of IS. The capability of innovation systems to reflect about orientation and goals and to bring together people to discuss about goals and to prioritize them should enter the IS concept as quality criteria additional to the system functionalities currently endorsed by the concept.

We have collected a first list of elements of this *Reflexive Governance*, which might serve innovation systems to identify, assess and ultimately guide innovation towards desired directions. At this stage of our research, this is a set of four capacities for the governance of IS which can render the situation analysis but also goal formulation and implementation into reflexive processes (see table 1).

Table 1 Criteria of Reflexive Innovation Systems

	Self-reflection capacities	Bridging and integration capacities	Anticipation capacities	Experimentation capacities
Situation analysis / awareness	Value awareness / orientation awareness, self-conception	Reciprocal responsiveness (accepting different knowledge claims), transdisciplinarity, collective intelligence, robust knowledge, acceptance of different points of view.	Futures literacy	Learning through failure on all levels and different contexts 
Goal formulation	Articulation, adaptation	Conflict recognition, conflict moderation, participatory goal formulation processes, participative generation of lead images, visioning	Ambitious, extra-systemic goal setting	All processes are co-existing, goals are co-evolving, they can change along the process; Allowing for parallel approaches in different contexts and at all levels; exchanges are possible through all levels (example living labs)
Strategy implementation	Adaptation, learning	Coordination, interactive strategy development	Attention to (non-intended) side-effects monitoring, early Warning	

Source: Own compilation based on Voß et al., 2006.

The next steps of our research will be to describe these capacities further and to work on indicators for these elements of reflexive governance, as well as on governance features of IS which help to address these discourses, i.e. different ways of raising awareness and shaping attitudes and different instruments, processes and fora to cooperate and coordinate collectively about orientation. We will also work on the implications of our findings for the graphical illustration of IS. From a governance perspective, a general critique of “classical” IS illustrations is that governance so far can be found in the “Policy”-Box. This does not mirror the state of the art of the governance literature and the considerations about reflexive governance in IS as

outlined above. In fact, governance is an overarching layer with implications for all elements of the IS and in particular on their interactions.

To bring in reflexivity into the IS concept means to strengthen the concept, as this helps to make explicit those structures, actors and processes which interact in order to orientate the whole system towards higher level policy objectives (missions, challenges and strategic priorities). In fact, we can observe that such higher level policy objectives already exist, so far often implicit or being taken as exogenous. Current developments of bringing in for example sustainability into the system reveal tensions, which illustrate that the enrichment of the innovation system, which we approach conceptually in this paper, is at the same also needed in empirical terms. One of our next steps in this project will therefore also be the study of empirical examples of reflexive (governance) elements in innovation systems in order to work towards a view how reflexive governance can look like in the practice of IS.

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INSTITUTIONS AND TECHNOLOGICAL INNOVATIONS: THE CASE OF THE ADOPTION AND DIFFUSION OF DIGITAL PROJECTORS IN FRANCE

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Keywords: Innovation diffusion; Institutions; Technological transition; Digitisation; Cultural industries

EXTENDED ABSTRACT

Summary

The accelerating pace of innovation since the digital revolution brings a lot of uncertainty and challenges. For companies, disruptive innovations sometimes present a real threat, in particular to the photography or the record industry in the digital age (Belton, 2002; Gomery, 2005; Chantepie, 2005). Faced with a problem of transition or at least, of industrial change and a number of actors (firms and institutions) find ways to facilitate the adoption of new technologies and to disseminate them. The film industry is a prominent example of an industry that is impacted by the digital wave at every productive level.

The academic literature has analysed the difficulties in the diffusion of innovations and identified for example, bottlenecks in the value chain or lock-in effects, which are sometimes caused by a short-sighted approach of public policy (Pratt, 2007). We slightly stand out from this literature since our review will seek to explain the diffusion of technology, basing on institutional economic theories. It supports the importance of institutional context in economic change (North, 1990; Nelson, 1994; Nelson and Sampat, 2001; Aoki, 2001; Gagliardi, 2008).

We also use the literature which makes an economic and political analysis of the cultural industries, the so-called "creative economy" and supports their growing importance (O'Connor, 2007). This literature also highlights the fact that the cultural property has particular characteristics that approximate the public good and that the treatment should be different from other goods (Benhamou, 2010; Caves, 2002).

Using a multi-level analysis (macro and micro), the paper explains the role of two institutions in the film industry in France (the CNC and the Virtual Print Fee system) in the diffusion of innovations and in particular the case of digital projector which was illustrative of the evolution of the industry and consumers' preferences in the early 2000 when the digitisation of cultural industries took place. Different strategies emerged and the dominant one was independently decided from traditional institutions. Hence, the paper highlights the different technological choices and paces of adoption between the industry and the institutions and studies the causes of such phenomenon. The paper aims to provide an understanding of the diffusion of an innovation as it creates a deep and lasting social change when disruptive by analysing both industrial strategies and the emergence of an institutional system.

Methodology

Opposing the static aspect of institutions to the dynamics of an industry experiencing a technological paradigm shift, the trajectory that a disruptive innovation takes is a reflection of these transformations because adoption and diffusion of a technology depend on the socio-economical frame in which they take place. Basing ourselves on second hand data (Forest, 2001; Bonnell, 2006; Kanzler et al., 2011; CNC, 2013). We will highlight the parallel evolution between the industry dynamics of the cultural sector and the historical film institution in France (the CNC- Centre National du Cinéma et de l'image animée) since the beginning of the digital revolution and on the other hand explore strategies for the adoption and diffusion of an innovation in a subgroup of players involved in equipping theatres with screens, projectors and sound systems. We seek, by this method, to explain how strategies differ among companies and institutions involved in these industries, that is to say how decisions depend on their motivations, their respective bargaining power and how they influence the organization of an industry that faces a disruptive innovation. The difficulty will be in the analysis of a very complex environment from the one hand, the diffusion of innovations and secondly, creative industries, two concepts that are both highly contextual.

Results and Implications

We find that adoption was slightly quicker for firms that chose alternative solutions for financing their conversion instead of following institutional guidelines, whereas the firms which could not do otherwise could not adapt or were slower. In terms of diffusion, the pace curve is a skewed one reflecting the prominence of bigger firms (often consortium) which have easy access to alternative solutions for conversion.

In the trade-off between cultural and industrial issues that players face, industrial interests are often put forward. This can be seen in the structure of the industry after the digital technology shock, particularly with the emergence of new leaders from media consortiums that are not strictly operating in the cultural sector. This new organisation challenges the industry's ability to stimulate creativity, to enhance the viewers' experience, and to support the conservation of heritage.

The results allows us to question the role of public institutions in the post-digital context, and their historical role that is to maintain cultural and technological diversity. In terms of public policy, this translates into the possibility of different levels of intervention but which may be limited when governments have myopic consideration of the complex challenges posed by changing creative industries.

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INSTITUTIONAL ENTREPRENEURSHIP IN THE EMERGING RENEWABLE ENERGY FIELD: INCUMBENTS VERSUS NEW ENTRANTS

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EXTENDED ABSTRACT

Climate change and the depletion of conventional fossil fuels require societies to go through a transition towards a low-carbon economy and a sustainable energy system. Such an energy system requires the development and diffusion of new energy technologies. Institutional change is an indispensable element in the emergence of new technologies. Institutions are ‘the rules of the game’ and structure behavior by enabling and constraining certain types of activities. Existing institutions tend to hamper the diffusion of innovations. Therefore, innovation requires the de-institutionalization of existing institutions, and the theorization and institutionalization of new ones. It entails the process of ‘existing set of beliefs, norms, and practices [coming] under attack, [undergoing] delegitimation, or [falling] into disuse, [being] replaced by new rules, forms, and scripts’.

The field of sustainability transitions traditionally focuses on new entrants as the agents of change, while incumbents are often found to defend the status quo. Incumbents are believed to be ‘restricted by their existing assets, which reflect past investments.

However, Stenzel & Frenzel (2008) argue that if a firm’s resource base matches with future developments, ‘incumbents can be drivers of transformations of the energy system both in terms of technological development and regulatory adaptation’ (p. 2655). The benefit of incumbents promoting sustainable innovation is their ‘promise to achieve a broader impact, since they have the potential to reach out to a mass-market audience’. In sum, literature indicates that not only new entrants but also incumbents are able to be agents of change.

Actors aiming to change institutions can engage in institutional entrepreneurship, which entails ‘... activities of actors who have an interest in particular institutional arrangements and who leverage resources to create new institutions or to transform existing ones’ (Garud et al., 2007:957). We may expect that new entrants and incumbents have distinct starting positions in terms of resources, skills, and networks. Therefore, incumbents’ institutional entrepreneurship as well as the related institutional change is expected to differ from those of new entrants. For instance, incumbents may engage more with policy-makers, due to their stronger connections with the political system.

Furthermore, due to their stronger position in terms of resources, we expect incumbents to be more successful in creating supportive system structures.

However, the difference between incumbent and new entrant behavior is a relatively unexplored area. Levy & Scully (2007) state that 'the strategic implications of their differential resources and locations have not been thoroughly explored' (p. 975). With this paper we address the above knowledge gap. We aim to analyze institutional entrepreneurship activities by incumbents as compared to new entrants. Therefore, we build on the framework of Pacheco et al. (2010), which presents cooperation, framing, and political tactics as the three main activities of institutional entrepreneurship.

We focus on the renewable energy case of biogas in the Netherlands. Negro et al. (2007) have shown that biogas producers have failed to create momentum for the development of biogas in the Netherlands in the time period 1970-2004. During this time span, actors were mainly new entrants to the energy market, in particular farmers with small co-digestion plants. Ever since the first production subsidy for electricity production from biogas was allocated in 2004, the profitability of biogas installations has been a concern [e.g. 29, 38]. From 2008 onwards, dramatic improvements occurred in the institutional framework for biogas and its upgraded version, biomethane (see Table 1). Firstly, financial support increased sharply, mostly in the form of a production subsidy and R&D tenders. Its pinnacle was the allocation of a striking 1 billion euros production subsidy to biomethane in 2011. Secondly, government offered regulatory support (e.g. the setup of a sustainability certification scheme). Thirdly, government statements indicate that biomethane turned into a government priority. This watershed coincided with the entrance of large incumbents from the Dutch natural gas sector into the field of biomethane (NAM, 2005:17), which is complementary to the biogas value chain.

This case study provides an excellent opportunity to study incumbent and new entrant institutional entrepreneurship and their respective impact on the institutional framework for biomethane. We will also discuss how the institutional change affects biomethane development on the ground. Due to the government's central role in the development and diffusion of new energy technologies, we focus on formal institutions. Our research question is: *How do incumbents and new entrants engage in institutional entrepreneurship to promote biomethane, and what are the effects on the formal?*

This study has the form of a case study covering the time period 2006-2012. Our analysis is based on a newspaper database including 250 news articles; policy documents; various other relevant publications; 15 expert interviews; and observations from gas industry conferences.

Our findings provide insight in the dimensions that distinguish between incumbents' and new entrants' institutional entrepreneurship activities, and how activities of cooperation, framing, and political tactics build on each other to have an impact on institutional change.

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THE EVALUATION OF BEHAVIOURAL ADDITIONALITY IN MEXICO: A CASE OF CURRENT METHODOLOGICAL PRACTICES

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EXTENDED ABSTRACT

The concept of behavioural additionality, or the modification of the agents involved or affected by a policy measure (Buisseret, Cameron and Georghiou, 1995; Georghiou et al., 2004; OECD, 2006; Gök, 2010; Amanatidou et al, 2014), has become of strategic importance (Gök and Edler, 2012; Amanatidou et al, 2014) to generate evidence-based policy and evaluation frameworks based on policy learning (Edler et al, 2013).

Initially developed as a concept which complemented the input and output additionality perspectives (Buisseret, Cameron and Georghiou, 1995), the concept has slowly but steadily gained momentum, becoming a key topic for evaluations (Amanatidou et al, 2014).

Different analysis of the utilisation of the behavioural additionality concept (Gök and Edler, 2012; Cunningham and Gök, 2012; Amanatidou et al, 2014) provide evidence of its role as an important policy design- tool, while also recognising that there is ample potential for enhancing its usefulness for policy-learning. Currently, the concept has served to demonstrate that public incentives generate different types of changes in terms of firm behaviour (OECD, 2006; Hyvärinen and Rautiainen, 2007; Cunningham and Gök, 2012), as well as potential modification of the policy maker's behaviour (Amanatidou et al, 2014).

The findings discussed above had been linked with the potential that behavioural additionality has in terms of: 1) its capacity to address societal impacts (e.g. sustainability, costumer needs and structural and, or regional development) and 2) intended and unintended impacts over long time-frames (Amanatidou et al, 2014).

It is precisely the first element indicated above, in specific regional development, which has become a central issue for the current political agendas of several Latin American and Caribbean countries (Crespi and Dutrénit, 2014; Dutrénit and Sutz, 2014), where the articulation of a coherent policy framework based on regional evidence has become a necessity. According to the region's necessities, the concept of behavioural additionality finds a natural niche, as it would enable policy makers to understand the system trajectories and (ultimately) generate Science, Technology and Innovation (STI) policies which are capable to address societal impacts and regional development.

Therefore an initial step is to understand if the concept of behavioural additionality currently permeates the policy agenda and the academic discussion in Mexico.

An initial exploration of the concept, it can be observed that it is slowly gaining momentum, mostly as an instrument for academic debate (Crespi and Dutrenit, 2014), and to a very limited extent in the current STI policy agenda, discussed as an implicit component of a series of instruments with the capacity to create a knowledge-based economy for Mexico (CONACYT, 2013).

Upon closer inspection, the concept appears to be biased towards a particular understanding of the role that the government should adopt in an intervention (market failure approach). There also appears to be a conceptual confusion in its elements and the mechanisms to evaluate behavioural additionality.

Based on the discussion presented above, this paper is produced with the intention to explore, and synthesize, with a qualitative approach (Pawson et al, 2004) framed as a case study, the knowledge and evidence of the different works existing in the subject of behavioural additionality in Mexico.

Thus, the paper discusses specific works found on the subject; namely those of Jaso (2006), Santos (2007), the body of work of Martínez-Covarrubias and Lenihan (2008; 2010; 2011) and Mungaray, López and Moctezuma (2013). The qualitative review done on the literature emphasises the use of the concept (definition of behavioural additionality), operationalisation (methodology), and lessons learned (results and limitations).

For example, the review identified that the works of Jaso (2006), Santos (2007) and Mungaray, López and Moctezuma (2013) employ in-depth questionnaires and ad-hoc surveys applied to top-level managers to assess behavioural change. On the other hand, the framework proposed by Martinez and Lenihan (2008; 2011) favours an econometric approach (2-step Heckman model) to measure increases in labour productivity as behavioural additionality.

Following the review, the discussion is framed under the significance of these lessons to Mexico's National Council of Science and Technology (CONACYT) policy agenda.

Based on the exploration of the selected literature, it can be observed that although there is conceptual congruence amongst the authors, as they define behavioural additionality similarly, there is major divergence in the operationalisation of the concept and its measurement, but surprisingly all report high levels of behavioural additionality based on their analysis.

In terms of the policy agenda, Mexico as a developing country, still requires to transit a long path in terms of science, technology and innovation policy. For example Corona et al (2014) have identified four main stages in the design and implementation of STI policies in Mexico which have been characterised by a linear approach in policy making, which receives with great difficulty new analytical proposals to policy making.

This paper is produced for the EU-SPRI 2015 conference on Innovation policies for economic and social transitions. It is observed this paper is important for several reasons. First, it discusses a novel concept (behavioural additionality) which is rapidly becoming central for the discussion on evaluation of STI policy. Second, it addresses two problems which are central for the understanding of the concept, that of measurement difficulty and insertion of the lessons obtained from its evaluation in a major policy learning-context. Thirds, although its focus is on a specific country context (Mexico), by approaching the topic as a

case study, the lessons extracted from it, can be informative for further refining the behavioural additionality theory.

The paper is intended to participate in the special track: Innovation and Collaboration to Tackle Societal Challenges and Promote Development as it directly focuses on Methodologies for bringing in different kinds of knowledge for innovation.

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EXPLORING THE ROLE OF INTERNATIONAL TECHNOLOGY TRANSFER IN ENHANCING INNOVATIVE CAPACITIES AND TECHNOLOGICAL CAPABILITIES OF FIRMS IN DEVELOPING COUNTRIES

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EXTENDED ABSTRACT

Technology transfer is at the heart of international policy deliberations and decisions on how to adequately address anthropogenic climate change and contribute to low-carbon development in developing countries (Fu *et al.* 2011, Ockwell and Mallett 2012). Yet fairly little is known about the actual process of transferring environmentally sound technologies in developing countries (Coninck and Sagar 2015), which is remarkable given the urgency in avoiding dangerous climate change and critical threshold behaviour of ecosystems (IPCC 2014, UNEP 2014, Steffen *et al.* 2015). It is imperative that developing countries going through various stages of industrialisation are not locked-in to the same fossil fuel energy infrastructure of industrialised countries but bypass and leapfrog to environmentally more benign alternatives (Perkins 2003, Gallagher 2006, Berkhout *et al.* 2009). At the core of this challenge is the transfer of environmentally sound technologies, which is widely recognised as the essential prerequisite to low-carbon development in developing countries (Byrne *et al.* 2011, Ockwell *et al.* 2014).

The two literatures on innovation systems (IS) and global value chains (GVC) consider how knowledge is transferred and diffused in developing countries, but there is limited understanding of how transnational linkages influence these processes and impact innovative capacities (Hansen and Ockwell 2014, Gosens *et al.* 2015). Recently, however, a synthesis between the two distinct perspectives has been proposed (Lundvall *et al.* 2009, Malerba and Nelson 2011, Pietrobelli and Rabellotti 2011, Jurowetzki *et al.* 2015). This paper explores how the synergy between the literatures adds to our understanding of technology transfer and innovative capacities in developing countries and how this connects to international policy initiatives in relation to climate change.

Research question

The paper is based on the following research question: How are knowledge flows in GVC embedded in and affected by IS in developing countries?

Theoretical framework

Encompassing the intricate networks of actors and institutions, IS provide the environment in which all processes of technology development and innovation occur. Innovation is generally studied through the economic operationalization of evolutionary mechanisms, a paradigm that emerged as a reaction to the often exogenous treatment of technological development in mainstream economic theory (Nelson and Winter 1977, Dosi 1982, Rosenberg 1982, Freeman and Perez 1988). Analysis typically conflates national (Lundvall 1992, Nelson 1993, Edquist 1997), regional (Cooke *et al.* 2004), sectoral (Malerba 2002, 2004) or technological boundaries (Carlsson and Stankiewicz 1991, Hekkert *et al.* 2007, Bergek *et al.* 2008) with IS, although the ex-ante delineation of boundaries is crude and influences the findings of analysis (Coenen *et al.* 2012, Wieczorek *et al.* 2014). It is often suggested that innovative activity is organised globally and transcends conventional boundaries and work between interrelated spatial scales (Bai *et al.* 2009, Binz *et al.* 2014). Moreover, the international dimension in which IS are embedded is often downplayed and referred to as a 'global technological opportunity set' to which all actors have equal access (Carlsson *et al.* 2002). This framing of IS is increasingly questioned and replaced with a view of differentiated access to unevenly distributed resources and structural system failures (Berkhout *et al.* 2009, Weber and Rohracher 2012, Hansen and Nygaard 2013). The emerging literature on geography of sustainability transitions is particularly attentive to this international dimension of innovation processes (Coenen and Truffer 2012, Hansen and Coenen 2013, Wieczorek *et al.* 2014, Gosens *et al.* 2015).

IS in developing countries differ from their industrialised counterparts, which are typically characterised by stronger institutions, regulations and support (Lundvall *et al.* 2009, Byrne *et al.* 2012). Initially, there is a need to build up a minimum level of innovative capacity and technological capabilities to absorb knowledge and incremental innovation that are new to firms in developing countries (Pietrobelli and Rabellotti 2011, Bell and Figueiredo 2012). However, key organisations and institutions are often inadequate and linkages among them and with the private sector are weak (Ostrom 1990, North 1991). This impedes the functioning of IS in developing countries. To augment the transfer and diffusion of environmental sound technologies in developing countries it is critical to understand how the interaction between IS and technological capabilities of firms creates access to external knowledge flows that are situated across different spatial settings. In particular, the accumulation of tacit knowledge is considered essential to firms in developing countries seeking to catch-up with technological frontiers, yet this form of knowledge is often difficult to transfer without close and extended interaction between user and producer (Jensen *et al.* 2007, Lundvall *et al.* 2009). Learning as a deliberate and active activity is therefore an essential part of enhancing innovative capacities, and the interaction between internal learning and external technology acquisition is considered and in many ways requires a coordinated and integrated process (Lema and Lema 2013).

While this first assessment is indeed too simple, it is argued that firms in developing countries are initially more concerned with the absorption of external knowledge and improvement of incremental innovation compared to firms in industrialised countries that are typically operating closer to the technological frontier (Dutrénit 2004). The absorption of knowledge produced elsewhere implies that IS in

developing countries are open and inserted in global flows of knowledge and technology (Kim and Nelson 2000). This crucial point is highlighted in much of the literature on IS but its importance is often downplayed and replaced with a narrow national perspective that fails to incorporate the international dimension of knowledge transfer and innovation activity (Ernst 2001, Fu *et al.* 2011, Pietrobelli and Rabellotti 2011).

Given the global pattern of industrial organisation and outsourcing the literature on GVC complements the restricted view on national systems of innovation, which is typically linked to specific government institutions and state policies (Jurowetzki *et al.* 2015). The literature explores the fundamental question of how integration of local firms in GVC contributes to economic development in developing countries. A common feature of the literature is that lead firms, often located in industrialised countries, for different strategic reasons engage in coordinating the activities of its suppliers (Gereffi 1999, Humphrey and Schmitz 2002, Schmitz 2004, Ponte and Gibbon 2005). A useful typology suggests five different governance patterns of GVCs, which are determined by three factors: (1) complexity of transactions, (2) ability to codify transactions, and (3) capabilities in the supply-base (Gereffi *et al.* 2005). GVC literature explores the role that lead firms play in fostering and supporting knowledge transfers to its suppliers; a dynamic which is intrinsically linked to the existing technological capabilities of firms (Bell and Figueiredo 2012). Knowledge embedded in technology is critical for technological upgrading but, at the same time, the availability of existing level of technological capabilities determine the degree to which new knowledge can be absorbed locally in developing countries (Lall 1992, Bell and Pavitt 1993).

It is argued that the literatures on IS and GVC have evolved in parallel yet interact in complementary ways. While the literature on IS in developing countries often disregards how GVC determine processes for knowledge transfer and innovative capacities, the GVC perspective tends to neglect how firms' strategies for integration in GVC are embedded in local and national contexts (Lundvall *et al.* 2009, Malerba and Nelson 2011, Jurowetzki *et al.* 2015). Pietrobelli and Rabellotti suggest that different forms of learning and innovation within GVC vary according to the form of governance adopted and, moreover, the outcome of integration in GVC is significantly affected by IS. This results in a relationship between IS and GVC that is nonlinear, endogenous and mutually affecting (2011).

Methodology

The paper will present a systematic review based on a rigorous process to identify, select and make a comprehensive analysis and critical synthesis of the relevant literatures that addresses the research question. Systematic reviews offer several advantages for researchers, including the identification of key scientific knowledge on the subject that meets explicit criteria for inclusion and exclusion and quality assessment of studies identified (Petticrew and Roberts 2006).

Relevance and expected results

This paper aims to provide a state of the art review of the synthesis outlined above. But this work is also more broadly related to international policy making on technology transfer and in particular the Technology Mechanism under the United Nations Framework Convention on Climate Change and the

Climate Innovation Centres being promoted under the World Bank. There is a distinct need to reorient international climate policy in ways that can be effectively targeted at enhancing capacities in developing countries. As internationally networked organisations, both initiatives represent an original approach to technology transfer, moving towards a more dynamic arrangement geared to foster the linkage between IS and technological capabilities of firms in developing countries. This adequately reflects the need for “nationally nested, demand-driven interventions that are internationally networked and based on learning across different context in order to build indigenous technological capabilities and well-functioning, context sensitive innovation systems” (Ockwell and Byrne 2015:4). In this regard, it is argued that the influence of transnational linkages in IS is fundamental to explain the accumulation of technological capabilities that allow firms in developing countries to leapfrog and reach technological frontiers.

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HIGHLY SKILLED MIGRATION AND KNOWLEDGE DIFFUSION: A GRAVITY MODEL APPROACH

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EXTENDED ABSTRACT

Introduction

Highly skilled workers are an important asset for a country's growth as they impact directly on, among other things, knowledge production and innovation (Nelson and Phelps, 1966; Vandenbussche et al., 2006). The network of knowledge exchange developing around these highly skilled workers generates externalities to the actors being part of this network (Elisabetta, 2008). Special attention has been given in the literature to the international dimension of such networks, with a focus on highly skilled migrants as the main actors and there has been some case studies on their contribution to the creation of knowledge in their host economies and to knowledge transfer to their homelands (Brinkerhoff, 2006; Kapur, 2001; Kuznetsov, 2006; Saxenian, 1999). Systematic empirical evidence is still scarce, with few recent works looking at the role highly skilled migrants play on the diffusion of knowledge from the US to their homelands (Agrawal et al., 2011; Kerr, 2008). However, to the best of our knowledge, no study has ever empirically tested for the exact nature of the link between highly skilled migrants and knowledge spillover to their home economies at a more global scale.

This paper intends to fill this gap of knowledge, while parallel to add on to the growing literature on high skilled international migration and its contribution to economic growth in migrants' home countries. In particular, it explores knowledge feedbacks to home countries generated by migrant inventors, a representative category of high-skilled migrants, most of them scientists and engineers. In line with a recent strand of literature on migration and innovation studies, we make use of patent and inventor data (as proxies for scientists and engineers and their output) to measure bilateral migration flows between countries, and test for our hypotheses in a gravity model framework. In particular, we look for how highly skilled migration (our focal regressor) affects knowledge diffusion, as measured by patent citations (our dependent variable). The present empirical analysis is made possible by the use of a novel dataset of inventors with migratory background as a proxy for a highly-skilled diaspora (Miguelez and Fink, 2013).

Results from our regressions confirm our initial assumption on the positive impact of highly skilled migrants on knowledge diffusion to their homelands. More precisely, we find that a 10% increase in the number of inventors of a given nationality at a destination country, leads to 1-percentage point knowledge diffusion to their home economy from that same host land. And these results are not driven neither by the

U.S. as a traditional country of highly skilled immigration, nor by India and China as the biggest highly skilled sending countries, since we obtain same results even after having dropped these three countries. Additionally, unlike what have been advocated in the migration literature for decades, on the detrimental impact of highly skilled migration from low income countries and an alarming brain drain (Docquier et al., 2007; Docquier and Rapoport, 2011), we found that low income economies as well as African countries technologically benefit from their migrant inventors living in high income countries.

Data and methodology

For the present analysis we make use of a new dataset of patent citations and inventors from Patent Cooperation Treaty (PCT) patents application, the patent database from the World International Patent Office (WIPO) for the period 1990 to 2010 (see Miguelez and Fink, 2013 for a detailed description of the dataset), from which we are able to identify migrants with a migratory background. The PCT data stands as a more convenient datasets for our analysis for three main reasons. One is its international dimension that makes it less likely to be biased towards a particular region as compared with data from regional patent offices. Another reason is the availability of information on migrant nationality and residence as provided by migrant inventors themselves upon patent application. And lastly, the yearly coverage of the PCT data allows a time-series kind of analysis. We aggregate this data at a country level and organize it into migration and citation pairs for 163 countries, for the period 1990 – 2010. Our data configuration calls for the use of gravity model in which a range of dyadic and country specific explanatory variables are included as controls. The dyadic variables include geographical distance, cultural and historical ties and technological similarity between citing/sending and cited/receiving countries. The first three variables come from ‘*Centre d’Etudes Prospectives et d’Informations Internationales*’ (CEPII). A detailed description of these variables can be found in (Mayer and Zignago, 2011). The country-specific variable captures the country technological production capacity with its total number of inventors per year. Given the presence of many zero in our dependant variable we estimate the multiplicative form of our model using Poisson pseudo-maximum likelihood (PPML) (Santos-Silva and Tenreyro, 2006)

Results

We run the PPML regression for different model specifications for robustness check and find a positive and statistically significant estimator for our variable of interest – the migrant inventors variable – in all specifications. In the baseline model, we find a 10% increase in the number of inventors of a given nationality at a destination country, leads to 1-percentage point knowledge diffusion to their home economy from that same host land. This effect is six times higher for “low income-high income” country pairs, meaning a 10% increase in the stock of highly skilled from poor economies living in rich economies leads to a 6 percentage point increase in knowledge diffusion from these high income economies to the low income ones. The inventor migrants coefficient remains positive and significant when focusing on “African-high income” country pairs, although with a lower effect. More interestingly, we find the knowledge benefit effect of low income economies and African ones in particular to be in the form of new technology, meaning a field of knowledge different from the field in which these poor economies actually specialize in. Another

interesting result is the sign of the coefficient for historical ties – as measured by past colonial ties – which is positive and significant for the baseline regression, but becomes negative and significant when running the regressions for “low income-high income” country pairs. This suggests unlike other country groups, low income economies do not benefit from their high income past colonialist economies in terms of knowledge diffusion but rather from high income economies with which they have no historical ties. All in all, we are aware of some potential endogeneity issue that we intent to test and correct for, using data on immigration law. The latter is an ongoing part of the project.

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TOWARDS NEW MISSION-ORIENTED RTI POLICY AND NEW RATIONALES FOR PROGRAMMING AND PRIORITY-SETTING: INSIGHTS FROM THE CASE OF SECURITY

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EXTENDED ABSTRACT

Currently, many RTI policy debates gravitate around the issue of mission-orientation, in particular when it comes to devising targeted RTI programmes. In spite of the widespread political support for this novel approach to RTI policy and programming, it is still struggling with many barriers, and for a number of reasons. Prevailing governance systems of RTI policy have grown over long periods of time, and have been geared predominantly towards purposes of enhancing competitiveness, for which there are stable rationales and practices in place. Due to the fundamentally different nature of new mission-oriented RTI policy, governments are still in search of a clear logic and rationales to underpin this new approach, but also of governance models for programming and priority setting.

The case of security research is a particularly daunting one, and we argue that the insights to be gained from this case are highly relevant also for other new mission-oriented areas of research and innovation policy. This paper draws on research work conducted in the context of the EU-funded project ETTIS – European Security Trends and Threats in Society (www.ettis-project.eu)

The current approach to security R&I policy and its deficits

The European security R&I programmes were launched in 2004 with the Preparatory Action on Security Research (PASR). In FP 7, the security theme was established as a significant part of the European research and innovation agenda, and it continues to be so in Horizon 2020. Overall, the establishment of a European security research programme was successful, but it is also fair to say that it did not fulfil all initial expectations. In particular, the uptake in practice of results from European research has been limited so far. Moreover, expectations with regard to what European security R&I should deliver have been changing in recent years.

The reasons for this development are manifold. The approach and process behind the security research programme were inspired by an industrial research and innovation model. While this approach may have its merits in many regards, it is not fully suitable for addressing the specificities of security R&I. One aspect is the need in security to provide solutions for a large number of very diverse low-probability, high-impact events. The fairly detailed specification of topics in the work programmes may be relevant in an area where demand for solutions is not so easy to articulate as in a “normal” industry, but it needs to be based on a comprehensive and systematic process of defining requirements (like, for instance, in defence), and this is hardly the case in security. Admittedly the role of end-users was often underlined, but not so many came to the table. And in view of the broad scope of low-probability problems simply asking the end-users “what they need” is not at all as likely as in an industrial setting to deliver useful answers. To this should be added the need in security to handle both very fast processes – like an ongoing emergency or the cyber threat development – and such that are too slow for a “normal” industrial innovation approach to work; climate change adaptation can be a case in point. And finally comes the imperative to address in a quite sophisticated way the societal aspects in much of security related innovation. Here, admittedly, activities of a respectable magnitude have been established in the European security research programme, particularly after ESRIIF. But how to bring this work to bear on the innovation process is still to a large degree an open question.

In parallel, we have also seen the emergence of new perspectives with regard to security R&I. The notion of Grand Challenges, as introduced in European R&I policy in recent years, usefully highlights precisely the need to understand security as a societal phenomenon; and therefore it is necessary to address technological as well as social innovation. As a consequence, a much broader spectrum of potential solutions, and thus of R&I topics, needs to be taken into the focus. This goal of orientating R&I towards such challenges complements the traditional motivation to enhance industrial competitiveness.

Against this backdrop, it is not surprising that a need was perceived to revisit the European approach to security R&I policy and programming. The ETTIS project has embarked on developing such a new approach to addressing the diversity, the complexity and the specificities of security R&I from the vantage point of societal challenges. It does this by drawing on an understanding of security challenges, which does not follow the traditional threat-response thinking, but rather stresses the need for strengthening resilience and sources of security in society.

Towards a new approach

The ETTIS approach to security R&I policy, programming and priority setting resides on three main elements:

1. A differentiated innovation model

ETTIS suggests departing from a purely industrial innovation model to underpin security R&I, and move to a more differentiated meta-model of innovation, which spans a sufficiently broad spectrum of security R&I configurations in the two dimensions rate of change and technical-social. In this continuum four archetypes have been developed more in-depth in the project. In addition to a modified industrial innovation model (ETTIS example: Professional Security Services), which still remains valid in several domains of security R&I but requires modification mainly due to the broad scope of low probability situations, three additional models are suggested: (1) a fast and open innovation model, where products and services are launched at a very high frequency (ETTIS example: Cyber Defence Systems), (2) a social innovation model (ETTIS example: Cyber Civic Resilience), and (3) a commons-oriented innovation model (ETTIS example: Climate and Migration).

2. A flexible and adaptive governance framework for the programming of security R&I

ETTIS has developed an adaptive model of the programming cycle, which takes into consideration many of the specific requirements which characterise security R&I. It departs from the prevailing linear model of moving from a guiding security vision to a strategic research agenda that is subsequently implemented. Instead, it stresses the idea that an interactive and adaptive programming approach is needed in security R&I. A continuous adjustment to emerging threats and options is necessary. It needs to be underpinned by research on both new options and a better understanding of security challenges. New insights from research need to be fed back continuously into the process of structuring and defining security challenges. This requires close coordination with security policy where the overarching ‘mission’ for security R&I is supposed to be defined. Finally, the involvement of stakeholders, and of end-users in particular, is crucial in all phases of the programming cycle and requires a sophisticated process design to be in place.

3. A process model for priority-setting

Priority-setting is an important part of the programming cycle. In particular when subscribing to an adaptive programming approach, clear guiding rationales of priority-setting are key ensuring coherence in deciding why some topics should be favoured over others. ETTIS suggests distinguishing between technical rationales (i.e. arguments that justify priorities from an overarching scientific perspective) and social rationales (i.e. arguments that relate to the perspectives of different stakeholders). Technical rationales can be of four different kinds: (1) Rationales from R&I policy are needed to argue what the purpose of R&I policy is supposed to be. In this regard, we have seen a shift from competitiveness as the main purpose of R&I towards enhancing societal security as the new mission of security R&I – and similarly for other societal challenges. (2) As a consequence of this shift towards a new mission-type approach, rationales from security policy need to be drawn upon in order to identify which security challenges are to be addressed by security R&I. (3) Security R&I policy rationales are needed to define the kinds of structural and thematic

issues to be addressed, taking into account the structural and organisational specificities of the security domain as described by the innovation meta-model. (4) Clear rationales are also needed to argue why policy intervention in R&I, and in particular also European policy intervention, is needed. Complementary to these technical rationales, a socially rational, usually participatory process should allow taking into account the interests, competencies and potential synergies/conflicts of actors and stakeholders.

These rationales apply at different stages of the priority-setting process, as piloted in the ETTIS project. It starts with confirming the mission of security R&I as being geared towards the concept of societal security. Then future scenarios in key domains are developed in order to identify future security needs in line with the overarching goal of enhancing societal security. Against this backdrop, more specific security challenges and possible R&I options for addressing them are specified in an iterative process. In order to deal with these challenges and options in security R&I systems, both structural priorities (i.e. how the R&I systems need to be organised) and thematic priorities (i.e. thematic R&I agendas) are developed. Finally, the question is raised regarding the need for and the instruments of policy intervention for realising R&I on these priorities. Stakeholder participation is essential along the entire priority-setting process, with different types of stakeholders likely to play more prominent roles in some stages, and less prominent roles in others.

Requirements for new mission-oriented security R&I programming and priority-setting

From the experience of the ETTIS project, ten principles or requirements for new mission-oriented security R&I programming and priority-setting have been derived. They also synthesize the structural priorities to be addressed in security R&I systems across the four types of innovation models explained above (of course there are also some structural specificities to be observed in each of the four models). While these ten principles were developed in the context of security R&I (Box 1), we believe that they are largely applicable also to other areas of challenge-oriented R&I policy.

Thematic priorities in selected case examples

The new approach to priority-setting as sketched above was piloted in ETTIS in four different case-studies. While ETTIS can thus neither claim to be comprehensive nor to have developed future R&I agendas in full depth, the thematic priorities suggested below give insight into the type of priorities we managed to come up with. Some priorities may already be known, but we do claim that some other priorities are novel in nature and would not have arisen from conventional processes of priority-setting.

- Case 1: Professional Security Services
- Case 2: Cyber Defence Systems
- Case 3: Cyber Civic Resilience
- Case 4: Climate and Migration

Given the recent shift of responsibility for security R&I in Horizon 2020 from DG ENTR to DG HOME, there is now a window of opportunity to reconsider the approach to security R&I programming at European level and gear it towards the goal of enhancing societal security. The insights from the ETTIS project point to novel inroads to new mission-oriented R&I priority-setting, programming and policy coordination; inroads that might allow European security R&I policy to set a new standard.

Box 1: Ten requirements for future security R&I programming and priority-setting

1. In order to tackle both threats to and the sources of security, give guidance and orientation to security R&I programming by a comprehensive concept of societal security.
2. As a consequence of the comprehensive societal security, it is essential to include the needs and perspectives of those who might be affected by or contribute to societal security in programming and priority-setting; this applies to all phases of the programming cycle.
3. Consider both social and technological innovation, even if the balance between them may differ across different innovation models.
4. Ensure flexibility and adaptivity in programming and programmes in order to take key features of the security field into account: diversity, complexity, uncertainty and ambiguity, but also both short-term research needs as well as long-term resilience-building.
5. Security R&I needs to be embedded in the context of use, which is strongly determined by public demand and regulatory requirements. Dedicated instruments are needed to manage the user interfaces in security R&I and ensure the embedding of R&I outputs:
6. Reinforce coordination with security policy; it is not only crucial with regard to the potential uptake and adjustment of innovations, but also for the definition of the missions driving security R&I.
7. Inter- and transdisciplinarity are essential for security R&I that is geared towards societal security needs. It requires close cooperation between social sciences/humanities and natural/engineering sciences, but also close cooperation with the users.
8. Security R&I programming needs to strike a balance between concentrated R&I efforts and the need for specific decentralised security solutions, taking into account path-dependencies of prior investments in both R&I and security solutions.
9. Address an appropriate geographic area of concern, and take into account the global embedding of security challenges in R&I programming.
10. Take ethical implications and dilemmas seriously; they touches upon sensitive and contentious issues that might easily get reinforced by second-order effects.

BETWEEN POLICY AND PRACTISE: THE EFFECTS OF INNOVATION AND SCIENCE POLICIES ON FACULTIES AND RESEARCH GROUPS

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Keywords: Governance; innovation policy; effects of research funding; variation in national science systems

EXTENDED ABSTRACT

Introduction

Science policy studies often take national contexts for granted and reproduce the policy idea that there is something like a national science system, with national scientific performances. Indeed national governments are key science policy actors and the main funding source. Many studies consequently assume that as funding is a crucial resource for researchers, changing the national funding mechanism will trigger the researcher to adapt her behavior. Remarkably, we know little about the effects of funding instruments. The evidence we do have (e.g. Van den Besselaar & Horlings, 2011), though, suggests that the relation between funding instruments and the behavior of researchers and research groups is much more complicated.

Local, regional and European governments, research consortia and policy coalitions as well as strong private funding bodies are becoming more active as science policy actors. As a result, from a researcher perspective, incentives embedded in national funding instruments interfere with other incentives. Moreover, funding for researchers increasingly creates new fields of interaction – like university strategy development, (joint) research programs, university-industry collaborations, European networks, national graduate schools, and regional smart specialization initiatives – that frame organizational responses of research organizations.

In this paper we study the possibility of a new conceptualization of the relation between science policy instruments and scientific practices by looking at the variation of organizational responses and research strategies that emerge as a result of multiple policies. Our main questions are how researchers and their organizational units respond to multiple policy incentives, and what patterns emerge in terms of organizational strategies and research dynamics as a result of the interference of these multiple incentives.

Description of the study

The Dutch government introduced a new innovation policy in 2011. The main goal of this policy was to strengthen the Dutch innovation processes in specific areas of national (economic) strength. The policy contained on the one hand incentives for industry to invest more in research and development, especially in cooperation with universities and research institutes, on the other hand it aimed to stimulate researchers to change their focus in the direction of research in the chosen areas via public-private cooperation. The policy for researchers was for an important part implemented via the national funding organization, which was obliged to show that about half of their funding was spent in the innovation areas chosen by the government.

In addition, the ministry of education, culture and science launched a new policy for universities stimulating them to focus the research done in their institution. The universities were free to choose their own focus areas, but they had to show their plans to a Review committee.

Since both policies were not accompanied by substantial extra investments, these developments worried researchers and the National Academy of Sciences. They feared research would become mainly geared towards directly applicable solutions, threatening innovation in the long run. In addition, they were worried about the position of the social sciences and humanities. This raised the question how the policy changes affect the research community and university internal policies, especially in the light of the wide array of other incentives (e.g. Horizon2020, external funders, national research schools) that may influence their behavior.

Actual effects of policy incentives are a result of responses at two levels. The first level is the lowest organizational unit that is responsible and accountable for transforming main science policies into organizational strategies. In Dutch universities this generally is the faculty level, which in some cases delegates part of its responsibilities to institutes or departments. The second level comprises research group leaders and individual researchers, who develop research strategies within specific scientific fields. For our study we surveyed almost seventy deans in person. They worked at thirteen universities which means we covered all research universities in the Netherlands, except the theological universities and the open university. The surveys comprised questions about funding of the faculty, internal allocation models, reaction to external policy incentives, internal strategy development and effects on the internal research dynamics.

In addition we have sent out an online survey among members of the scientific elite about the relation between policy incentives and research dynamics in their field.

Results

We found considerable variation among faculties in (financial) situation, opportunities, faculty policies, funding sources, dependence on the number of students and influence of national

and European policy. This variation did not only occur between faculties in general, but also within faculties from the same domain (i.e. natural sciences, technical sciences, language and culture, behavioral and societal studies, health, economics and law).

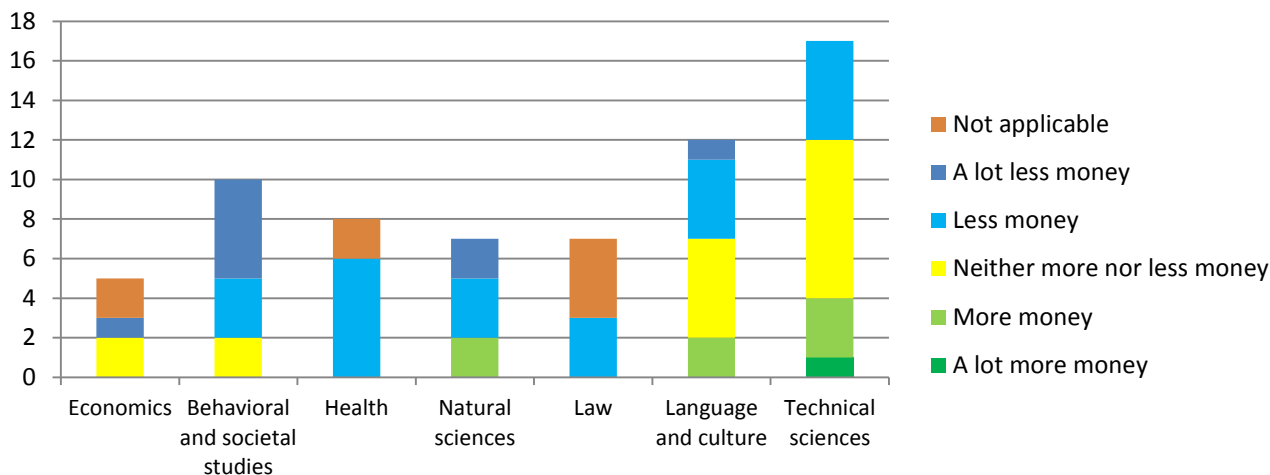


Figure 1 The financial effects of the changes in allocation by the Netherlands Organization for Scientific research by type of faculty. The numbers are number of faculties (N=67).

As can be seen from figure 1, the deans report differently on the financial effects and the applicability of the changes in policy of the Netherlands Organization for Scientific research to their faculty, even if they are from the same domain. Only in health and to some extent behavioral and societal studies there seems to be a majority view. This is of course partly due to the small numbers. However, since this is almost the whole population (75% of all faculties), we would not expect the overall picture to change fundamentally if the response had been higher. This shows that effects of national policies are contingent upon local circumstances. In the current policy debate, there are often worries about specific domains like language and culture or behavioral and societal studies. Our study shows that although they have certain things in common, the situation, faculty policies and effects of external developments differ to a large extent between faculties in the same domain.

One of the possible explanations for the differences between faculties from the same domain is the choice in focus areas of their respective universities. However, the situations and strategies of faculties within the same university were as diverse as they were within the same domains. This implies that new policies do not have an effect on the system as a whole, but different effects scattered over the system.

The influence of the national policies or university policies on the strategy of the deans and the financial position of the faculties was relatively small compared to the influence of local circumstances (like number of students or the introduction of new fields of research) and the European programme Horizon2020.

The research leaders do feel they are influenced by the new policies both with respect to financial resources and the choices of topics in their field. In the open questions however, they did not indicate that they changed their research topics. Some researchers indicated that they framed their research differently as to be eligible for funds from the targeted programmes.

Discussion

Van den Besselaar and Horlings, (2011) already showed that earlier policy incentives aiming to change the focus of the Dutch national portfolio did not succeed. The fields for which more funding was available and which were stimulated with special policy incentives did not stand out with respect to other fields which did not receive extra funding, nor did they become internationally more prominent. In this study we tried to uncover the mechanisms that may be responsible for this unexpected outcome.

The decisions and strategies of Dutch deans are influenced by many factors. New innovation and university policies are among them, but certainly not the only ones. Especially the circumstances of their faculty with respect to funding sources, attractiveness for national or international students, opportunities for specific areas in which they have expertise and the internal dynamics of the faculty influence the organizational response to new policies. Since most of these circumstances differ between faculties, the response to new policies differs as well. In addition, teaching needs, contractual obligations and agreements make some changes that may be desirable from one perspective (for instance research profile) less desirable from another (e.g. teaching needs). Deans need to find a balance between the functions of their faculty in terms of research, teaching, funding and knowledge transfer that is optimal to the circumstances of their faculty. This may mean that in some cases groups that get a lot of external funding are stimulated with extra financial support and possibilities and in others their external funding helps to fund groups that have many students or an important function in society, but are less successful in fund raising. These types of choices on lower organizational levels in universities are often needed to keep the system going, but are also interfering with policy aims.

Policy makers should therefore consider whether adding a new policy instrument with different aims to all other incentives that are already in place is an effective way to achieve their goals.

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MEASURING THE KNOWLEDGE FLOW BETWEEN SCIENCE AND PUBLIC: MASS MEDIAS' ROLE IN INNOVATION SYSTEMS

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Keywords: Foresight; Innovation System; Mass Media; Text Mining; News Reporting; Innovation Diffusion; Public Discourse

General Submission Track: *Evaluation and measuring knowledge and innovation*

EXTENDED ABSTRACT

Insights into innovation systems and their dynamics and architecture are most relevant for future planning activities due to the close relation of foresight, policy planning and innovation system performance. Possible contributions of foresight are adapting and reorienting the innovation system or strengthening its links. Therefore, a profound analysis of current (technical) developments and their spread and societal acceptance are most central.

While it is commonly agreed that innovation needs to be viewed as a systemic process, the society as such or mass media as a distribution channel are not explicit elements of the prominent definitions of innovation systems. This article introduces a new approach to measure innovation discourses based on textual data, and a framework based on Python and SQL is developed. This framework uses scientific publications and newspaper articles (texts are edited, validated and of similar quality as scientific publications) to emphasize the link between science and society. To examine and monitor science performance, publication analysis is frequently used. However, it is not only relevant what happens in science and which developments take place. Most important is especially which issues pass their way out of science to other areas of the innovation system. Here, mass media (respectively news articles) is an important channel contributing to the public opinion by its functions for society. These functions are for example informing society, a critique and control function, and that it to a certain degree mirrors and reflects the public discourse. Media also has an influence on innovations and new developments by reporting or not with an intention and its accepted meaning in the spread of innovations (Rogers, 1995). Currently, there is no related work on the comparison of news articles and scientific publications, only of theoretical nature.

Applications applying text mining on newspapers are also rare because in most cases discourse analysis is still used.

Hence, the objectives of this work are (1) to adapt the innovation system model and integrate mass media in its intermediary role and the society as an overall framework and (2) to develop an (technical) approach that measures the knowledge flow between science and media. Therefore, it is first discussed which role media plays in innovation discourses based on the work of Waldherr (2012). In her work, she considers media in its central role as intermediary between the actors of the innovation system (politics, economy, science) and interprets the society as overall framework.

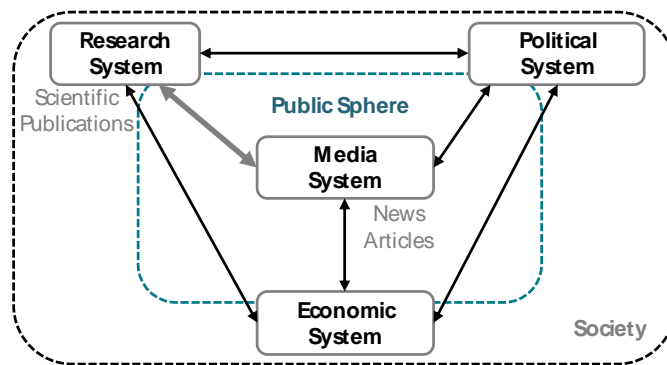


Figure 1: Adaptation of the Innovation System (Waldherr, 2012)

This model is on a very high aggregation level but nevertheless illustrates the interplay of the key actors very well. With reference to the work of Hekkert et al. (2007), Waldherr (2012) describes how the functions of innovation systems are improved by the media. This will also guide the methodological part of this work where a focus is set on the link between science and media. A framework to measure and compare science and societal discourse is developed. This framework is based on text- and data mining methods (Bird et al., 2009; Manning et al., 2009) with regard to the functions of innovation systems (Hekkert et al., 2007). This enables a structured comparison of both data sets on the one hand and the opinion on certain issues on the other hand (opinion mining on news articles). In contrast to the previous work, not only scientific publication data but also news articles are examined. So for example for the “knowledge diffusion” media is seen as a channel between science and society. The diffusion is examined using a SQL-framework that automatically compares and maps the content of both data sets in form of retrieved phrases. For examining the “creation of legitimacy”, the media is seen as a platform, and opinion mining is applied on the news articles to infer possible influences on public opinion and discourse. Finally, several case studies for different technologies, for example cloud computing, are conducted to assess the approach. In summary, the results show that the analysis delivers valuable input on which issues are only discussed in one data set and which interrelation is noticeable. However, this work also shows the

limits of text mining: Text analysis cannot replace reading but gives a first overview, and data cannot speak for themselves but further skills and expertise are mandatory.

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CHALLENGES OF THE EUROPEAN RESEARCH AREA IN SHIFTING TOWARDS LONG-TERM TRANSFORMATIVE SCIENCE, TECHNOLOGY AND INNOVATION STRATEGY

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Keywords: Science; technology and innovation policies; Multi-Level Perspective; Multi-regime; Scenarios; Foresight

EXTENDED ABSTRACT

Introduction

The framework of Multi-Level Perspective (MLP, Geels 2002) is increasingly popular in science, technology and innovation (STI) policy studies seeking innovative and sustainable solutions to grand socio-economic challenges. The MLP framework is used in analysing such transformation pathways in which niche innovations, driven also by STI and related policies, may transform old socio-technical regimes to new ones over the long time horizon. To be successful such long-term regime transformations set essential new requirements (1) to the analysis itself due to complex governance and management of multi-level and multi-disciplinary dimensions of systems, (2) to interdisciplinary horizontal STI activities crossing relevant policy-making areas, and (3) to related ex-ante and ex-post assessment of (additional) impacts of STI policies (to private action).

Weber and Rohracher (2012) analyse how MLP and transformation approaches change the policy rationale compared to the rationale of traditional STI policy orienting only to economic growth objectives. This article builds on this analysis and considers potential benefits of MLP and transformation approaches in the context of a less examined topic, i.e. on the level of the European Research Area (ERA). The ERA faces remarkable challenges in the future, such as the integration of fragmented STI communities in order to avoid duplication of research and turn scientific excellence into innovative solutions in global markets supporting STI based European competitiveness.

Among the arising research questions of this article are how to support the formation of long-term transformative STI strategy for ERA with high impact on EU's and Member States' policy actions and governance; what are the most efficient and effective types of governance in reducing or eliminating fragmentation of programmes between Member States and between the EU and Member States; how to balance STI investments and research collaboration between the EU and Member States level in order to attain high impact of STI on policies and of policies to consequent sustainable solutions; which qualitative and quantitative indicators best depict the shift from current fragmented European STI towards targeted

integrated STI, and, besides indicators, which other elements should be included in ex-ante and ex-post impact assessment procedures?

The scope and diversity of STI activities are extensive and it is challenging to cover all of these in one study and, accordingly, this article has a more confined focus. The European Commission accepted in 2013 the EU FP7 project RECREATE¹ the focus of which is in the three priority areas of Horizon 2020, i.e. climate change, raw materials and resource efficiency. As all the authors of the article participate in RECREATE project, the article uses this on-going project as case material in the analysis of research challenges referred above, in addition to the experiences of the authors from several other past and on-going studies applying the MLP framework.

Case study and methodology

Among the aims of the RECREATE project is to overcome the fragmentation by creating and implementing an inclusive research agenda for the Horizon 2020 priority areas of climate change, raw materials and resource efficiency. The RECREATE project (1) analyses the support of research and technological development (RTD) for such transition management strategy and processes, and (2) examines trade-offs and integration of research communities and STI programs between the three H2020 priority areas mentioned above, and (3) engages key stakeholders in a proactive manner into the implementation of this proactive strategy. The time horizon of the RECREATE project is beyond the year 2020. Among the tasks of the RECREATE project are the collection and analysis of strategic information about medium and long term research and innovation trends and prospects, and a forward looking analysis in the three focus areas. These tasks result in trend analysis reports and three scenarios until year 2050.

The article analyses the challenges of STI and related policies in contributing to innovative and sustainable transformations of socio-technical regimes by exploring how far empirical studies consist of elements of transformative STI policy approach, as suggested by Wieczorek and Hekkert (2012) and Weber and Rohracher (2012). The article applies the multi-regime approach (Raven & Verbong 2007) in drafting synergies and interactions of current regimes tackling with both STI and relevant other “horizontal” policies in the areas of resource efficiency, climate action and raw materials. These synergies and interactions are captured in the three scenarios drafted in the RECREATE project.

Preliminary results

The creation of the RECREATE draft scenarios has been of exploratory nature, starting from the present and moving ahead to the future on the basis of past path dependent trends, expert views of the author team, stocktaking of existing policy initiatives in the Member States, and brain storming. In other words methods from all quadrants of the “Foresight Diamond” (Popper, 2008) have been used. Implicitly the

¹ REsearch network for forward looking activities and assessment of research and innovation prospects in the fields of Climate, Research Efficiency and raw mATERials. <http://www.recreate-net.eu>

scenarios incorporate also transformation paths and stages of scenarios from 2014 till 2050. The scenarios build on alternative speculative hypotheses of factors and tensions affecting the transition of national STI systems of EU Member States in interaction with the European and global STI systems. Examples of factors that are considered when drafting the scenarios include the key actors in ERA, the nature of research (multi-, inter- or transdisciplinary), the sources of research and innovation funding, sources and strategy for competitiveness and the emphasis on the synergies between the three focus areas of RECREATE. Initial scenario drafts have been made on a basis of existing trends and views, but the work is still on-going and will include refining the draft scenarios with stakeholders.

One way to refine the scenarios further and ensure their relevance to STI policy is to explicitly examine the strengths, weaknesses, opportunities and threats of the draft scenarios vis-à-vis following four dimensions, (1) societal challenges (economics, resources), (2) industry and business development, (3) research, development and innovations, and (4) innovation policy. The scenarios are based on transformative long-term view and a multi-regime context. The four dimensions support the refining of the scenarios, the assessment of their relevance to policy and the formation of policy recommendations. The policy recommendation could be related to strategies around challenge-driven research, for example by assessing its robustness in different future development pathways, or they could give guidelines to patent policy by taking into account the trends around e.g. open science, just to give two examples.

Conclusions

The article considers issues with potential contribution to transformative long-term strategies of the European Research Area. Among the challenges of STI activities are

- the reduction of duplication of STI efforts and the related intensification and integration of STI communities and research programs on the Member States and European levels,
- the improvement of effectiveness and impacts of policies, and
- in terms of MLP and transition management the identification of synergies between regimes and support for the emergence of new regimes.

In addition there is a need to go beyond political and generational cycles in long-term STI driven strategies of searching for solutions to grand challenges, or in the case of this article, to more sustainable future developments in the three priority areas of Horizon 2020, climate change, raw materials and resource efficiency. The article is aimed to contribute to preconditions to long-term transformative STI strategy.

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A SYSTEM DYNAMIC AND MULTI-CRITERIA PERSPECTIVES IN EVALUATION OF INNOVATIONS

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Keywords: Multi-criteria evaluation; system dynamic modelling; methodology development; innovation; service innovation; system innovation

EXTENDED ABSTRACT

Systematic evaluation is an activity that has been an essential part of strategic thinking for decades. It has been linked both to the general development of organizations and to more specific functions. It has played a particularly important role in the context of innovation and R&D. In public interventions – often carried out in the form of policy programs – evaluation has been an embedded practice whose purpose has been to support decision making (Rip, 2003). Since the early days of evaluation, impact assessment has been a typical way to implement evaluation, which has meant that evaluation has been understood in terms of performance-related steering and monitoring (Chelimsky, 1997; Rip, 2003). The primary idea has been to produce indicator based information to prove accountability and to legitimate the role and existence of individual organizations and policy instruments.

This kind of an approach to evaluation includes several problems. First, it is backward looking and does not work well as a guiding instrument in the current society that is characterized by rapid changes (Todd & Wolpin, 2010; Weijermars & Wesemann, 2013). Second, the approach is “atomistic”: it focuses on individual organizations or policies and overlooks the fact that impacts are co-produced by several actors and emerge in a broader context (Rip, 2003). Third, the indicator based assessment simplifies phenomena that emerge in cyclic, complex and long-term processes. Indicators assume a simple causal relationship between intervention and impacts, which is incompatible with the modern view about the emergence of innovations (e.g. Hansson, 2006; Van der Knaap, 2006). Summarizing, the linear input-output-outcome -thinking included in the traditional evaluation does not correspond to the complex development processes and the multiple relationships between the contributing actors (Arnold, 2004; Patton, 2011).

Recently, the increasing “servitization” of society has put pressure to develop a more advanced approach to evaluation. Here, an additional problem linked to the traditional impact assessment has become apparent: the indicators have been one-sidedly technologically focused (Toivonen, 2010; Rubalcaba et al., 2013). These kinds of indicators do not capture the immaterial and interactive aspects that are central characteristics of services. Today services are also increasingly forming systemic wholes – especially the most urgent problems in the present society cannot be solved via the development of individual services or technologies. Conversely, these challenges require various innovations and simultaneous development of

organisations, technologies, services and multiple network relationships (Windrum & Garcia-Goñi 2008, Harrison et al. 2019). The current evaluation methods are unable to tackle the challenge of the systemic nature of innovation (Smith, 2000; Edqvist, 2005; Ahrweiler, 2010).

Even though we are looking the challenges of evaluation through the lenses of “servitization of society”, the arguments are strongly rooted in general innovation theories basing on the Schumpeter’s definition of innovation that has afterwards been regenerated to “the neo-Schumpeterian” theory of innovation or “the broad view of innovation” (Lundvall, 2007). These traditions are interlinked by several common aspects that affect both the definition of innovations and evaluation of their effects and impacts. Important cornerstones are complexity and uncertainty of innovation process, intangible nature of innovation and systemic view of innovation encompassing multiple sources and actors taking part into the innovation process. (Kline & Rosenberg 1986, Dosi 1988, Lundvall 1992, Freeman 1991, Nelson & Rosenberg 1993).

Also from the perspective of general innovation literature conclusion has been parallel: current practices in defining innovation and evaluating them do still follow the mainstream linear innovation thinking which simplifies too much the innovation process as well as the complex dynamics between actors contributing innovation (e.g. Arnold 2004, Patton 2011). In particular, the measurement and indicators of innovation and performance are still largely based on the industrialist and technologist definitions (e.g. Smith, 2000; Edqvist, 2005; Smits & Kuhlmann 2004, Djellal & Gallouj 2010, 2013). Thus, it does not take into account the systemic view of innovation (e.g. Smith 2000, Edqvist 2005; Ahrweiler 2010) and does not capture the multifaceted and diversified performance of innovations (e.g. dealing with societal issues such as health, education, sustainable development) (see e.g. Freeman & Soete 2009). In addition to the narrow view on innovation, the dominating view on performance is also mechanical and narrow. It is usually linked to the concept of productivity which refers to the linear and mechanistic input-output function (e.g. Djellal and Gallouj, 2010, 2013, Kellogg foundation 2004, Patton 2011). Its’ traditional definition is unable to recognize the “hidden performance” concerning the societal aspects of services and innovations like equality, ecological sustainability and societal well-being. It also often excludes the aspect of social innovation. (e.g. Rubalcaba et al., 2012)

As an answer to these problems, researchers have suggested a more versatile view: “plurality of methods” (Dyehouse et al., 2009; Williams & Imam, 2007). Systems thinking have often been applied hand in hand with this view. It means highlighting interrelationships and feedbacks between the whole, its parts and the environment they are interacting with (Cabrera et al., 2008, Sterman 2000).

This paper aims to contribute to the above described need for a more diverse evaluation approach and to sketch a new type of dynamic multi-criteria evaluation approach for the evaluation of systemic innovations. Suggested approach integrates the multi-criteria perspective (Djellal & Gallouj 2010, 2013) of innovation and system dynamic modelling (Sterman 2000). In the methodology multi-criteria perspective describes the various impacts by giving insight to different societal spheres and their principles and values (Gadrey 2005; Djellal & Gallouj 2010, 2013). In the model the outcomes are evaluated from the perspective of different goals encompassing both the traditional measures and the modern evaluation criteria taking into account the needs of knowledge society. In addition to the different target areas the model takes into account

the long time-scale in the generation of impacts by dividing outcomes into the direct, short-term outputs and indirect, long term-outcomes (or impacts). The table 1 below illustrates the different worlds given the specific justification criteria related to the each of the worlds (Gallouj 2002; Djellal & Gallouj, 2013).

Table 1 Multi-criteria framework to analyse innovations (modified from Djellal & Gallouj 2010, 2013)

Worlds	Industrial and technical world	Market and financial world	Relational and domestic word	Responsible word	Reputational world
Output (direct, short term) <i>Performance related</i>	Volumes, flows and technical operations	Value and monetary and financial transactions	Interpersonal and organizational relations, trust, quality of relationship	Values like sustainable development, responsibility, equal treatment, fairness and justice	Brand, image
Outcome (indirect, long term) <i>Performance related</i>					

Analysing the impacts from the perspective of different worlds makes visible the multifaceted nature of innovations. However, analytical table remains static and does not increase understanding of their dynamic and complex nature. It does not show how the different impact criteria are mutually interlinked and may reinforce or contradict each other. This perspective in our framework is considered with the system dynamic modelling, which pays attention to the interaction of various actors and their values in the evaluation situation (cf. Giddens 1987) and provides information how the system structure creates complex dynamic behaviour over time (Sterman 2000). System dynamics (e.g. Sterman 2001) is a methodology that focuses on the underlying feedback structure of a system. It incorporates causal connections between system elements that can be mapped using causal loop diagrams. Furthermore, it helps to explain the role of feedback loops between different actors and factors that promote or hinder the emergence of impacts.

The focus in the new methodology is in understanding the dynamics of innovation creation and the use of new type of evaluation methods to indicate the impacts of innovations. At a more detailed level, our study provides analytical material about the complementarities and contradictions between different actors and indicators in innovation development.

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EVALUATING LONG-TERM TRANSITIONS ON A SHORT-TERM BASIS: TOWARDS AN EVALUATION TOOL

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EXTENDED ABSTRACT

Although the body of literature on transitions has expanded rapidly throughout the last few years, research on the evaluation of transition processes is still scarce. One possible explanation is the inherent long-term nature of transition processes, which increases the complexity of the evaluation (e.g. Ros et al., 2006 or Mazur, 2015). However, as the stimulated niches and adjacent policy actions are undertaken on a short-term basis, and often in the context of short-term policy cycles, an increasing need for evaluation can be observed. The question thus arises how long-term transition processes can be evaluated on a short-term basis, and how learning and evaluation moments can contribute to the transition process as a whole. In order to do so, a focus on niches is needed, which will be done by combining both literature on the multi-level perspective (e.g. Geels, 2002) (which focusses on niches (micro-level), the regime (meso-level) and landscape (macro-level) developments), as well as literature on strategic niche management, which aims at nurturing niches to enhance systemic innovation and destabilize the existing regime (e.g. Markard et al., 2012).

In 2014, Creten et al. made a first attempt towards evaluating transitions, by providing a literature review which combined transitions theory and evaluation theory, which led to a first attempt towards an evaluation instrument (Creten et al., 2014). The instrument mainly focused at three possible problems: first, the possibility of an application deficit, where the transitions literature was not properly applied. Secondly, an implementation deficit can occur, where wrong policy instruments were chosen to foster the transition program (ibid). Finally, a policy theory failure could occur, where the transition theory itself is at fault (Creten et al., 2014). The instrument makes a distinction between different phases. These phases can be distinguished as the development of a long-term vision, the set-up of a transition arena, the development and nurturing of niches, the implementation of policy instruments, the possibility of decreasing regime resistance and the causality between the program and the intended outcomes (Creten et al., 2014), thus looking at many different aspects of the transition process. However, this theoretical instrument needs

adequate testing in order to make it usable in practice, and fit for use by non-academic transition managers and other actors in transition processes.

In this paper, we apply the existing evaluation tool to two case studies, which are part of the Flanders in Action program (Vlaamse Overheid, 2012a). As that program has a particular focus on nurturing niches, we take these niches as the starting point for our research, by looking at their implementation and expected outcomes. In the paper we address the role of governmental actors in these transition processes, the risk of regime reinforcement (e.g. Geels and Schot, 2007), the set-up of learning moments, and the possible causal relationship between the actions undertaken in the transitions program and their outcomes (based on Gysen et al., 2006). The study is executed by performing action research and in-depth interviews with relevant stakeholders.

The first case study concerns the transition towards “smart mobility” (Vlaamse Overheid, 2012b). Within this transition program, which is strongly supported by the Flemish government, multiple niches have been set up. We first look at the development of a “mobility budget” (Vlaamse Overheid, 2012c), which aims at providing employees a budget for their transportation, rather than a company car. Secondly, we look at the set-up of infrastructure for electrical cars, which aims at providing recharging stations and adjacent facilities in order to foster the use of electric cars (Vlaamse Overheid, 2012d). After this first case study on mobility, we make an analysis of the benefits and drawbacks of the evaluation tool, and we update the tool for our second case study. This second case study looks at the transformation process towards sustainable agriculture, in which the governmental actors play a smaller role (Transformatieproject, 2014). This program encompasses five niches (e.g. on the valorization of corn-waste to pig feed (ibid), which are the starting point for the study.

The expected outcomes of the study, to be presented at the conference, are threefold. First of all, the study makes a short-term evaluation of the two above-mentioned transition processes, taking into account the three possible problems identified by Creten et al. (2014). Secondly, the results of the first phase study will lead to an updated tool and manual with specific evaluation questions, which will be ready to use by policy-makers and transition managers. The tool is thus expected to have a significant impact on the perception of transitions governance by policy makers, and aims to streamline ongoing transition processes. Finally, the paper is expected to contribute to both the transition literature and the evaluation literature, by providing a critical reflection of the theory-practice dilemma. We believe that the results of the study are relevant to the general conference theme and general submission track. As our study combines transitions theory and evaluation theory, and aims to make an evaluation tool which is usable by non-academics as well, we align ourselves with the requested “Evaluation and measuring knowledge and innovation”.

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THE TOWER OF BABYLON IN THE CIVIL SERVICE: FORESIGHT AS A METHOD OF COORDINATION

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Keywords: innovation policy, multi-level governance of innovation, co-ordination, foresight, grand societal challenges

EXTENDED ABSTRACT

With numbers of governmental but also non-governmental organisations taking part in the governance of society increasing, the coordination of diverse sets of organisations becomes ever more important. A large number of measures has been tried for enhancing government coordination (Peters 1998; Verhoest et al 2007; Lindner 2012; Biegelbauer 2013) for both the policy and administrative levels.

Problems, however, are persistent in many cases. Indeed the coordination of organisations featuring differing functions and goals is complicated to begin with, since organisations draw their legitimation from serving these respective goals which may or may not be congruent with the goals of other involved organisations. Complications furthermore stem from the fact that organisations are varying with respect to norms, values, cultures, clientele and practices developed to navigate the daily tasks specific to each organisation. The uniqueness of this set of variables characteristic for an organisation is an important reason for the failure of inter-organisational communication, cooperation and coordination.

In the face of all the complications arising from coordination measures and the frequent failings of “quick fixes” and “one size fits all” solutions, we want to put on display an interesting case of government coordination. In this case a complex set of preconditions in a crosscutting policy field made the development of an advanced set of tools sensible in order to create preconditions necessary for an intergovernmental group to go ahead with its difficult coordination tasks. We want to show that there is hope for coordination efforts even under adverse circumstances, when certain conditions are met. We want to discuss what in our understanding these conditions are and how most of these were met in the case study.

The case we are analysing is part of the RTI-Strategy of the Austrian Federal Government, which after the production of the actual document in 2011 has resulted in a number of working groups, one of which has focused on the issues of quality of life and demographic change (BKA, BMF, et al. 2011). The two topics the interministerial working group has to tackle are part of the grand challenges formulated by the European Commission and are rather broad areas, which are not located next to each other. The working group had a hard time to formulate a common position on the goal of the group, which was a result of the broadness and general perspective of its goals, the effect that it consisted of five ministries with a diverse set of tasks and was provided with no additional resources for coordination.

In order to speed up the process, two years into the life of the working group one of the ministries decided to finance a pilot study on a subset of the issues the working group was to address. The study had specific goals for both the financing ministry and the working group. The authors have been part of the team providing the working group with study and accompanying process. We therefore draw our knowledge of the case from our engagement with the civil servants over the year of 2014, which was the duration of the project.

The key objectives were to contribute to the setting up the foundations for a research and innovation policy roadmap for the future development of mobility research and innovation which a) tackles the grand societal challenge of demographic change, and b) incorporates an emphasis on quality of life in all its actions.

In the following we highlight the critical conditions and respective key success factors that helped to shape the results of the process.

Creation of common understanding

While the rationale for setting up the working group dealing with “demographic change and quality of life” was rooted in the Austrian RTI strategy, the concrete objectives of the working group were only vaguely defined. It was not clear on which policy fields such a strategy should focus and which measures it should emphasize. In particular, the working group did not reach agreement concerning working definitions for “quality of life” and “demographic change” and whether “quality of life” or “demographic change” should be the focal point of action for the working group.

It was necessary to assist the working group in structuring the discussion. By means of a literature survey the concepts and interdependencies of quality of life, demographic change and mobility were analysed. It proved to be necessary to first inform the working group concerning the multi-dimensional aspects of quality of life and the underlying academic debate. The fact that quality of life is structured and interpreted in life domains / life contexts (cf. Kerce 1992) and recent research efforts trying to operationalise and measure quality of life at European and international level helped to form a common understanding on relevant issues (OECD 2013).

Based upon the information provided, the working group was able to grasp the complexity of the two domains. A common ground for discussion and for structuring subsequent actions of the working group was achieved. While “quality of life” was seen as the overarching objective of policy interventions, “demographic change” was interpreted as dominant factor that will have an impact on a number of life contexts to which policies have to respond to.

Development of an analytical model that structures the problem analysis

A second task of the study team was to devise an analytical model that allowed structuring the policy planning progress. Our model distinguished between four life contexts or areas of actions that comprised the main (social) determinants of quality of life within the mobility sector, and functional classifications of research and innovation policy instruments in the area of mobility. By integrating determinants of quality of

life (i.e. life contexts) into the analytical model, it was possible to incorporate the overarching quality of life aspect into the policy analysis and to structure the future oriented stakeholder process, in which we identified main drivers and trends concerning the relevant life contexts/areas of actions and put forward strategic policy objectives.

Incorporation of a forward looking approach - provision of a learning arena and prioritisation of actions

For structuring the policy making process a participative foresight process was implemented. The participative foresight process was organised in two stakeholder forums: a “visioning forum” and a “roadmapping forum”.

Forum 1 identified main societal, technological, economic, environmental and political drivers in each life context and developed a positive vision for each life context for the year 2035. In a second step, the vision was contrasted with an analysis of existing policy measures in order to classify and identify gaps in the policy landscape and prioritize demand.

Forum 2 put forward a summary on five cross-cutting domains (themes reflecting specific demand) and provided suggestions for possible inter-ministerial actions (policies/instruments) based upon the results of Forum 1 and additional interviews with relevant stakeholder groups. The workshop participants validated results for each cross-cutting issue and provided research questions within each domain.

Based upon the results of Forum 1 and Forum 2, the study team was able to elaborate the concrete demand in each domain, formulate specific objectives and identify relevant research policy measures together with the working group.

Conclusions

The study team has helped to create conditions, which would allow for a more successful coordination effort than has been possible before. The concrete approach was chosen for several reasons. As demographic change is a grand societal challenge which can only be resolved by means of technological, economical and societal transformations, knowledge needed to be gathered from numerous societal actors, with distinct knowledge in certain domains. Embedding the policy design process for formulating a research and innovation strategy in this field, helped to identify common ground for action in a complex field, in which neither obvious objectives nor measures existed, but options for coordinated future actions just had to be elaborated.

Embedding the policy making process into an analytical study including a participative foresight process proved to be helpful for various means. Firstly, it allowed policy makers to directly engage with relevant stakeholders. Secondly, the process provided direct feedback concerning the relevance and appropriateness of the policy analysis conducted in the study. Thirdly, it also provided a room for prioritization of actions that went beyond actions of single ministries.

The results of the study were welcomed by the interministerial working group, which now has a more sound basis for its work regarding the definition of key terms, its main goals and a set of policy suggestions targeting one of its policy areas. Future will tell if these building blocks will suffice to successfully

coordinate the activities of several ministries. Yet regardless if this will be the case or not, the one year process has led to a communication between working group members regarding their *raison d'être* and the way forward, which by itself is already a nontrivial coordination task.

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WHAT IS AN EMERGING TECHNOLOGY?

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EXTENDED ABSTRACT

Introduction

Emerging technologies are perceived as new technologies with the potential to change the economy and society. For this reason, these technologies have been the subject of much debate in academic research and also a central topic in policy discussions. Evidence of the increasing attention being paid to the phenomenon of emerging technologies can be found in the growing number of publications dealing with the topic and news articles mentioning emerging technologies, as depicted in Figure 1.

Nonetheless, no consensus has emerged as to what qualifies a technology to be emergent. Definitions proposed by a number of studies overlap, but also point to different characteristics. For example, certain definitions emphasise the potential impact emerging technologies are capable of exerting on society (e.g. Porter et al., 2002), while others give great importance to the characteristics of uncertainty (e.g. Boon and Moors 2008) or novelty and growth (e.g. Small et al., 2014). This also extends to the wide variety of methodological approaches that have been developed, especially by the scientometric community, for the detection and analysis of technological emergence (e.g. Small et al. 2014; Glänzel and Thijs 2012). These methods build on relatively loose definitions of emerging technologies or often no definition at all is provided. Approaches to the detection and analysis of emergence tend to greatly differ even with the use of the same or similar methods.

We aim to address these shortcomings. To do so, we attempt first to integrate different conceptual and methodological contributions on the topic in a precise and coherent definition of ‘emerging technology’. Second, we develop a framework for the operationalisation of emerging technologies by reviewing scientometric methods for the detection and analysis of emergence in science and technology.

Defining emerging technologies

The definition of “emerge” or “emergent” refers to “the process of coming into being, or of becoming important and prominent” (New Oxford American Dictionary) or “to rise up or come forth [...] to become evident [...] to come into existence” (The American Heritage Desk Dictionary and Thesaurus). The primary attribute of emergence is “becoming” – that is, coming into existence. Emergent is not a static property; it is

a label for a process. The endpoint of the process is variously described as visible, evident, important or prominent. There is a second definition of emergent given by The New Oxford American Dictionary as: a property arising as an effect of complex causes and not analysable simply as the sum of their effects. This concept of emergence is used in the study of complex systems, where “emergence” has been subject of much debate. Though research on complex systems may have a certain cachet, we would argue that in the phrase ‘emerging technology’, ‘emerging’ is generally understood in the standard sense, not the complex system usage.

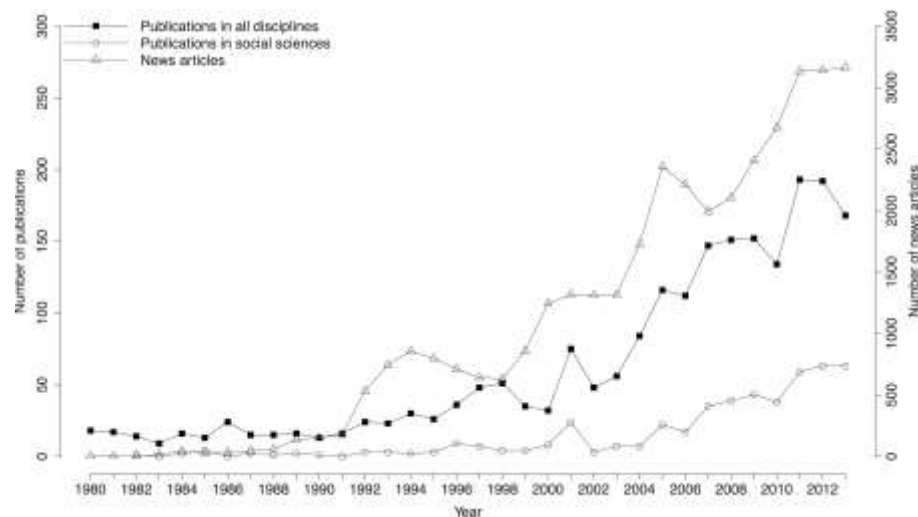


Figure 1: Publications (left axis) and news articles (right axis) including the variations of the terms “emerging technologies” as reported in SCOPUS and FACTIVA, respectively.¹

To further clarify what is meant by emerging technology, we reviewed literature in innovation studies dealing with definitional issues of emerging technologies. To identify relevant studies, we searched for “*emerg* technolog**”, “*tech* emergence*”, “*emergence of* technolog**”, or “*emerg* scien* technol**” in publication titles by querying SCOPUS. The search returned 501 publications within social science domains (see Figure 1). This enabled us to identify a core set of twelve studies that contributed to the conceptualisation of technical emergence (see Table 1). The proposed definitions identified a number of features of emerging technologies that we summarised in terms of five attributes.

First, emerging technologies are radically novel. They are characterised by “novelty (or newness)” (Small et al., 2014). The novelty may appear either in the method or the function of the technology. To achieve a new or a changed purpose/function, emerging technologies build on basic principles that are different from the ones used before (Arthur 2007) (e.g. cars with an internal combustion engine vs. an electric engine). Novelty may also be generated by putting an existing technology to a new use. Evolutionary

¹ Publications were retrieved by querying SCOPUS data with the following search string: “TITLE(“*emerg* technolog**”) OR TITLE(“*emergence of* technolog**”) OR TITLE(“*tech* emergence*”) OR TITLE(“*emerg* scien* technol**”)”. Publications in social sciences were defined as those assigned to the SCOPUS categories “Business, Management and Accounting”, “Decision Sciences”, “Economics, Econometrics and Finance”, “Multidisciplinary”, “Psychology”, “Social Sciences”. News articles were identified by searching for “*emerg* near2 technolog**” in article headlines and lead paragraphs as reported in FACTIVA.

theory views as the ‘speciation’ process of technology (Adner and Levinthal 2002). From the perspective of developing a definition of emerging technologies, it is therefore important to contextualise radical novelty in relation to the domain(s) in which the technology is arising.

Table 1. Definitions of emerging technologies (studies are chronologically ordered).

Study	Definition (elaborated or adopted)
Martin (1995)	“A ‘generic emerging technology’ is defined [...] as a technology the exploitation of which will yield benefits for a wide range of sectors of the economy and/or society” (p. 165)
Day and Schoemaker (2000)	“emerging technologies as science-based innovation that have the potential to create a new industry or transform an existing ones. They include discontinuous innovations derived from radical innovations [...] as well as more evolutionary technologies formed by the convergence of previously separate research streams” (p. 30)
Porter et al. (2002)	“Emerging technologies are defined here as those that could exert much enhanced economic influence in the coming (roughly) 15-year horizon.” (p. 189)
Corrocher et al. (2003)	“The emergence of a new technology is conceptualised [...] as an evolutionary process of technical, institutional and social change, which occurs simultaneously at three levels: the level of individual firms or research laboratories, the level of social and institutional context, and the level of the nature and evolution of knowledge and the related technological regime.” (p. 4)
Hung and Chu (2006)	“Emerging technologies are the core technologies, which have not yet demonstrated potential for changing the basis of competition” (p. 104)
Boon and Moors (2008)	“Emerging technologies are technologies in an early phase of development. This implies that several aspects, such as the characteristics of the technology and its context of use or the configuration of the actor network and their related roles are still uncertain and non-specific” (p. 1915)
Srinivasan (2008)	“I conceptualize emerging technologies in terms of three broad sub-heads: their sources (where do emerging technologies come from?), their characteristics (what defines emerging technologies?) and their effects (what are the effects of emerging technologies on firms’ strategies and outcomes?).” (p. 634)
Cozzens et al. (2010)	“Emerging technology — a technology that shows high potential but hasn’t demonstrated its value or settled down into any kind of consensus.” (p. 364) “The concepts reflected in the definitions of emerging technologies, however, can be summarised four-fold as follows: (1) fast recent growth; (2) in the process of transition and/or change; (3) market or economic potential that is not exploited fully yet; (4) increasingly science-based.” (p. 366)
Stahl (2011)	“[...] emerging technologies are defined as those technologies that have the potential to gain social relevance within the next 10 to 15 years. This means that they are currently at an early stage of their development process. At the same time, they have already moved beyond the purely conceptual stage. [...] Despite this, these emerging technologies are not yet clearly defined. Their exact forms, capabilities, constraints, and uses are still in flux” (p. 3-4)
Alexander et al. (2012)	“Technical emergence is the phase during which a concept or construct is adopted and iterated by [...] members of an expert community of practice, resulting in a fundamental change in (or significant extension of) human understanding or capability.” (p. 1289)
Halaweh (2013)	Characteristics of (IT) emerging technologies “are uncertainty, network effect, unseen social and ethical concerns, cost, limitation to particular countries, and a lack of investigation and research.” (p. 108)
Small et al. (2014)	“[...] there is nearly universal agreement on two properties associated with emergence — novelty (or newness) and growth.” (p. 2)

Second, emerging technologies tend to be characterised by a “fast clock speed” (Srinivasan 2008) or “fast growth” (Cozzens et al. 2010), or at least by “growth”(Small, Boyack, and Klavans 2014). As with the radical novelty attribute, the fast growth of a technology needs to be contextualised. A technology may grow rapidly in comparison with other technologies in the same domain(s), which may be growing at a slower pace. We therefore deemed it more suitable to refer to this feature in terms of ‘relatively fast growth’.

Third, emerging technologies exhibit a certain degree of coherence, and this coherence persists over time. The analysed definitions (perhaps implicitly and with different wording) describe this attribute in terms of “convergence of previously separated research streams”(Day and Schoemaker 2000), and technologies that “have already moved beyond the purely conceptual stage” (Stahl 2011). Alexander et al. (2012) point instead to the role of “an expert community of practice”, which adopts and iterates the concepts or constructs underlying the particular emerging technology.

Fourth, emerging technologies tend to be those that may “yield benefits for a wide range of sectors” (Martin 1995), “create new industry or transform existing ones” (Day and Schoemaker 2000), or “exert much enhanced economic influence” (Porter et al. 2002). Accordingly, we identify ‘prominent impact’ as another key attribute of emerging technologies. It is worth noting that most of the analysed definitions conceived the prominent impact of emerging technologies as exerted on the entire socio-economic system. However, this conceptualisation would inevitably exclude a range of other technologies that may still exert a prominent impact within specific domains without necessarily affecting the broader system. Such a perspective suggests, as with the attributes of radical novelty and relatively fast growth attributes, the importance of contextualising the prominent impact of the observed technology within the domain(s) from which the technology emerges.

Finally, the prominent impact of emerging technologies lies in the future. Thus, uncertainty features in the emergence process. Uncertainty is included, to a different degree and often not very explicitly, in half of the reviewed studies’ definitions, generally being expressed in terms of the ‘potential’ that emerging technologies have for changing the existing ‘ways of doing things’ (Day and Schoemaker 2000; e.g. Boon and Moors 2008; Hung and Chu 2006). Yet, none of these definitions explicitly consider another important aspect of emergence. This is ambiguity, which arises when the knowledge of possible outcomes of emergence is incomplete (Stirling 2007).

Building on the identified attributes, we define an emerging technology as *a radically novel and relatively fast growing technology characterised by a certain degree of coherence persisting over time and with the potential to exert a considerable impact on the socio-economic domain(s) which is observed in terms of the composition of actors, institutions and patterns of interactions among those, along with the associated knowledge production processes. Its most prominent impact, however, lies in the future and so in the emergence phase is still somewhat uncertain and ambiguous.*

A framework for the operationalisation of emergence

We identified relevant scientometric studies by adding to the initial search string the term ‘topic’ and extending the search to publication titles, abstracts and keywords. However, we focus on journals mainly or

to a significant extent oriented toward the publication of novel scientometric techniques. These are: Journal of the Association for Information Science & Technology (JASIST), Journal of Informetrics, Research Policy, Scientometrics, Technological Forecasting & Social Change, and Technology Analysis & Strategic Management. The search in SCOPUS returned 151 publications. We analysed this set of documents and focused on those publications dealing with the detection and analysis emergence. The final set of documents is composed of 55 publications.

Radical novelty

When data scarcity limits the application of scientometric techniques, documents such as news articles, editorials, review and perspective articles in professional as well as academic journals represent valuable sources to assess, in a timely manner, the extent to which a potentially emerging technology is radically novel as compared to existing technologies. On the premise that clusters of documents or words in these networks represent different knowledge areas of a domain or different literatures on which the domain builds, radical novelty can be assessed with citation and co-word analyses when longitudinal data are available. Radical novelty has been suggested to be associated with the appearance of new clusters that also link otherwise weakly connected clusters (e.g. Shibata et al., 2011), that cite more recent clusters (Morris et al., 2003), or that are new to the co-citation model as well as to the direct citation model (Small, Boyack, and Klavans 2014). Overlay mapping techniques add to the set of tools for the assessment of the radical novelty attribute (Rotolo et al., 2014).

Relatively fast growth

Most of the reviewed studies implicitly assume rapid growth as a *sine qua non* condition of emergence. Indicators and trend analyses based on the yearly or cumulative count of documents over a given observation period are widely used (e.g. Porter and Detampel 1995). Rapid growth is also detected by fitting the document count to a function (e.g. forms of logistic function) (e.g. Bengisu 2003).

Coherence

When data are relatively scarce because of the contemporaneity of the technologies examined, coherence may be detected by examining the scientific discourse around a given emerging technology. Signals of coherence may come from the creation of dedicated conference and journals (Leydesdorff et al. 1994). On the other hand, when data are relatively abundant and longitudinal, cohesion can be assessed on the basis of entropy measures (Watts and Porter 2003).

Prominent impact

For those cases of technologies for which retrospective analyses is limited by scarcity of data, scientometrics can only contribute to a very limited extent to the operationalisation of the characteristic of prominent impact. Mixed qualitative-quantitative approaches are required. In this regard, the extensive work conducted by science and technology studies (STS) scholars on the role of expectations in driving technological change

is of a particular relevance (Borup et al., 2006). News articles, editorials, review and perspective articles on professional and academic journals, vision reports and technological roadmaps have all been used to identify statements representing multiple and potentially competing expectations surrounding a given technology (e.g. Bakker et al., 2011). When publication and patent data are instead largely accessible for longitudinal analysis, the prominent impact of the particular technology under scrutiny can be analysed by using techniques that produce intelligence on the emergence process (e.g. Hicks et al., 1986).

Uncertainty and ambiguity

STS research approach can be also used to qualitatively assess the degree of uncertainty and ambiguity associated with an emerging technology (e.g. van Lente and Rip 1998). This approach can be possibly combined with more quantitative analysis when appropriate data are available (e.g. Gustafsson et al., 2015). The uncertainty and ambiguity attribute, however, remains largely unexplored in scientometric studies.

Discussion and conclusions

To reduce the likelihood of detecting false positives or missing patterns when examining emerging technologies, a coherent conceptualisation of what is an emerging technology is firstly required. In this regard, our paper provides an important contribution. Complementing the scientometric data-driven approach for the detection of emergence with a more qualitative investigation of technological emergence (e.g. with the STS approach) seems instead a particularly promising avenue for future research on the operationalisation of emerging technologies as well as to increase our understanding of this phenomenon.

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DEMAND-BASED POLICIES AND INNOVATIVENESS OF THE ECONOMIC SECTORS

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EXTENDED ABSTRACT

The role of demand in innovation processes is widely recognized in the literature, but how this knowledge can be applied to formulate appropriate basis for policy, is still not clear. The need for incorporating demand-side aspects into systemic innovation policy is discussed in the literature seeking to balance the dominant supply-side measures generally in Europe (Edler, Georghiou, 2007; Malas-Gallart, Davies, 2006), but also specifically in Central and Eastern European countries (Tiits et al. 2004).

In this article we discuss the different role of demand-side innovation policy measures relevant for economic sectors depending on the technological trajectories of the sector. We also attempt to evaluate empirically our propositions. We apply the definition of the demand-side innovation policies proposed by (Edler 2013), considering the public measures for increasing demand for innovation (readiness for innovation, capabilities to acquire and use innovations), determining new functional requirements for products and services, and incorporation of customers to the innovation process.

The barriers of entry for the innovations can be lowered by mediating lead-users knowledge (von Hippel, 1988, Lilien et al. 2002), relevant home buyer needs and focusing on the location of potential new markets geographically (Porter, 1990). In addition, the interaction of users and producers plays essential role in the innovation process itself (Lundvall, 1988) by reinforcing the relationship between demand and innovation with positive feedbacks (Kaldor, 1981; Arthur, 1990) and encouraging further innovation by directing the investments into invention and innovation activities (Schmookler, 1966). However, as Neij (2001) points out, the need for different demand-side policy measures is related to the maturity of the sector related to the technological trajectory of the industry under discussion.

We use the taxonomy of Pavitt (1984), which has been elaborated further for services by Castellaci (2009) and for SMEs by de Jong & Marsili (2006). These taxonomies distinguish four basic groups of industries according to the sources of technologies and knowledge and profit appropriability mechanisms.

1. Supplier-dominated industries (e.g. textiles, services), where new technologies are obtained from the suppliers by investing in new components, or equipment, and where technology transfer occurs mainly through learning by doing and learning by using (hence internal knowledge sources for innovation

dominate). Appropriability is weak in these sectors and in many times there the barrier for innovation is related to the price sensitivity of the consumers. Therefore the consumer awareness, demand articulation, direct subsidies for consumers to uptake the innovations, but also other education and training measures, additionally also standard-building measures for better compatibility of different innovations would be more relevant for these sectors.

2. Scale-intensive sectors (e.g. car and steel industry), where process innovation is crucial and both internal knowledge sources (R&D activities, learning by doing) and external sources (suppliers) are used. The appropriation mechanisms appear in the form of patents and trade secrets. As those are also sectors selling to the end-market consumer, similar demand side measures like in supplier-dominated sectors, but also bulk purchases on behalf of the government as an end user, and regulations for safety, environment would be relevant.

3. Specialised suppliers (equipment producers), where innovation processes concentrate on improving results, and reliability and consumer friendliness. The knowledge sources used are internal (experience-based, skilled technicians within the firms), but also external (user influences), and the appropriability stems mainly from the local and concentrated knowledge, but also from interactions. In the case of non-high-tech users having no formal R&D personnel, the innovation occurred mostly when the user received a large order of uniform products, then a creative person on the factory floor “*used an innate sense of engineering design and machine parts lying around the factory*” (Von Hippel, 1988) and sometimes it yielded innovation in terms of the process equipment that later filtered through to the manufacturers. Here the demand side innovation policy measures related to the public technology procurement, demonstration, information, but also cluster measures are relevant.

4. Science-based sectors (like pharmaceuticals, electronics etc.), where product and process innovations are rapid, the knowledge used is internal (R&D activities), but also external stemming from universities and research institutes and the appropriability mechanisms vary from patents and waiting times to different learning curves and trade secrets. Andersen (1992) differentiates between the production of mass products where interaction is not needed and new products where the interaction is crucial. When products are novel and more complex (which might require adaptations in use on the part of the customers) or the market is poorly defined, collaboration with users is essential to ensure market expansion. For supporting these sectors, R&D procurement, technology procurement, technology platforms, demonstration, in addition also common awareness and vision building are relevant.

Data and methodology

As our goal is to study, how the demand-side innovation policy measures are related to the innovativeness of the economic sectors, we use sector-level data from EUROSTAT (CIS) from 2008-2012. The dependent variable in all models is reflecting the innovativeness of the industry; therefore it is the share of innovative firms (having product, service and process innovations) in respective period. The independent indicators available are related to innovation inputs and processes (R&D investments, cooperation indicators, but also hampering factors), but also indicators related to the output (level of the innovativeness) in previous

periods. Public policy indicators are the public support existence for innovation, procurement-related indicators available in the latest survey covering the years 2010-2012. We have also incorporated the indicator expressing public regulation quality from Worldwide Governing Indicators (WGI). The models are also controlled for the country specific effects.

Preliminary results

By summarizing preliminary calculations, the factors supporting innovation (cooperation, sources of innovation etc.) are relevant as expected in the model for all sectors generally supporting earlier industry level empirical analyses. The results show that if innovation requiring public procurement is also positively related to the higher innovation activities in the sector and if public procurement didn't require innovation, it is related to the lower innovativeness of the industry in general.

By assessing the innovativeness of industries of the science based group, the results show as expected the role of R&D investments, cooperation with universities and investments for acquisition of the external knowledge playing innovation-enhancing role. From policy variables, better regulative quality plays positive important role. If public procurement was not requiring innovation, it was related to the lower innovativeness of the sector.

In case of scale intensive industries, the innovativeness in the past periods and supplier collaboration contribute to the innovativeness, but also several barriers (personnel, but also regulative barriers) play important role in hampering the innovativeness. In this model, the procurement related indicators are having no effects in or model.

In supplier dominated and specialised supplier industries earlier innovativeness, but also openness for cooperation is contributing to the innovativeness. As the models are having multicollinearity problem, we still have to work further to find robust results.

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ENTREPRENEURIAL SCIENTISTS AND THE GOVERNANCE OF PUBLIC RESEARCH: THE CASE STUDY OF CHINESE ACADEMY OF SCIENCES

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EXTENDED ABSTRACT

Research question

While the emergence of academic entrepreneurship received much attention from policy makers, it also presented challenges for the governance of public research organizations.

Driven by the Bayh-Dole Act (1980) in USA and similar legislative changes in other industrialized countries, more and more universities and public non-universities research organizations change their research agenda to include commercialization as one of their focus fields. Academic entrepreneurship activities are emphasized more than ever by innovation policy makers of industrialized countries viewing S&T as an increasingly important driving force of economic growth as their contribution to economy is increasingly important (Shane, 2004). Legislature changes and budget adjustments were adopted in those countries targeting to encourage and urge more scientists of public research organizations to undertake and various mechanisms such as technology transfer organizations, science parks, industrial liaison offices and incubators were set up to facilitate entrepreneurial activities (OECD, 2003; Guena,2001; Wright et al. 2007).

Public research organizations nowadays improve their governance structure to adapt to the research agenda change concerning their emphasis on knowledge creation, technology development and industrialization innovation. Naturally, with their dual targets of knowledge exploration and exploitation, R&D activities of the Pasteur Quadrant have generated impact upon the governance of public research organizations. The academic entrepreneurship activities too, with their triple targets of research, exploitation and commercialization, may bring about more conflicts within the public research organization.

Entrepreneurial scientists are the actor of the academic entrepreneurship who engages commercializing their academic research knowledge (Oliver,2004). It has been noticed that university scientists take a leading role in the commercialization process of their research knowledge (Etzkowitz,1983). They can be characterized and classified in terms of university-industry boundary, industry-linkage, motivations, awareness of commercialization and roles identification.

Entrepreneurial scientists often face conflicts between academic and entrepreneurial norms. In the entrepreneurial activities, their decision-making is influenced greatly by innovation policies and the

governance of their institutes. When a public research organization, especially one of those large ones which undertake various R&D activities from basic study to technology innovation and receive guide from government's policies more frequently, it is possible that their governance structure can affect the policy's effectiveness to promote industry-university cooperation and academic entrepreneurship. The main concern of the paper is to identify and explain the conflicts with the governance of their institute faced by entrepreneurial scientists in their R&D and commercialization activities that need to be regulated by science and technology policy and can be avoided by governance enhancement.

Methods

The paper applies the Institutional Analysis and Development (IAD) framework (Ostrom, et al. 1994) to synthesize the various works of "academic entrepreneurship" literature, integrate the China-special contexts and comprehend the complex situations. Based on the Rational Choice Theory, the framework constructs the policy action situation in which the entrepreneurial scientists it concerns inform themselves, consider alternative courses of action, make decisions, take action, and experience the consequences of these actions and which is influenced by physical conditions, community attributes and rules-in-use.

While the initiative purpose of the paper is to tackle the policy ineffectiveness with a special interest, the qualitative case study methodology is used. The consideration is that using inductive techniques to identify influential factors in a historical development process will be conducive to the analysis and understanding of the complex causes of the policy ineffectiveness. The paper is also an instrumental case study, selecting for intensive case study two of celebrity and with success experiences in transforming S&T achievements from the winners of the CAS's Beijing Branch Excellent Research and Technology Transfer Teams Selection for the consideration that the CAS's Beijing branch gathers the elite forces of its subordinate institutes, has obvious advantage in the research fields and its competence in promoting transformation and scale industrialization is the most outstanding all over the public research organization.

Data

Data from archives and interviews are used.

Archives data include four resources: (1) CAS almanacs and annual reports of the 2000-2013 period are reviewed and analyzed not only to find out the general trend of academic entrepreneurship activities and profiles of important spin-off companies of the public research organization but also lineate the policy action situation in a systematic manner within a historical context. (2) Data from relevant news and media reports of the same period providing important supplementary information that help understanding almanac statistics in a more meaningful way. (3) Annual working reports of the CAS Beijing Branch's TTO offer a general view of the growth of its academic entrepreneurship activities and the dynamic status of its important commercialization projects. (4) The appraisal and application files of the Beijing Branch Excellent Research and Technology Transfer Teams Selection provide details of those entrepreneurial scientists' planning to commercialize their research knowledge which are useful for valuing their decision-making capabilities and from which information about community attributes and physical conditions is also collected.

Important data about micro processes and infrastructures of academic entrepreneurship and relevant facilities and policy situations are gleaned from 13 interviewees in the case study. Five of them are from the academic entrepreneurial teams under study and eight are from TTO of the institutes they belonging and the Beijing Branch separately. The main issues of the interview for the former include but not limited to motivation for, attitude toward, and decision-making process of their academic entrepreneurial activities. For the latter, issues on underlying facilities and governance and policy of the institute and the superior level are the focus.

Results or expected results

The preliminary conclusion of the paper is that public research organizations like the Chinese Academy of Sciences whose research activities involve multiple innovation value chains face the challenge to form a positive feedback loop between industrialization and academic research at R&D project level and mutual tolerance mechanism between science culture and entrepreneur culture. It can be concluded that the policy ineffectiveness results from the conflicts among the multiple-level innovation governance.

Relevance to the conference theme

The paper suggest that conflicts between the national governance of science and the R&D management of public research organization and between science culture and entrepreneurship within the organization may restrain academic entrepreneurship activities which are important increasingly contributor to economic growth and deserve more attention.

Stage of the research

The research was started in 2014. The author now has finished the research design, literature review, interviews, data collecting and processing and draft of the research paper. He will refine the paper at University of Twente, STePS during his visiting fellow period starting from April, 2015.

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INTERMEDIATION FOR ECO-INNOVATIONS: AALTO CENTRE FOR ENTREPRENEURSHIP IN THE CONTEXT OF A UNIVERSITY INNOVATION ECOSYSTEM

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Keywords: innovation intermediaries, innovation ecosystem, eco-innovation, transition

EXTENDED ABSTRACT

While the discussion on eco-innovations has been ongoing for over two decades, the issue continues to be important as the prevalence of environmental issues in political agendas shows that previous actions have been insufficient to solve problems related to climate change, resource use and environmental degradation. The transition towards more sustainable societies requires action on multiple levels, from changing user practices and creating social and technological (eco-)innovations to unlocking currently unsustainable socio-technical systems.

Innovation ecosystems play a role in transition processes. They have been defined as “system[s] in which all components are present in a balanced way and which develop positive interactions, and in which firms in particular are engaged in networks of co-operators and competitors oriented towards innovation” (Nauwelaers, 2011, 468-469). In innovation ecosystems, various actors play a role, including inventors, universities, financiers, producers and users as well as intermediaries arbitrating between such heterogeneous constellations of actors. Previous research also emphasises the dynamics of innovation ecosystems (Oksanen and Hautamaki, 2014).

An innovation intermediary is “[a]n organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties” (Howells, 2006). Most attention in the literature on innovation intermediaries has been paid to mediation between technology developers and users (e.g. Howells, 2006; Stewart and Hyysalo, 2008). Individual studies of different types of intermediaries have been published, including consultants (Bessant and Rush, 1995) and university technology transfer agencies (Macho-Stadler et al., 2007). Less attention has been paid to intermediation in the early stages of an innovation process, i.e. in the period from invention in academic research to pre-commercialisation. This is important because some university inventions are too embryonic, making them unfit to be commercialised or even patented, and in need of facilitation during the first development stages. We argue that there is an explicit need for intermediaries to operate in the pre-commercial phase – in addition to intermediation in the context of the adoption and scaling up of an innovation (e.g. Howells, 2006).

In addition to the less studied role of the intermediaries in the pre-commercialisation phase, a second gap in the literature concerns their role in eco-innovation processes. Eco-innovations refer to any innovation resulting in less negative impacts on the environment over previous alternatives (cf. Kivimaa, 2008). As exceptions Klewitz et al. (2012) studied intermediaries driving eco-innovation in SMEs and Polzin et al. (2015) examined institutional innovation intermediaries in the context of eco-innovation financing. We perceive intermediation facilitating eco-innovations as part of innovation ecosystems. Intermediaries could be seen as crucial parts of innovation ecosystems adding balance and interaction between its components; perhaps even as their keystone players (cf. Clarysse et al., 2014). In this light, intermediation and the characteristics of intermediaries that are important in the shaping of inventions into eco-innovations are significant to study.

To address these two gaps in literature, we examine intermediation in the pilot and pre-commercialisation phases of eco-innovations by studying a novel type of agency within a university: an agency that combined technology transfer activities with other forms of entrepreneurial support. We study the roles of Aalto Centre for Entrepreneurship (ACE) in the wider context of the innovation ecosystem of Aalto University and various other innovation ecosystems it operates in. The viewpoint adopted is that of Clarysse et al. (2014) in the sense that universities consist of many actors and divisions that could together, in themselves, be considered as an ecosystem interacting with business ecosystems and other knowledge ecosystems. This paper focuses on the dynamics within these ecosystems before commercialisation, taking into account interactions between micro-level actions and wider system changes.

We approach the research problem by using two methods: generally examining the roles of ACE and investigating three specific cases of eco-inventions/innovations. We examine the characteristics that an intermediary between inventors/researchers and commercialisation has and the kind of innovation ecosystem that is emerging in Aalto university. By reviewing previous literature on innovation intermediaries and technology transfer, an analytical framework on intermediation activities is constructed. This framework is used to examine the roles that ACE has taken more generally, and specifically with respect to the selected cases. This study comprises two different sources of empirical material: interviews and database information of projects managed by ACE. The interviewees include ACE employees, other staff/students at Aalto University responsible for innovation/entrepreneurship support, and researchers at Aalto that are customers to ACE through its eco-innovation projects. In autumn 2014, ACE had 69 projects it identified as 'cleantech', covering inventions related to biofuels, solar power, reduction of energy consumption, waste water treatment, nitrogen oxide emissions, etc. Based on scoping discussions with ACE employees, three projects, covering energy, transport and waste sectors (Slag2PCC carbon capture and storage through mineral carbonisation of steel industry slag, Kutsuplus automated demand response service for public transport, and UbiQloud platform for potential application in waste collection) were selected for the more detailed study.

Aalto University was established in 2010 as a merger of three previously existing universities: Helsinki University of Technology, Helsinki School of Business and Helsinki School of Arts and Design. One of the intentions was to create an "innovations university" that would be better equipped to meet future

challenges by fusing activities in research on technology, business and arts. As part of the merger, ACE was established with an idea to expand the operation of a previous technology transfer centre over all the faculties. ACE's mandate was to commercialise research carried out in Aalto University in Finland. When set up ACE had four components: technology transfer including activities related to patent transfer and commercialisation; education related to entrepreneurship and innovation; research on entrepreneurship; and a venture garage. During the past five years of operation many of the activities have been transferred away from ACE. ACE as it stood in the end of 2014 had returned more to the capacity of a technology transfer centre rather than a multifaceted innovation intermediary.

Our findings show that ACE as an organisation has had no particular eco-innovation goals, nor does it engage in a potential role envisaged for universities in 'co-creating for sustainability' (cf. Trencher et al., 2014). However, ACE's project portfolio covers a range of inventions with potential in terms of advancing environmental sustainability. In the studied invention/innovation cases, the key influence of ACE has been to stimulate the idea of entrepreneurship to the minds of the (often academically focused) researchers and provide early-stage funding to take these business ideas forward, besides more standard activities in intellectual property rights. Moreover, the interviews demonstrate that ACE is a part of vibrant university ecosystem that ACE itself has co-developed. The environmental drivers and supportive organisational networks to the eco-innovation cases have been in place largely outside the influence of ACE. However, we argue on the basis of our results that similarly to ACE feeding into the idea of entrepreneurship to researchers, it could also act as a feeder of environmental awareness and business opportunities to those researchers not already aware of them. The UbiQloud case demonstrated that, for example, a software invention may have potential applications in a range of sectors, of which only some link to sustainability or the environment.

Towards national innovation policy actors, ACE has mainly interacted with Tekes the Finnish Funding Agency for Technology and Innovation. However, from the perspective of eco-innovation and more transformative innovation policy in terms of sustainability, connections of university intermediaries with other actors, including environmentally oriented organisations and think tanks as well as cities and municipalities would be extremely useful. The Kutsuplus case demonstrated how a network of researchers with national and municipal actors can benefit the commercialisation of eco-innovations.

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POLICY, TRANSFORMATION AND PRODUCTIVITY

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Keywords: climate change mitigation; industrial transformation; industrial policy; innovation and sustainable transition, productivity

EXTENDED ABSTRACT

Global energy related CO₂ emissions stalled on the 2013 level during 2014. This is due to growing energy efficiency but also to a large extent to the slowdown of economic activity in many countries, not the least in China. This single year observation may be looked upon as a first indicator on a break in the long term trend of annually growing CO₂ emissions in the magnitude of 3% leading towards an increase in global temperature of 4-6°C according to reports from organisations like IEA (2014b), IPCC (2014) and the World Bank (2012).

The challenge, however is not only to stabilise global emissions but to reduce them in a magnitude of 4%/year during the decades ahead; assuming that we still stick to the 2°C target to which there is a lip service among global policy makers.

Mankind has never in history managed to combine a sustained growth with long term decline in fossil fuel inputs although this has, now and then, been observed in individual countries during shorter periods. The development in the EU since 1990 is unfortunately not an indicator that European countries are on the right track. Looking deeper into the statistics reveals that the period 1990 – 2000 is dominated by the close down of East European non-competitive carbon based industries. And the decline since 2008 is primarily a consequence of the stagnation in the European economy (Fagerberg, Laestadius & Martin, 2015).

What we are talking about is a coming giant transformation of industrial activities. Our *research problem* is identifying and analyzing the policy conditions for such an industrial transformation (being aware that such policies may be strongly integrated also to life styles). There is no evidence that this transformation can take off without significant policy measures.

Let us identify some of the framing conditions. Although economic growth for two centuries has been strongly related to an increasing energy input (Brondel, 1976) which in reality to 80% comes from fossil fuels (IEA, 2014a) it is far from obvious that it has to be like that:

First, the total energy content in the radiation to earth from the sun is in the magnitude of 10000 times the energy used by mankind (Sandén, 2008). In short: we are not running out of energy for a decent life, we use the wrong forms of it only.

Secondly, the strategies of transformation can not take the form of new fuels in old containers only: neither is there time enough nor are there sustainable fuels enough for such a process. The process must follow several paths which may be summarized in the three categories used by IEA (2012):

- *avoid*: CO₂ emitting systems and processes should primarily be avoided.
- *shift, substitute*: for processes, systems and solutions which cannot be avoided shifts should take place to less polluting substitutes. This includes shifts to sustainable sources of energy.
- *efficiency, improvement*: remaining processes and activities should be made more efficient.

Policies reducing systems activity to half (avoid); substituting remaining activities and fuels to half (shift/substitute) and doubling energy efficiency (improvement) will reduce GHG emissions with almost 90% of the present.

This aggregate discussion must, however, be downscaled to sectors/systems and/or industries to make sense from an industry policy perspective. This can be done in (at least) two ways; both complementary.

First, it can be related to a "green post Keynesian" model (further developed in Laestadius, 2013 & 2015). Dividing the Keynesian "demand" sectors into green (sustainable goods/systems and processes), blue (enabling systems and processes) and black (GHG emitting goods/systems and processes) the transformation problem develops into promoting green sectors/activities – often with help from the blue ones – and eliminating the black ones.¹

Secondly, it can be related to a Dahmén inspired development bloc (DB) model (Dahmén, 1950; Laestadius & Rickne, 2012). The DB is a construct analytically connecting technologies, firms and industries which in their development are interrelated to each other.²

Summarizing so far: we argue that the three policy packages suggested by IEA (avoid, shift/substitute and efficiency/improve) may be applied on one or both of the disaggregated systems/categories discussed above to sharpen the policy analysis.

Further: when analyzing the conditions for transforming industrial activity towards sustainable solutions we will consider the productivity measurement problem. In short we may argue that productivity achievements historically have been made with the use of "brain power" (knowledge more or less embedded in technology) and "external power" (to run larger, stronger or more intelligent systems). The external power has globally to 80% been based on fossil fuels, which to a large extent explains the increase of "labour productivity". Assumptions based on historical productivity increases, thus, are of low value in formulating industrial policies and expectations for the future.

In addition we will move to a still less aggregated level of analysis in our analysis of policy conditions:

- 1 We argue that energy, transport and natural resources are the core development blocs to focus on in order to speed up the transformation towards sustainability.
- 2 This DB focus may, however, have second order consequences; i.e. point to certain technologies or industries – sometimes related to several DB:s - which are of core importance for/in these blocs.
- 3 To illustrate:
 - a. the transformation of forest based industries is to a large extent based on new and improved process technologies.
 - b. wind power and photovoltaics technologies are related to several different industries and technologies within manufacturing and ICT.
 - c. the "transport bloc" may be looked upon as a nexus of a large number of different technologies and systems; altogether constituting a "regime". This contributes to a complex policy situation as regards what parameters to influence.
- 4 The steel industry may constitute a case in itself. It can be looked upon as part of a "steel bloc" but also highly integrated in several other DB:s. Being on the one hand Sweden's largest single GHG emitter and on the other an enabling provider of solutions to a sustainable economy makes the steel industry a complex target for

¹ Honestly we here face a lot of definition/classification problems: although steel products normally may be classified as "black" steel processes intending to produce capital goods for railways may be classified as "blue", i.e. enabling the transformation from air traffic and maybe personal car to railway transport. Further discussion on that are left to the final paper.

² DB:s are not identical with "industry" or a specific "technology" as these may change over time. DB denotes a system with family resemblance as the salient/reverse salient model developed by Hughes (1992). Also the analysis of these details will be left to the final paper.

policy. While steel should be "avoided" in many activities it is part of wind power systems and railways of the future (substitute and improvement). In addition, in a world when there is a strong focus on low carbon industries (like ICT and pharmaceuticals) the real contributions in climate change mitigation industrial policies must be achieved in the transformation of the highly emitting ones like steel and cement (Laestadius, 2013a). The globalized character of the industry in addition creates challenges for policy.

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RENEWAL OF MANUFACTURING INDUSTRIES: HOW TO SUPPORT RADICAL INNOVATION?

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Keywords: radical innovation, manufacturing industry, innovation policy, innovation process

EXTENDED ABSTRACT

Radical innovations involve novel knowledge bases, technologies and markets, which generate new growth opportunities and unforeseen features (Tellis et al., 2009). Therefore supporting their development is a key objective of public innovation policy (OECD, 2010). Promoting radical innovations is especially relevant in industries, such as the manufacturing industries, whose competitiveness is in decline in many advanced countries.

The distinction between the development of radical and incremental innovation is prevalent in the management literature, but a topic rarely addressed in academic discussions on innovation policy. Research on innovation processes has provided understanding of differences in the ways incremental and radical innovations are developed (e.g. Veryzer, 1998). Incremental development is traditionally realized as a linear process, where pre-structured stages are planned and implemented one after another. Such approach works fairly well when the objective of the innovation process is incremental – doing what we do but better – and when the outcome of the process can be determined in advance. However, when dealing with radical innovations, characterized by high uncertainty and risks, the linear pre-planning approach seems to fall short and the conventional processes may even be detrimental for promising radical ideas.

Radical innovation process is described as non-linear, stochastic, and highly experimental. The process can somewhat be managed and controlled, but with different practices than the ones of incremental development (Veryzer, 1998). Early prototyping and quick market experimentations have been recognized as key mechanism of radical innovation development. Explorative experimenting builds ground for continuous learning and makes it possible to iterate the project, reframe the development targets, and gain realistic knowledge about the markets when conventional analyses fail (Lynn et al., 1996).

If radical and incremental innovations differ in the ways they are developed, supporting their development might necessitate different policy measures. Market failure approach to innovation policy is perhaps the most pervasive framework for innovation policy. It is based on the notion that because of the uncertainty and risk associated with innovation, companies tend to underinvest in it (Arrow, 1962). Public support for innovation is justified because at the macro-level the outcome is better if the government takes some of the risks from innovation. Policy measures associated with the market failure approach include e.g. R&D subsidies, support for basic research and IPR protection. Typically, incremental and radical

innovations are not distinguished in this line of research. However, if the risks and uncertainties are especially high, as in the case of radical innovations, the underinvestment is likely to increase as a result of individual-level risk aversion.

Lately, a strong literature stream on system innovations has touched on the topic of radical innovation from the policy perspective (e.g. Geels, 2005). System innovations are large-scale transitions from one socio-technical system to another. These studies have broadened the scope of innovation policy from traditional market failure based measures to include, for example, public procurement, facilitating interactions with companies, and demonstrating technical feasibility. Although radical innovations are central for system innovations they should not be considered equivalents. System innovations are based on combinations of both radical and incremental innovations and are typically larger in scale (Geels, 2005). Moreover, it might be difficult to distinguish between the production part and the innovation part of innovation systems (Markard and Truffer, 2008). In addition, system innovation literature puts significant weight on the diffusion part of radical innovations, whereas many other studies based on the market failure approach or innovation management theories arguably focus more on the development part.

In this study, we aim to answer a twofold question: what are radical innovation processes like and how they can be supported by innovation policy? To answer this question, we conducted a qualitative multi-case study on Finnish manufacturing firms and innovation policy. Our motivation is to provide guidelines on how to foster renewal of the manufacturing industries.

Methodology and Data

The context of our empirical study is the Finnish innovation system. Lately the Ministry of Employment and the Economy of Finland has emphasized the importance of radical innovations for the Finnish economy, especially to the manufacturing industries. Nevertheless, official documents on innovation policy do not explicitly distinguish between innovation types. This situation offers a fertile ground for research.

Because of the exploratory nature of our study, we chose interviews as the main data collection method. To gain a comprehensive picture of the examined issues we decided to collect data from both private and public sectors. From the private sector, we chose four Finnish incumbent companies from different sectors. Three of the companies represent subfields of the manufacturing industry: steel manufacturing, industrial engineering, and forest industry. The fourth company contrasts the other three and operates in the broadcasting industry, which enriches our data set and allows comparison between industries. We conducted two rounds of interviews. First, we interviewed 33 managers from the case companies to understand their radical innovation processes. During the second round, we interviewed seven policy makers in key positions and revisited five key company informants to find connections between radical innovation processes and innovation policy.

Results

Our analysis resulted in the identification of four key attributes of radical innovation processes: unpredictability, adaptability, iterativeness, and demonstrability. Furthermore, the attributes are observed to have great relevance for innovation policy. We present general observations on the relationship between

radical innovation and innovation policy. Then, we introduce each attribute by illustrating how they are present in the development process of radical innovations. We also discuss how the attributes relate to innovation policy, and what kind of policy challenges were identified in Finnish innovation policy concerning them. Based on these findings, we develop propositions about the relationship between radical innovation processes and innovation policy. The key results are summarized in Table 1.

Table 1 Summary of the key results

Attribute	Description	Policy challenge in Finland	Proposition
Unpredictability	Innovation projects are not planned in detail in advance.	Applying for R&D funding requires detailed planning.	P1. Requirements for detailed project plans in funding innovation projects may hinder the development of radical innovations.
Adaptability	The direction of an innovation project may change course.	Funding is granted for specific direction.	P2. Public policies for radical innovation need to be flexible to allow justified changes of course.
Iterativeness	Planning, development, and commercialization phases mix in experimental development.	Commercialization is outside most R&D funding tools.	P3. Radical innovation benefits if public funding is not restricted to specific development phases.
Demonstrability	Commercial success is often dependent on reference products which may be very costly.	Lack of policy tools for building references.	P4. Public support for building references and prototypes benefits radical innovation.

Conclusions

Our innovation process attributes are well in line with the existing management literature. The current state of management practices seems to reflect well the unpredictable and iterative traits of radical innovation processes (e.g. Lynn et al., 1996; Veryzer 1998). Continuous learning through experimentations and quick market testing are the established way to acknowledge the iterative nature of radical innovations processes, as emphasized by former studies. However, extant studies have not taken into account the role of innovation policy, which may have great impact in fostering radical innovation development.

Our results suggest that the first three attributes can be addressed by implementing more flexible criteria for public R&D funding, whereas the fourth may be supported by facilitating networking, creating demonstration platforms, public procurement, as well as direct funding for demonstration projects. We compared the manufacturing companies and the broadcasting company and found that radical innovation processes were much alike in all of them. However, we identify some differences in policy needs between the industries. As an example, the manufacturing companies, being more capital intensive, relied more on innovation policy in radical innovation processes whereas the broadcasting company was more capable in operating independently.

This article contributes to innovation policy studies in combining innovation management and innovation policy research to provide policy makers knowledge about how to support the emergence of radical innovations and the renewal of manufacturing industries. We present propositions which are of use in policy design in the manufacturing industries. Furthermore, we compare our results to different innovation policy literature streams and position our study with respect to current theoretical discussions. We also address the limitations of the study and provide suggestions for future research.

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THROUGH THE ICE AND THE COLD WAR DEVELOPMENT OF THE FINNISH ARTIC SHIPBUILDING

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Keywords: Arctic shipbuilding, Cold War, history of technology, industrial innovations

EXTENDED ABSTRACT

After the Second World War, Finland was a small, agricultural and poor country that had lost both the war and its direct access to the Arctic Ocean. During the Cold War the Finnish shipbuilding industry evolved, expanded and diversified until the end of the 1980s. Today, only icebreakers and luxury cruisers are left of the Finnish Cold War shipbuilding. This paper focuses on the development of the Finnish Arctic shipbuilding technology in order to understand, how the shipyard industry was able to specialize in a narrow niche of ice-going vessels and transform it into a longstanding competitive advantage. Alike the Caribbean Cruisers that have not been built in Finland because of the sunny summers, the majority of the icebreakers globally in operation today have not been built in Helsinki just because of the northern location of the shipyard. The new industry emerged and evolved in a historical context that was shaped by the interaction of physical and non-physical artefacts as well as organizational and institutional factors. The study is conducted as a historical analysis by using both public and private archival sources¹ that are complemented with interviews.

The Finnish shipyard industry has contributed greatly to several technological innovations increasing the feasibility of icebreaking operations such as bow propels, air bubbling system, the concept of double acting ships and Azipod marine propulsion units (Laurell 1995; Turunen & Partanen 2011). However, only the number of technological innovations does not determine longstanding competitiveness of an industry. Further, innovations never occur in isolation, but the environmental conditions compose a decisive context for innovation processes (Fagerberg, 2005; Edquist, 2005).

This study analyses the development of the Arctic technology as the part of the broader industrial system. I use the “system” as a conceptual tool to define the research approach and the level of analysis and to integrate the technology into the social, environmental, economic and political context. The relationship between the environment and the innovation processes has been conceptualized and theorized in several ways. In general, system of innovation approaches share the idea that innovations cannot be elaborated

¹ ELKA (Elinkeinoelämän Keskusarkisto) Central Archives for Finnish Business records in Mikkeli; Finnish archive of the Ministry of Foreign Affairs and Finnish National Archive, Helsinki.

purely as an independent activity inside a firm, but the innovation processes are embedded in institutional and environmental context (Smith, 2000; Edquist 2005). My research approach is also strongly affected by the research tradition of the socially constructed technological system (For example Hughes 1987. See also Olsson 1998 and Summerton 1998).

Instead of technological innovation, the study focuses on the dynamic interaction between the environmental factors and the shipbuilding industry as well as the political and economic context in which the technological innovations are invented and implemented. The environment affects the technology but at the same time, the technology shapes the system. The technological innovations in icebreaking and process innovations in shipbuilding enabled the shipyard to maintain its position in the markets, the strong ice-going vessels enabled offshore industries to drill ice on arctic seashore or to navigate through the northern sea routes and the cost-effective icebreakers enabled the Finnish industry to continue its foreign trade without seasonal variation. Shortly, the icebreaking technology opened new possibilities for political and economic activities. From this perspective, the technology was co-shaping its own demand. The evolution of the Arctic shipbuilding industry cannot be studied only by focusing on the development of technology or the political situation boosting the industry, but as the interaction of these two.

Based on the research, the political and economic restrictions together with domestic industrial cooperative culture formed the framework in which the Finnish shipbuilding cluster was developed in the scale and scope that would otherwise not been possible. The indigenous cold winters and necessity of winter navigation functioned as a trigger for icebreaker building, but Finnish governmental procurements alone would not have been alone sufficient for the expansion, the specialization and the technological development of the arctic shipbuilding without the vast demand from the Soviet Union.

I argue that especially three political factors stemming from the bipolarization of the Cold War markets, politicization of technology and Finnish cooperative business culture shaped the development of the Arctic shipbuilding during the Cold War.

First, the superpower confrontation divided the global markets into two blocs and provided for the Finnish industry an advantageous location. As the western high technology embargo set restriction to the East-West technology transfer, Finland became politically and technologically an appropriate compromise for the Soviet Union. The bilateral trade with the Soviet Union provided extensive demand for ice-going vessels complementing the small domestic markets and the protected western markets.

Second, if the Cold War located Finland geopolitically in between the East and the West, the politicization of the technology located icebreakers somewhere in between civilian and military technology. Polar icebreakers were strategically important for the Soviet Union to pay special attention to the Finnish icebreaker but not explicitly military technology so that they were possible for the Finnish shipyard to sell. The Finnish shipyard was able to utilize this political dimension of the icebreaking technology in order to promote its business.

Third, the centralized bilateral Finnish-Soviet trading system enabled the Finnish shipyards to establish a secret export cartel that allocated Soviet ship orders among the shipyards. Together with the high-

volume demand from the Soviet market, this arrangement supported technology differentiation, knowledge accumulation and longstanding technology development in the project-based industry.

In this paper I problematize the straightforward narrative of the development of the Finnish Arctic technology cluster as a linear path from the Northern location of Finland to the global technology markets. The entrance in the new industrial markets and the ability to maintain competitiveness in a specialized niche has been resulting from the successful adaption of the shipyard in the transforming possibilities and restrictions created by political, economic and environmental factors.

The development of the innovative Finnish icebreaking industry was initiated before the concept of “innovation policy” was established. The public policy and the close interaction between the political and industrial actors shaped the development essentially but mainly as a part of foreign affairs and trade politics. During the Cold War the domestic industrial and education policy traditionally regarded as essentially part of state-driven innovation policy, had only a minor role. In this case the “smart industrial and innovation policy” should be regarded as a combination of foreign affairs, trade politics, personal networks, education policy, and public procurement policy that enabled the shipyard to navigate through the Cold War.

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INNOVATIONS IN WOOD-BASED PROCESS INDUSTRIES IN TRANSITION: MANAGEMENT & POLICY IMPLICATIONS

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Keywords: Wood-based Process Technologies; Pulp & Paper Industries; Coupled and Diverging Innovations, Disruptive and Sustaining Innovations

EXTENDED ABSTRACT

As any mature industry the forest industries have gone through many transformations and structural changes. Historically, forest industries in the Northern hemisphere (North America and Northern European countries) have been rather successful by moving forward in the value chain in order to avoid market decline or raw material shortage (Hylander 2009). From timber exports and charcoal in the 17th-18th century; sawmill products in the 19th century; pulp and papermaking transformed by using sawmill residues in the early 20th century for production of graphic papers; and by inventing chemical pulping technologies in the early 20th century particularly for hygiene products and stronger paperboard which expanded in the mid-20th century.

However, in recent decades the pulp and paper industries located in the Northern hemisphere are confronted by manifold challenges while the incumbents has got stuck into its “big is beautiful” paradigm. Most of these challenges are connected to global transformation pressures, due to digitalization and multimedia (i.e. decline of printed media), competition from fast-growing economies in the Southern hemisphere, uncertain energy supplies, and environmental challenges (not least climate change) which increase the pressure on resource intensive process industries such as the pulp and paper industries in Western industry nations (UNECE/FAO 2009/2011).

In this short paper I will concentrate on the nature of innovation in pulp and paper industries (P&P), the largest biomass infrastructure on earth, and its implications for management and policymakers. The point of departure is the academic discourse on disruptive innovation followed by industry specific cases in order to explain the nature of innovation in process industries. Clayton Christensen (2000) settled an important distinction between disruptive and sustaining innovations. A disruptive innovation is an innovation that generates a new market and value chain, and finally disrupts an established market and value chain by shifting trajectory or replacing earlier technologies.

A sustaining innovation may be looked upon as either incremental (or evolutionary) or a more radical innovation. The incremental innovation contains gradual upgrading that improves a product in an existing market by means that customers are expecting, while the more radical innovation contains a major shift and

is perceived as unexpected within the industry. Both have in common that the market and business model do not transform in a significant way.

However, the outcome of global upscaling of pulping processes and the fact they have been tightly coupled with the papermaking paradigm rooted long ago (e.g. main production technologies and machines even have the same terms as a century ago!) made this industry even more inflexible and fixed to the paper mill layout. P&P is today the largest biomass industry on earth with a production capacity of almost half a billion tons per year. The cutting edge production units have since the 1950s doubled in production capacity every decade. Between 1950 and 1990 Swedish pulp and paper mills were back then on average among the most scale intensive, during this period Swedish mill on average went from roughly 15,000 to 225,000 tons per year (Skogsstatistiska Årsboken 1951; 1991). A couple of major sustaining innovations were more or less successfully integrated by the incumbents (e.g. automation control technologies in the late 20th century). In the 2000s the Nordic technology suppliers were vital to the sustaining innovation of eucalyptus plantation based Greenfield mills in the Southern hemisphere – innovating huge continuous digesters in kraft pulp mills – which today easily exceed production capacities over one million tons per unit annually.

Economically, new P&P machines have investment horizons of several decades and exceed the actual plant's annual turnover, making it difficult to switch technological trajectory. In particular, innovations are tightly coupled with the physical lock-in issue in the sense that mills are highly integrated, internally and vertically in the technological system of pulp and paper. Any substantial change in any paper machine requires bottleneck, chain reactions in related parts of the system. Moreover, any change of one of the product features changes the production process chains and input materials. As an example, a Swedish paperboard producer in 2007 launched a paperboard with 50% whiter surface on the inside of the paperboard in order to have the same whiteness on both sides of the board. In this case a new product feature was not just a question of changing one or two parameters in the production process, it required a feasibility study of (almost) all production processes characterized by a continuous flow, of upgrading several production stages in the board machine – e.g. stock preparation, formation, pressing, drying, calendering and coating, wrapping machine, and preparing stages for converting, as well as feeding the board layer with stronger pulps in order to compensate for whiter, bleached board ply. The paperboard mill also set up a pilot machine for controlling numerous parameters in the paperboard production processes due to the difficulties to test the new product in the plant. The pilot machine also served its cause due to the mill's only paperboard machine with a capacity of 300,000 tons annually and few occasions for running new product tests in the existing machine (Novotny 2007). Summa summarum: even an incremental product innovation in this kind of industry contains a chain reaction of simultaneous process innovations.

In the case of process industries, product features are strongly coupled to structure and the structure is strongly coupled to the processes (Linton and Walsh 2008). The number of co-evolved changes to the product and process will be greater than in assembly manufactured industries, since product innovation will result in a cascade of changes along the production process. This may even lead to opportunities for the product in the decline phase of its product lifecycle to enter a growth phase in an alternative market (Foster 1986).

Demonstration plants are particularly crucial in process industries because of the capital intensive and inflexible plant layout, on the one hand, and tightly coupled process and product innovations, on the other. The whole production chain ought therefore to be standardized and tested at large scale whenever an innovation is launched. This characteristic of large-scale process industries is even more augmented by the fact that production plants have high requirements on production availability and runnability with huge costs in case of production breaks, a trend that has been reinforced in recent decades of intense competition (Abdulmalek 2006; Novotny 2007). In addition, the R&D shift from P&P companies to technology suppliers makes demonstration plants even more crucial for innovations (Larsson 2006; Novotny and Laestadius 2014).

During the last decade the large corporations with mills located in the Northern hemisphere and positioned in declining graphic paper markets are literally dying in the chimney fire. Niche players and incumbents of chemical market pulp for new applications and bioproducts replacing fossil based products in packaging, textile, chemical and construction industries are growing in the 2000s. First movers with biorefinery products based on the sulfite process – Borregaard, Lenzing and Domsjö – are now followed on large scale by agents with other separating/fractionation technologies. An example of the latter is the Lignoboost technology which separates the lignin – the second most abundant organic compound on earth – to very high purity levels. This new process technology opens up completely new, diverging “product-tree” families of lignin-based chemicals. This in turn opens up new technological trajectories for the other two main compounds – cellulose and hemicelluloses which basically can replace any product in chemical industries and even steel/metal industries. The dismantling of the converging papermaking paradigm based on the gigantic capital intensive paper machine results in an opportunity to make use of the disruptive biomaterial diverging technologies/products (see figure 1).

Potentially, these sophisticated diverging technologies may also be disruptive for established pulping technologies in the longer run. Examples of difficulties in managing disruptive innovations are numerous in history as the Schumpeterian idea of “creative destruction” demonstrates. Schumpeter himself stated that it was not the stage-coach companies that initiated the transition for the new railway construction business in the 19th century. The incumbents were inclined to exploit incremental innovations and external, new entrants the disruptive innovations. Such transitions might turn incumbents’ existing resources out of date when new industries are emerging. A recent example is large integrated steel mills that struggled to respond to the mini-mills in the 1980s and 1990s (Christensen, 2000; Tushman & Anderson, 1997). For now, at least integrated P&P mills are losing out to unintegrated chemical pulp mills.

Another management/policy implication of studying a process industry like pulping is that market and technology shifts are rather about coupled process and product innovations where the outcomes are potentially disruptive and diverging, e.g. the Lignoboost technology that took ten years and several, upgraded pilot/demo-plants to commercialize. This is a different mind-set compared to innovation theories in general and specifically to those based on high-tech assembled manufacturing or ICT (cf. Utterback 1994), which converge instead of diverge. Steel, chemical, mineral and the pulping biorefinery case exemplified are

very much about separation technologies with a wide range of diverging product tree, cascade alike innovations, the opposite of assembly based manufacturing.

In the medium/long run this opens up for completely new development blocks of biomass refining industries which potentially can replace large part of today’s polluting and material intensive petro-chemical, metal and clothing industries. The nature of innovation in this kind of process industry however urges policy tools both on micro- and meso-levels. In the former case for more favourable conditions in setting up demonstration plants, to lower the barriers to entry for innovators that seldom have access to biomass feedstock, R&D infrastructure and venture capital. In the latter for policies in order to encourage diverging innovations in material technologies and different process industries - i.e. to encourage new development blocks in biomass based industries.

This paper is at quite an early stage and the author would probably need to develop the methodological and conceptual parts as well as to further explain the industry specific nature of innovations and the settings of exemplified technologies. Moreover, the management and particularly policy implications are still on a very rudimentary level and most probably would need a section of its own.

The chemical pulp biorefinery – some possible products from wood compounds

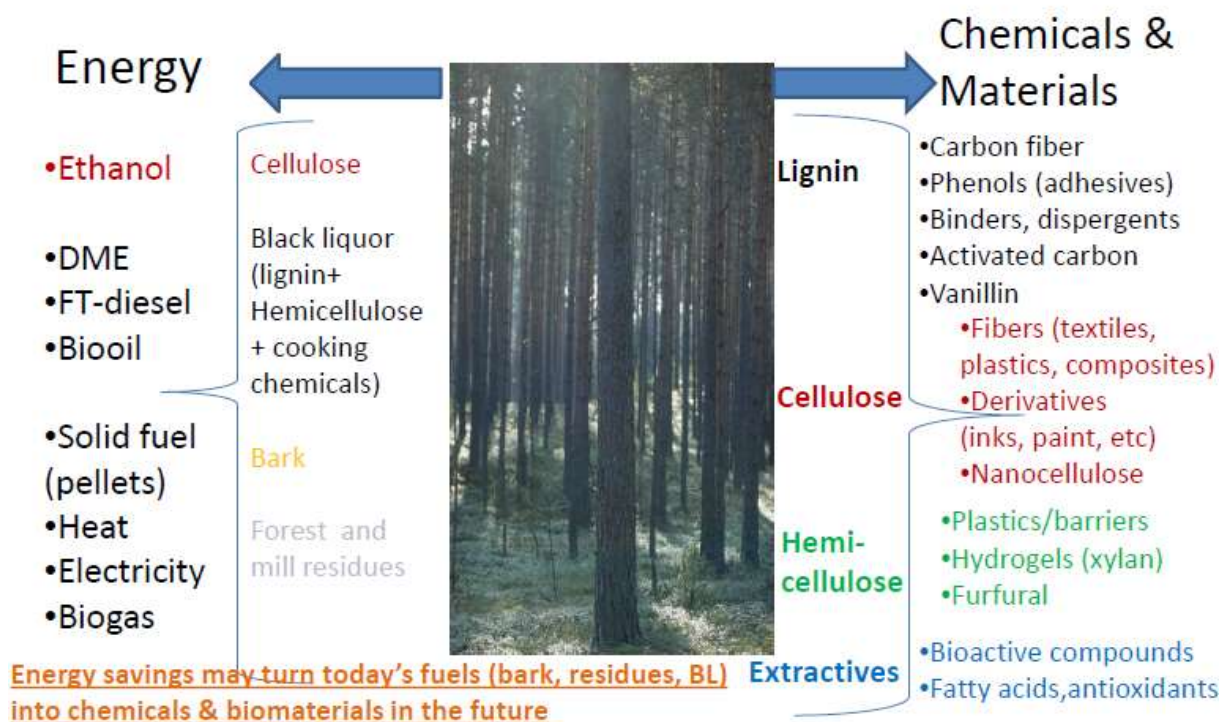


Figure 1: Chemical pulp biorefinery based on Axegård (2009) and Kamm et al (2010).

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ROADMAP FOR DEPLOYMENT OF NANOTECHNOLOGY FOR HEALTH IN LATIN AMERICA BY 2025

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Keywords: Societal Challenges; Health; Nanotechnologies; Europe; Latin America

EXTENDED ABSTRACT

This paper presents the roadmap for the deployment of nanotechnologies for health in Latin America, which has been realized in the auspices of the NMP-DeLA¹ (Nanosciences, Nanotechnologies, Materials and New Production Technologies Deployment in Latin American Countries).

According to the International Standardization Organization (ISO 2010 online) nanotechnology is the application of scientific knowledge to manipulate and control matter in the nanoscale (referring to particles which size range from approximately 1 nm to 100 nm) in order to make use of size- and structure-dependent properties and phenomena, as distinct from those associated with individual atoms or molecules or with bulk materials. At the nanoscopic or nanoscale materials acquire new characteristics that can be used in a wide range of novel applications. They potentially include cheaper and more efficient technologies that can benefit the world's poor, such as cheap water filters, efficient solar powered electricity, and portable diagnostic tests (Nano-Dev 2010).

The roadmaps are being built with the timeframe of 2025 and considered the criteria against which technologies and applications were judged (impact, burden, appropriateness, feasibility, knowledge gap and indirect benefits) used by Salamanca-Buentello et al (2005); the governance of nanotechnology (transformative, responsible, inclusive and visionary) proposed by Roco *et al* (2011); and the capability approach (public engagement, national sovereignty, private investment, access to higher education and research jobs and environmental sustainability) of Nussbaum (2006) adapted by Malsch (2011). Guiding questions were used in order to allow for best selection of research methods, which included desk research, individual and focus group interviews and participatory workshops. Firstly, the state-of-art of deployment of nanotechnologies and new materials (NMPs) in the context of societal challenges was identified; secondly, how they can be possibly deployed; and finally, what would be good practices and recommendations for bi-

¹ NMP-DeLA project is funded by European Union Framework Program 7. Together with this roadmap the authors are presenting papers related to the roadmaps on deployment of nanotechnologies for water and energy in Latin America and the bibliometric mapping exercise, which findings have supported the analysis made in the roadmaps.

regional collaboration in order to advance the deployment of nanotechnologies in LA. The structure of the roadmapping process is shown in Figure 1.

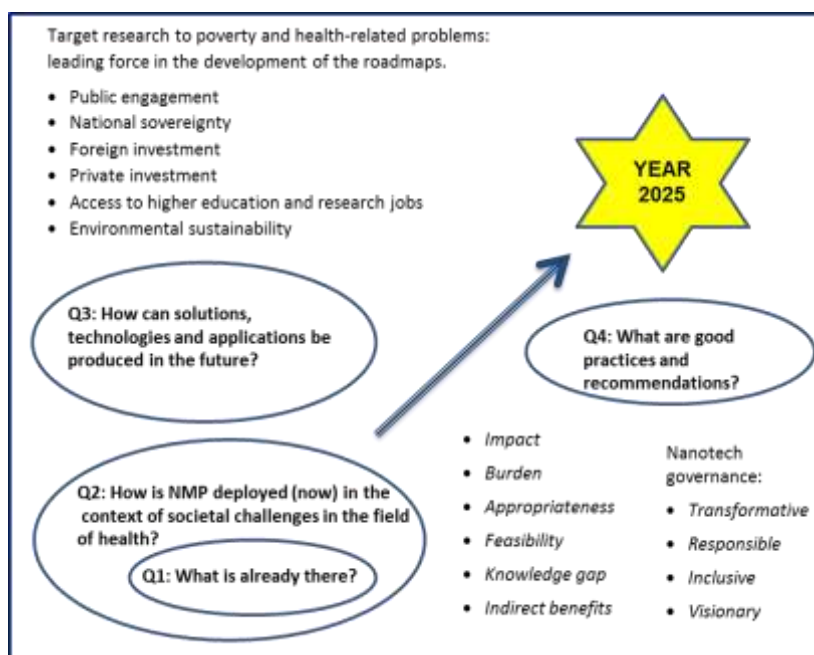


Figure 1: Research questions, criteria and capabilities in construction of NMP-DeLA roadmaps

General applications of nanotechnologies for health are within the fields of nanobiotechnology, nanomedicine and nanodevices (Frost & Sullivan 2008). According to the European Technology Platform on Nanomedicine (ETPN), nanomedicine is the application of nanotechnology to achieve innovation in healthcare (ETPN 2014). The potential contribution of nanotechnologies in medicine is extremely broad and includes: new diagnostic tools, imaging agents and methods, drug delivery systems and pharmaceuticals, therapies, implants and tissue engineered constructs (Filipponi & Sutherland, 2013). Nano-enabled medicine is comprised of new applications for healthcare, in which nanomaterials and nano-electronics are being used for targeted drug delivery or for early detection of diseases (a combination of therapeutic treatments and early diagnosis of illnesses, known as theranostics).

The roadmap focus on diseases that impose burden especially for disadvantaged populations of Latin America: neglected tropical diseases, with special focus on tuberculosis, and cancer. A mapping exercise carried out by Invernizzi et al (2014) shows that in LA all the countries have research groups in nanomedicine with specialization on different topics: Brazil (mainly drugs and therapies and drug delivery); Mexico (materials for diverse applications in nanomedicine, drugs and therapies, and drug delivery); Argentina (drug delivery and tissue engineering); Chile (drugs and therapies); Colombia (nanotechnology applied to cancer research); and Uruguay (small group of research scattered among different areas). Furthermore, the exercise indicated the difficulty to distinguish what research in the area of nanomedicine could be of social relevance for LA. On the one hand, most of the research is very basic in nature, so the potential applications and benefits are very difficult to envisage. On the other hand, several Latin American countries have crossed the “epidemiological transition” and present a very similar pattern of diseases and

causes of deaths than most developed countries. Although some typical diseases such as tropical diseases are still of importance, most research seems to be directed to a more global landscape of medical issues.

Tropical diseases, despite the heavy burden it imposes to poor populations across the globe seem to be the ones the least contemplated in studies considering deployment of nanotechnologies. This calls for public policy and international funding agencies action. There are developments though that could help to prevent, diagnose and treat, at least some of them. They were identified by Look et al (2010).

In order to have nanotechnologies deployed for health for the selected diseases and by means of collaboration with Europe, some findings are relevant. Interview-based data showed that, in particular, German research on drug targeting with dendritic polymers can be adapted to applications for neglected diseases including Leishmaniasis, especially in R&D being done at Oswaldo Cruz Foundation (FIOCRUZ), and Chagas disease, as well as the fluorescent labelling of biological macromolecules like therapeutic antibodies. Austrian allergy research can be targeted to the higher allergy incidence rates in Peru and Brazil, but also be adapted to parasitosis caused by unsafe drinking water in developing countries. The European Nanofutures platform is inviting contributions to its new nanoroadmap under development. ETPN as well is considering opening up to third countries.

Future research priorities in the EU Nanosafety Cluster include discussing the development of measurement methods for real life exposure to nanomaterials for protecting worker and consumer safety. It is necessary to adopt standard protocols and to disseminate information on the correct methodology in the nanorisk assessment community. Opportunities in LA are offered by the Cuban research community and the Brazilian National Institute of Metrology, Quality and Technology (INMETRO).

For education and training interviewees revealed interest in setting up education in biomedical engineering and rehabilitation (monitoring, robotics), training physicians and technicians in nanotechnology for health, and disseminating information on nanosafety to academics, industry and stakeholders in sessions, workshops and training schools.

For policy-making, at global level, the World Health Organization is including nano in its Healthy Workplace Programme in the form of occupational health and safety regulation/guidelines for nanomaterials.

For manufacturing of nanomedicine (including therapies, sensors and devices) interviewees saw different market opportunities for nanotechnologies in LA. On a general level, already existing industry, such as biotech companies, should be used to reinforce connections of nanomedicine with the healthcare market. It is necessary to create the industrial capacity for nanotechnology manufacturing and take advantage of initiatives, such as of the French government, who aiming to stimulate converging technologies for Artemisin (malaria drug) and dengue in order to lower production costs and increase supply to larger segment of the global population.

In LA as well as Europe, there may be local market opportunities for a service industry offering nanosafety evaluations for industry. Potential applications are monitoring safety at the workplace / consumer safety, safety by design and failing cheaply, following the example of the Pharmaceutical industry: quality by design.

Opportunities for contributing to Ethical, Legal and Societal Aspects of NMP are two-fold: in organizing dialogue about these issues, and in targeting projects towards improving societal benefits. The ETPN already offers a platform for elaborating questions and answers in the grey zone of ELSA of nanomedicine. An example is discussion about the ethical aspects of nanomedicine coming from the EU projects and experiences of Institut Pasteur, in this field, when implementing nanomedicine. There is interest in extending this network to LA. Furthermore, the question how to make sure that the benefits of the research can be shared equitably with populations that do not have access to those medications is included in Horizon 2020 calls.

The above presented findings are to be expanded with analysis of specific European funded projects addressing the diseases NMP-DeLA roadmap focused on and an innovation strategy based on a survey with LA research institutions and companies.

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QUALITATIVE ANALYSIS FOR ACTION PRIORITIZATION FOR THE IMPLEMENTATION OF INNOVATIVE TECHNOLOGIES IN THE HEALTH SECTOR

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Keywords: Healthcare; ICT, Needs; Qualitative Research

EXTENDED ABSTRACT

ICT is already playing an important role in healthcare and wellness. The experience so far has shown that the healthcare systems can improve health outcomes and efficiency by using products and services developed by technology companies. However, there are still gaps to overcome and significant barriers to successfully integrating ICT and creating real value adding health services (Li, et al., 2013). In this study, research has been performed to identify the needs and expectations of stakeholders and users, in order to set priorities that will favour the successful implementation of ICT, to guide interventions and facilitate innovation, business development and internationalization for ICT companies that focus their efforts on health sector innovations (Mahmud, et al., 2013), (Golan & Hansen, 2012).

Work Methods

Firstly, identification of the stakeholders and analysis of the ecosystems were conducted in four European regions, to map human and material resources involved in the implementation of ICT in health. Once these resources were identified, research regarding the needs, opportunities, strengths and barriers for implementing ICT with special focus on cloud and mobile technology, and interoperability was conducted using qualitative research methodology, followed by prioritization of the identified areas.

The main objectives of the study were:

- 1) Understand the opinions, expectations and attitudes of leaders of four regional health systems regarding the implementation of ICT in patient care and well-being.
- 2) Identify barriers and resistances in the implementation of ICT.
- 3) Conduct a prioritization exercise to resolve needs with the participation of international experts.

A qualitative study was performed using in-depth interview and focus group methodology; participants were selected with convenience sampling; in-depth interviews were performed with professionals related to health systems and involved in leadership, management and assistance; focus groups were integrated with patients and citizens (Gill, et al., 2008) (OFFICE OF QUALITY IMPROVEMENT, 2007) (Pappas, et al., 2013).

The study was conducted in four European regions, Oulu in Finland, Midi-Pyrénées in France, Murcia in Spain, and Skåne in Sweden. To ensure the methodology was standardized, the project was coordinated by one region and training sessions were offered to all participants. Members of the research team conducted in-depth interviews (60min.) and focus groups (90min.). All interviews and focus group sessions used an established script, based on a literature review, and audio or video was recorded. These interviews were transcribed and analysed, categorized and validated through a triangulation and saturation of information process. Thematic areas and categories of the needs were identified through a qualitative data analysis. A quantitative prioritization exercise with a dual methodology was carried out based on perceptions of the identified needs importance, where each of the 12 researchers scored all identified needs from 1-10. In addition a qualitative prioritization exercise took place using a scoring system of 1 to 5, according to criteria of feasibility for implementation in health systems, acceptance by the environment and the expected impact after implementation. The focus groups were developed using the same methodology (Tromp & Baltussen, 2012).

Results

A total of 81 health professionals and service providers were involved including managers, technicians and health leaders, who were interviewed, and 18 patients/citizens participated in the 3 focus groups, belonging to the four regions. 81 one to one in-depth interviews were undertaken, including 22 decision makers, 32 health experts and influencers, 11 health professionals, 2 health managers, 8 development managers, 4 researchers, and 2 chief executive officers belonging to regional governments, hospitals and primary care.

Five thematic areas with a total of 32 perceived needs for the implementation of ICTs were identified (Figure 1):

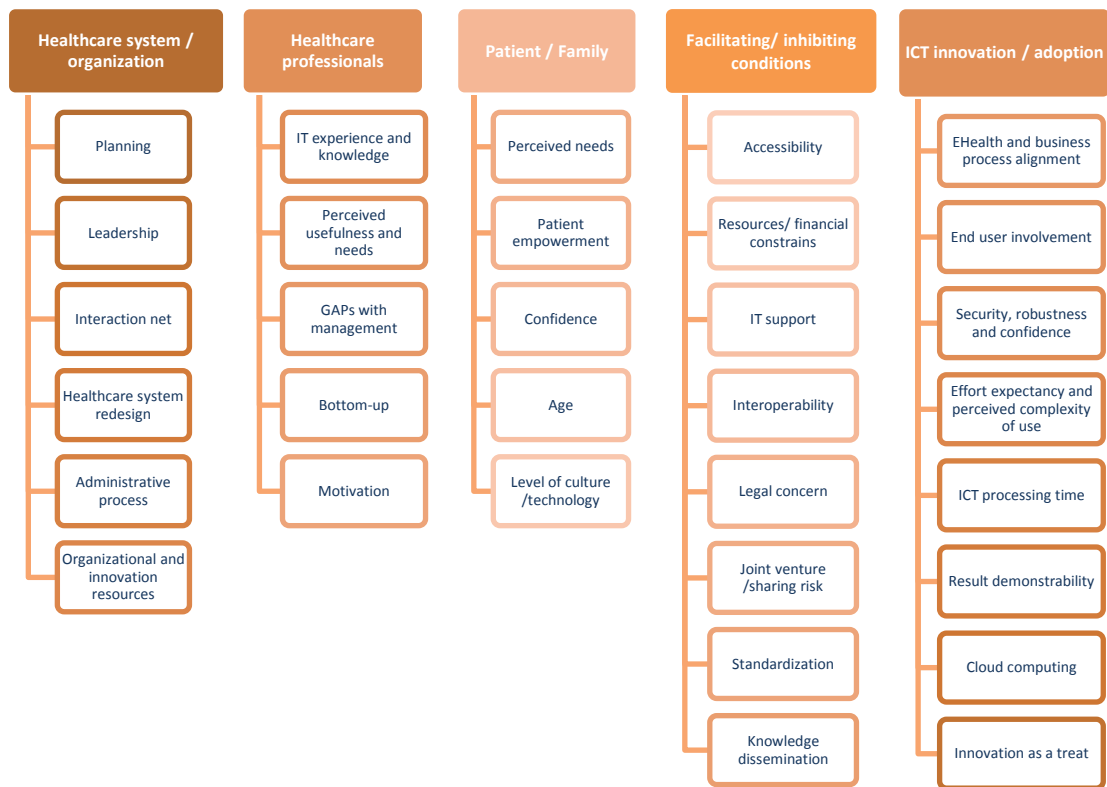


Figure 1: Concept Map of Data Analysis Framework

1) *Health system and organization* consists of people, institutions, and resources that deliver health and care services to meet the health needs of target populations (Integrated by 6 needs: Strategic planning, Leadership, Interaction net, Healthcare system redesign, Administrative Process, Organizational and innovation resources).

2) *Health professionals* who provide preventive, curative, promotional or rehabilitative health and care services in a systematic way to individuals, families or to communities (Integrated by 5 needs: IT experience and knowledge, Perceived usefulness and needs, Gaps with management, Bottom-up, Motivation).

3) *Patient and family* where the patient is most often ill or injured and in need of treatment or monitoring by a physician or physician assistant. Family is the members that are involvement in care (Integrated by 5 needs: Perceived needs, Patient empowerment, Confidence, Age, Level of culture/technology literacy).

4) *Facilitating or inhibiting conditions* are the degree to which a health provider or patient / family believes that an organization and technical infrastructure exist to support the use of the eHealth system (Integrated by 8 needs: Accessibility, Resources/Financial constraints, IT support, Interoperability, Legal concern, Joint venture/sharing risk, Knowledge dissemination, Standardization).

5) *ICT innovation and adoption* are the influential factors to health provider's / patient's acceptance of a new ICT / eHealth system and the development of new organization processes. (Integrated by 8 needs: eHealth and business process alignment, End users involvement, Security, robustness and confidence, effort

expectancy and perceived complexity of use, ICT processing time, Result demonstrability, Cloud computing, Innovation as a treat).

The results of the top needs from qualitative prioritization was: 1.The end user involvement; 2. Strategic Planning; 3.Leadership; 4.Interoperability; 5.Knowledge dissemination; 6.Security, robustness and confidence.

The result of the top needs from quantitative prioritization was: 1.Leadership; 2.Strategic planning; 3.Interoperability; 4.Patient empowerment; 5.Perceived Needs (patients); 6. Resources/Financial constraints.

The results are shown in Figure 2.

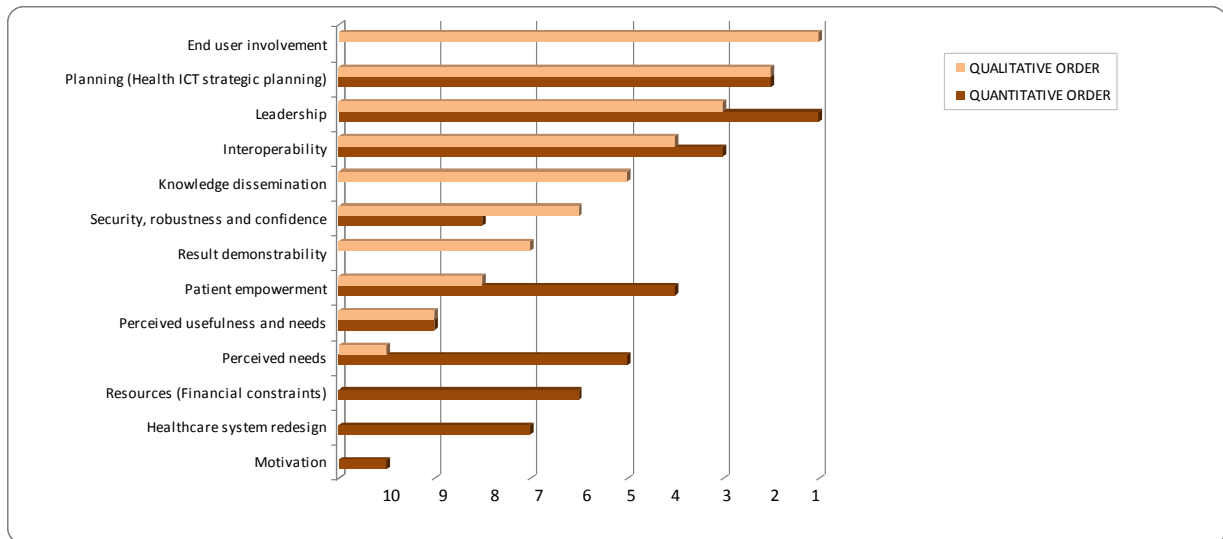


Figure 2: Top 10 Prioritized Needs

Conclusions

Aspects to facilitate the implementation of ICT in health and care have been identified. Addressing the lack of leadership involvement in eHealth, in the organizations, the need for changes in patterns of care for patients with chronic disease, and the involvement and active participation of citizens / patients and professionals is essential. The feedback from participants suggests that the integration of actions and care processes would improve with the better incorporation of ICT.

The quantitative prioritization exercise showed that the most important needs which should be addressed initially are: strong eHealth perception in leadership, strategic planning based on real needs and including eHealth, ensuring interoperability of information systems, working towards the empowerment of patients, and developing initiatives in response to the perceived needs by users / patients.

Differences in prioritization are identified in other categories. An example is how the need to promote bottom-up initiatives has a low score in the quantitative assessment, while in the qualitative assessment has an outstanding rating, which means that professionals see the promotion of greater feasibility and integration of ICT in health systems as important. A similar situation applies to the category regarding the need to address expectations about the effort and complexity arising from the use of ICTs, which was considered a low priority in the quantitative prioritization exercise but of higher importance in the qualitative prioritization exercise.

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PUBLIC HEALTH AND MEDICINE IN THE MIDDLE-EAST: INNOVATIONS AND INSTITUTIONS

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Keywords: Innovation; Middle East; Global Health; Engineering Education

EXTENDED ABSTRACT

Middle East and North Africa are a region of contrasts. In the last few decades, driven in part by the increasing wealth through the oil and gas sector, the Gulf Arab states have seen an unprecedented increase in improvement in the quality of life of its citizens. Maternal mortality has decreased, access to clean water and medicines have increased and overall life expectancy has continued to climb. Within the last decade, further emphasis has been laid on creating institutions focused on science, engineering, and innovation.

On the other hand, countries in the Arab world in the Mediterranean region (e.g. Lebanon, Syria, Jordan) affected in part by governance challenges and in part by internal and regional conflicts, have struggled in providing basic medical care to its citizens. However, recent medical challenges, such as regional epidemics (such as MERS) and global epidemics (such as Ebola) have created new common challenges for all countries in the region. Additionally, alarming levels of obesity and diabetes, as well as other chronic ailments such as heart disease and cancer have also connected the rich and the poor neighbours with a common goal.

The focus of this work is to understand these new and emerging public health challenges and analyse how the countries in the region are responding through investments in innovation and change in innovation policy. It is important to note that historically public health innovation has not been a major area of development or growth in the region. Innovation historically has focused on oil and gas, infrastructure and more recently in the IT industry. However, recent developments and an urgency associated with emerging public health challenges are resulting in changes that will have both short and long-term consequences. In order to contextualize the discussion in this work, we will look at four cases. Two of the cases will represent higher income countries, namely Saudi Arabia and Qatar, while two will represent developing countries in the region, namely Lebanon and Jordan. The similarities and differences in the demographics, vision and policy focus within and compared across the economic divide will provide a rich matrix of information about the status, landscape and future of innovation in the region.

Our work is divided into three main parts. In the first part, we look at medical and public health challenges faced by the region and historical capacity issues associated with these challenges. In this regard, we will discuss both infectious and chronic diseases and how they have influenced policy in the region. We will also look at chronic challenges with internal capacity, influence of migrant workers and non-local institutions and how these factors have impacted growth of the innovation sector.

In the second part, we will focus on recent developments in the innovation sector. In particular, we will focus on development of new regional institutions, emphasis on higher education by several governments in the region and role of researcher mobility in the region. Recent establishment of institutions such as King Abdullah University for Science and Technology in Saudi Arabia, foreign institutions in Qatar as well as renewed emphasis in medicine at the American University of Beirut and medical innovation in Jordan will provide contrasting perspectives. In particular, we will look at changes in government policy, foreign aid, entrepreneurship incentives and public perception of innovation as it pertains to recent challenges associated with MERS and Ebola as well as diabetes, mental health, heart ailments and cancer. We will look at specific initiatives and policies in the medical and public health sector to incentivize innovation and strategies to increase product and solution commercialization.

In the third and final part, we will look at the policy and sustainability implications of these policies and how they are changing the innovation landscape in the region. We will also discuss how these changes are affecting foreign aid, research, higher education and medical practice. We will also discuss, as a comparison, how these initiatives compare with other innovation initiatives in public health in other oil and gas rich regions such as Norway. Overall, our study will provide discuss how innovation, medicine, public health and healthy policy interface in one of the most complex regions of the world and what implications it may have for the region as a whole.

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INTEGRATION SERVICE DEVELOPMENT OF INFORMAL LEARNING ACTIVITIES WITHIN THE DISTANCE EDUCATION IN BRAZIL

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Keywords: Informal Learning; Distance Learning; Integration; Service

EXTENDED ABSTRACT

The use of Internet technologies allows mobility and gradually changes people's relationships with their learning. Discussions on informal learning activities have been intensified over the past few years. In Brazil, there has been a common problem with online courses that train technicians and graduate staff. These have been offered by the Open Technical School of Brazil and the Open University of Brazil, and managed by the Federal Government or course managed by private institutions. The challenge has been how to aggregate the informal activities into formal teaching practices. According to Melo Filho et.al (2014(a)), a typical Internet user can have more than one email account, different profiles on various social networks and access different channel videos. They also share documents, create blogs, collect photos in albums, and they can also be enrolled in several courses in different educational institutions, using different Learning Management Systems (LMS).

In most cases, teachers of institutions that offer courses, do not realize the full potential of these opportunities. In the current model, the courses have a significant number of learners separated by numerous groups. This makes monitoring always restricted to what each student performs only in the official LMS. The practice of individual monitoring is virtually impossible. Consequently, any other activities performed by the learners outside the official environment are not considered. These activities go from the use of a notebook to the use of computational artefacts like smartphones or tablets. This expanded learning scenario is called a Personal Learning Environment (PLE).

The isolated technologies, which personify the spirit of the PLE, have risen in the past years. They allow and facilitate the resource sharing throughout a lot of different channels and media. According to Conde et al. (2013), Attwell (2007(a), 2007(b)) and Schaffert & Hilzensauer (2008) in a PLE, learners are able to choose from a very simple set of tools to more sophisticated resources. These may be customized to deal with users necessities and preferences in a single environment. The authors Milligan et al (2006) point out that for some, the PLE concept facilitates. The learners can choose and control, allowing the selection and combination of informal and formal learning opportunities from a variety of sources. Others see the

notion of PLE as an extension of the portfolio, providing a learner-centered environment in which they can record achievements, plans and efforts towards their goals. Korhonen (2013) says what is most important in a PLE and an ePortfolio is that students make their competences visual and therefore there are a lot of cooperation elements within the PLE and ePortfolio.

Many PLE solutions are conceived to support learning. A great number of them are focused on providing autonomy to learners, without keeping track or accompanying their activities systematically outside the LMS environments. According to Conde et al. (2013) there are many initiatives, although, none of them offer an efficient method to ensure complete integration and interaction between the LMS and PLE. To that extent Wilson et al. (2007) proposed three scenarios for coexistence. Scenario #01 corresponds to a parallel existence of the LMS and the PLE. The PLE becomes a type of dominant conception in informal learning environments or even in learning based on competences. The LMS would remain as a key environment of the formal teaching systems. In Scenario #02, the LMS would make available its structures, establishing interoperability with the PLE. Finally, Scenario #03 consists of joining the features of the PLE to LMS, thus, incorporating the transforming power that exists in the PLE.

According to Cross (2007) informal learning has no intentionality. Its features are: (i) it can occur at any time and anywhere, (ii) it has no pre-established agreements, (iii) it can be completely unstructured, (iv) it is often controlled by the learners, and (v) it does not have declared results and inaccurate content. Rogers (2014, p.22) says that informal learning is now recognize as being far more extensive than formal learning. On the ICT perspective, Foster (2011) describes that informal learning invites practitioners to look again at technologies in developing countries, especially unfamiliar work built around social inclusion initiatives, and reconsider their potential to develop projects in this field.

Based on these assumptions, the work, a doctoral research in progress, aims to acquire new knowledge on informal learning activities within formal distance education, and on the basis of research results, develop the research-based service to provide teachers and tutors evidence to support the assessment of learners, and develop the autonomy in their learning activities.

The goal of the research is to investigate the phenomena that derive from the insertion of service between LMS and PLE to accomplish a formative accompaniment in educational contexts. Consequently, the data for the research will be gathered by using a non-intrusive strategy to collect and register information about the events related to learning activities in their PLE. The research process also creates the new concepts and methods for the research-based service under development. The goal is to test and define such data gathering and analyzing methods that allow learners to perform independently, as well as share learning experiences and contents of their PLEs in educational contexts.

They may also help and receive help from others, which may provide teachers and tutors with essential and meaningful information about formative accompaniment. In doing so, the formative accompaniment service in online learning adds the conceptual characteristics to its development as proposed by Gross (2009). Furthermore, the operational characteristics are described in Wilson et al. (2007) in Scenario #02. This scenario is represented by three references in Figure 1.

References “1” and “3” refer to educational contexts PLE and LMS. Reference “1” corresponds to the formal teaching environments also identified as institutional environments. In the proposed scenario, the service considers that one institution may have one or more than one LMS working; or eventually social media. Reference “3” refers to a context in which the PLE may be inserted. It is represented by the resources of the web and by the mobile devices. Reference “2” represents the formative accompaniment service.

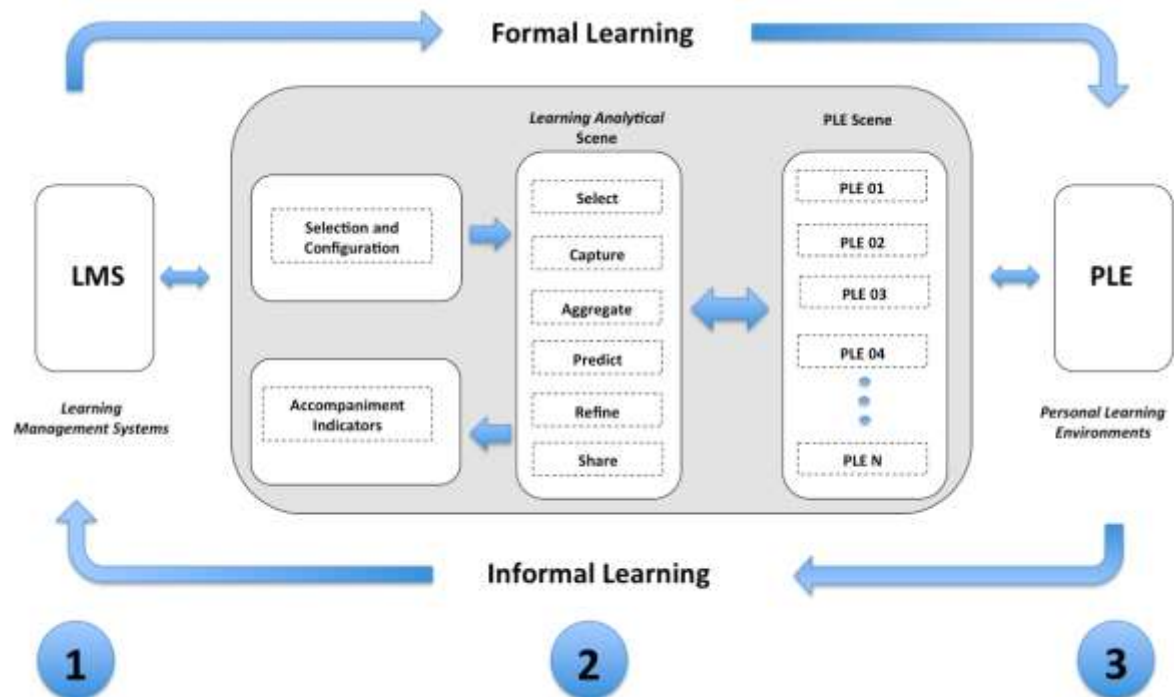


Figure 1. Formative Accompaniment Service. (Melo Filho et al., 2014 (b) (c)).

The stages build up this service search for exclusive investigation of the phenomena between the educational contexts, so that it allows the teachers or tutors to have elements or indicators to the individual knowledge or even in a group. Furthermore, it helps to perceive who is in trouble along the whole learning process, and eventually, it may make a deeper analysis of the formative accompaniment easier, allowing that decisions may be made in agreement with profile and learners’ learning context. It comprises four stages: (i) Selection and Configuration: this stage has the objective to allow the teacher or tutor to select and configure properly which relevant events, related to the learners’ activities, can be pointed out; (ii) Learning Analytics Scenario comprises six elements with the intention: to select the PLE scenario to be considered; investigate, and capture pieces of information related to the learners’ activities; add information based on the definitions of stage 01; be able to predict possible future actions of the learners’ activities and refine the obtained information and share the refined results, (iii) The PLE Scenario refers to the definition on which elements and/or technologies are going to be considered as PLE from the point of view of the service, (iv) The Accompaniment Indicator aims to provide the indicators, based on the previous selections set the stage of "selection and configuration", so that the formative accompaniment support.

Currently, the project is in the identification stage of the needs of teachers, tutors and students. The needs should be identified and a real scenario can then be specified, developed and replicated in different contexts. In December 2014 this project became a part of the VET – Teachers for the Future Program that

runs in Häme University of Applied Sciences in the city of Hämeenlinna in Finland, in partnership with the Ministry of Education of Brazil. The goal is to enrich the methodological approach in which this project is being developed. For its comprehensive character and according to the recent transformations offering professional courses in presencial or distance teach modality in Brazil the context in which this project intends to act is vocational education and training. At this time, a research plan is being developed so that the actions for improvement will follow the successful educational activities that are practiced in Finland.

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