

- BOOK OF ABSTRACTS -



Roma, 5-7 June 2019



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A1 MISSION-ORIENTED REASERCH

- Special Session –

Wednesday 05 June 2019 from 11:00 to 13:00

Abstract 66

TOWARD NEW FRAMEWORKS FOR MONITORING MISSION-ORIENTED RESEARCH

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Aim of the proposal:

The purpose of the interactive session is to debate and explore the contexts, principles and pragmatic challenges that must be negotiated in developing monitoring systems for RRI and OS. This includes engaging with discourses of responsible metrics, reflexivity and anticipation to ensure that future monitoring approaches adhere to the original principles and values promoted by RRI and OS. As the concepts themselves remain vague and ambiguous, this makes it even more difficult to evaluate and monitor RRI practices, their implementation, practical implications and impacts. Significant effort is made to define evaluation and monitoring criteria for assessing the effects and impacts of RRI and OS interventions and the impacts of the change in the R&I system. This session thus seek reflections and experiences relevant to these challenges, including the interconnections between policy instruments and the different actors involved, generally, and specifically in monitoring and evaluation.

Background:

In Europe, recent developments under the banner of science with and for society have focused on two major policy themes: Responsible Research and Innovation (RRI) and Open Science (OS). These mission oriented concepts share a vision of a transformed research and innovation system, which is more transparent, inclusive and aligned with the socio-economic and broader challenges confronting citizens and society. RRI and OS are closely related in many respects, promoting transformations in practices and values that both makes R&I more accessible to citizens and interested groups and more in line with their expectations and needs. As a support to policy and practitioner communities surrounding RRI and OS, to make policy implementation more effective and develop indicators for assessing impacts, new initiatives have been launched to explore the development of frameworks for monitoring the evolution of RRI and OS.

Methodology and empirical base:

We want to provide a space to share experiences and knowledge about cases and pathways towards RRI or OS. We want to discuss together with contributors who are having ideas or experience regarding the monitoring and evaluating of projects that have a distinct reference to RRI or OS or aligned approaches (e.g. implementation of single key dimensions like Gender, Ethics, Open Science, Societal Engagement, Science Education within projects). Further, discussions are welcome about experiences in assessing the impacts that RRI or Open Science have on the R&I system, its actors and its outputs. Thus, experiences in the implementation of RRI and impact assessment (indicator development) are very welcome.

The session is open to theoretical contributions and case studies, including reflections on the usefulness and limits of the methodologies. Possible lines (among others):

- RRI/OS pathways and sustainable R&I trends in policies, and its monitoring and evaluation

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- Cases and experiences in RRI/OS, generally, and with a special focus on policy instruments/ measurement/ evaluation initiatives
- Benefits/learnings from RRI/OS cases and measurement of impacts: how can impacts be characterized, are there differences/commonalities between keys, beyond keys, differences/commonalities between institutional settings, different kind of benefits, etc.
- Co-creation initiatives with stakeholders: not only in the implementation, but also in the development of indicators

Results:

Speakers are welcome to give a short presentation and then - according to the diversity of contributions and the audience – get into an interactive format with the plenary to exchange knowledge and experiences. Therefore, the organization team will invite representatives of past and ongoing RRI projects from the SwafS portfolio (funded 2014 up to 2019).

Invited contributors to the session will have the possibility to give a short presentation (3-5 minutes) about their experiences. In the second part of the session, a world café setting will be set up (3 tables) on which different guiding questions should be discussed in each of the 3 stations. The questions will be selected according to the actual contributors and will be sent to the EU-SPRI organization committee prior to the conference. In the end, a summary of the main discussing points will be presented to the whole audience by the three table hosts. The open format also allows including people from the conference audience who are attending the session without prior invitation to contribute to the discussions and to get in exchange with the other participants.

Conclusions:

We want to bring together knowledge on different levels, therefore people actively involving in the session can bring in experiences on a theoretical or methodological approach (e.g. about the selection criteria of RRI or OS use cases), focus on the coverage of one or more key dimensions or beyond, look on different types of benefits (scientific, democratic, societal and economic), have different actor groups (keywords: stakeholder involvement, quadruple helix innovation) and levels (micro, meso, macro) in mind, looking on single or multiple country comparisons and focusing on current topics (e.g. SDGs).

A2 STI POLICIES 1

Wednesday 05 June 2019 from 11:00 to 13:00

LUCIO MORETTINI, Chair

Abstract 20

ROBOTICS AND ARTIFICIAL INTELLIGENCE: IMPLICATIONS FOR THE FUTURE OF WORK

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The current wave of technological change based on advancements in artificial intelligence (AI) has created widespread fear of job loss and further rises in inequality. This paper discusses the rationale for these fears, highlighting the specific nature of AI and comparing previous waves of automation and robotization with the current advancements made possible by a wide-spread adoption of AI. It argues that large opportunities in terms of increases in productivity can ensue, including for developing countries, given the vastly reduced costs of capital that some applications have demonstrated and the potential for productivity increases, especially among the low-skilled. At the same time, risks in the form of further increases in inequality need to be addressed if the benefits from AI-based technological progress are to be broadly shared. For this, skills policies are necessary but not sufficient. In addition, new forms of regulating the digital economy are called for that prevent further rises in market concentration, ensure proper data protection and privacy and help share the benefits of productivity growth through a combination of profit sharing, (digital) capital taxation and a reduction in working time. The paper calls for a moderately optimistic outlook on the opportunities and risks from artificial intelligence, provided policy-makers and social partners take the particular characteristics of these new technologies into account.

Keywords: Artificial intelligence, technological unemployment, inequality, productivity growth.

Abstract 84

DEVELOPMENT OF CITIZEN EXPERTISE: TOWARDS A NEW ENVIRONMENTAL GOVERNANCE?

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Aim of the proposal:

This paper aims to continue a strong track that emerged from our doctoral thesis and which focused on the citizen consultation in the frame of environmental monitoring of former uranium mines.

Background:

At the local level, the end of uranium mining in the 2000s prompted many questions in the world of associations supported by the Commission for Research and Independent Information on Radioactivity (CRII-RAD) main figure of "expert militancy" in the nuclear field (Topçu, 2006). Uncertainties related to the environmental and health consequences of uranium waste have strongly called into question the monitoring carried out by Areva and the government, leading to the mistrust of citizens (Rosanvallon, 2006). At a prime time and on a public channel, on February 11, 2009, the report "Uranium, the scandal of the contaminated France" revealed to the public the consequences of radioactivity and the uncertainty about the traceability of the distribution of uranium waste (used to be distributed to public). The government reacted by the publication of the circular Borloo (2009) a few months after the broadcast of this report. This text sets out four major objectives:

- 1) the control of old mine sites
- 2) to improve knowledge of the environmental and health impact of old uranium mines and monitoring
- 3) to manage uranium waste
- 4) to develop public consultation

Methodology and empirical base:

From two case studies (La Commanderie, Piriac-sur-Mer), we rely on a sociological methodology that articulates the analysis of documents and semi-structured interviews (30) conducted with the various stakeholders.

Results:

This work has highlighted, in one of its conclusions, the role of the Gamma Prospecting Detector (DG5) in citizen claims for the decontamination of radioactive areas in the commune of Piriac-sur-Mer (Loire-Atlantique, France). The democratization of measuring instruments, and the transmission of a methodology for measuring radioactivity by CRIIRAD have enabled a group of citizens to detect contaminated areas in Piriac-sur-Mer. Another group of citizen activists also against the effects of radioactivity in a neighboring town, but lacking the same human and technical resources as the first group, opted for a litigation strategy.

Conclusions:

We are therefore interested in research still under-studied in Science and Technology Studies, that of the role of instruments in the production of technical knowledge (Knorr-Cetina, 1981, Latour, 1987).

Abstract 75

EXPLORING A MATURE R&D NETWORK: THE EVOLUTION OF NETWORK TOPOLOGIES AND RESEARCH TOPICS IN THE OIL AND GAS INDUSTRY

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Aim of the proposal:

The aim of the proposal is to explore the evolution of a mature knowledge network. Who are the actors? What are the research topics? What roles do different actors play and do they change over time? This work is not meant as a pure quantitative assessment of mechanisms within a mature network, but rather a qualitative exploration of how priorities through research calls affect the topology and actor composition.

Background:

RQ: What drives the evolution of actors and collaborations in a mature R&D network?
- Do they follow a generic path postulated by industry life cycle literature? If they do, we should expect mature networks to become more rigid with time.

Methodology and empirical base:

There is strong evidence that knowledge networks affect innovation and industry performance (Gulati, 1998; Powell, Koput, & Smith-Doerr, 1996), network analyses have thus become a vital part of studies of innovation. That sectors differ is at the core of innovation literature and it is postulated that every sector has its distinct set of knowledge base, networks and institutions (Malerba, 2002, 2005). Empirical studies on network and innovation have also confirmed that sectors differ in their knowledge network patterns (Broekel, Graf, & Technology, 2012; Malerba & Vonortas, 2009). Furthermore, recent work has emphasised the importance and potential of introducing the dynamic dimension to studies of network and innovation (Balland, Boschma, & Frenken, 2015; Boschma & Frenken, 2010; Glückler, 2007; Powell, White, Koput, & Owen-Smith, 2005). If the locus of innovation lies in networks, dynamic network studies is a good way to portray the evolution of economic development. The advance in dynamic network methodology is particularly strong in the field of economic geography ((Balland et al., 2015; Boschma & Frenken, 2010; Glückler, 2007). Here, the approach has been used to show how different types of proximities matter for innovation and partner selection and how these change over time. Although most empirical works focus on emerging networks, there are studies that postulate how networks develop over its lifecycle. For instance, the industry lifecycle literature suggest that networks follow predetermined paths as they evolve (Balland, De Vaan, & Boschma, 2013; Klepper, 1997). Related research also claims that (R&D) network characteristics are invariant across sectors (Tomasello, Napoletano, Garas, & Schweitzer, 2017), and that they, over time, experience periods of rise and fall. Such findings are also related to general insights from network studies, which has shown that most types of networks show power distributions of actors' degree centrality and core-periphery structures (Barabasi & Albert, 1999).

I would argue that the existing literature does not explain the evolution of mature networks for all types of sectors very well. There are (at least) two reasons for this. First, the general

findings that networks show similar features across sectors is based on calculations of degree distribution and the appearance of small worlds in many industrial knowledge networks. However, these are structures of most types of networks, even in ancient bacteria (see e.g. Barabasi & Albert, 1999). For the understanding of innovation and the evolution of the economy however, it cannot be irrelevant which actors that take up central and peripheral positions. I would thus claim that the strength of network analyses for studies of innovation is not that networks appear to look similar when drawn with algorithms. Rather, insights about the evolution of actor composition and their position has to be included in such analyses. Here, there are obvious sectoral differences (Malerba & Vonortas, 2009). Second, the industry life cycle theory is built on the product life cycle literature (Klepper, 1996). Large parts of the economy does not necessarily deliver concrete products as their main output (von Tunzelmann & Acha, 2006). This is important, since the industry life cycle literature postulate that mature industries reach a declining stage as they mature. However, many large firms are old and operate in mature sectors, but still stay relevant and most likely technologically updated (e.g. food sectors, energy sectors, etc.). There is little empirical evidence that networks around such industries decline in mature phases.

With these perspectives in mind, this paper investigates the evolution of a mature sector by analysing an extensive dataset of Norwegian petroleum-related R&D collaboration between 2005 and 2015. The oil and gas sector is, although mature, among the largest sectors in the world and highly profitable. Previous studies of mature industries (often termed “low-tech”) have shown that these types of sectors rely heavily on collaborations in the supply chain (Robertson, Smith, & von Tunzelmann, 2009; Trott & Simms, 2017). This is relevant also for the petroleum sector. This is not a low-tech industry, but an industry highly reliant on technological upgrading through user-producer interactions in order to extract increasingly inaccessible resources (Acha & Cusmano, 2005; Simensen & Thune, 2018). In the analysis of this R&D network, the topology and network statistics over three periods are analysed, and then broken down by type of actors. To shed light on the observed development of the topology and actor composition, research calls and projects descriptions are examined to see how changing priorities affect the network evolution.

Results:

Comparing the network over three periods

The empirical base of the analysis is a network analysis of a unique dataset of publicly funded R&D projects in Norway. The network visualisation tool Gephi was used to draw network graphs and to calculate network metrics (Bastian, Heymann, & Jacomy, 2009). The database had 11 years of data suitable for a network analysis (2005-2015). Next, the dataset was divided into three intervals where each interval represents a timespan for projects' start up dates (in line with previous work, e.g. Phelps, 2003). The first period, 2005-2008, includes the research projects that started in the four years 2005, 2006, 2007 and 2008, similarly, four years in 2009-2012 and three in 2013-2015. The logic behind this is that the decision to start to collaborate is affected by the actors' priorities and the incentives given by research council. It also allowed for an analysis of three points in time, which is needed to investigate the changes. The overall metrics for the connected actors (giant component) of the social network for the three different intervals are shown in table 1.

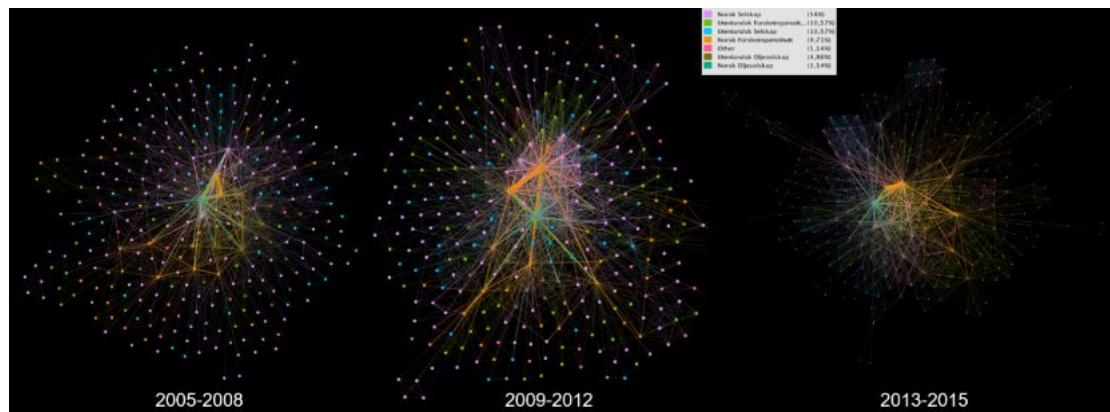
Table 1.

Overall network metrics for the giant component over the three periods.

<u>Network statistics</u>	<u>2005-2008</u>	<u>2009-2012</u>	<u>2013-2015</u>
Average degree	10,05	10,91	10,47
Avg. weighted degree	17,10	18,01	15,035
Network diameter	5	5	5
Graph density	0,033	0,034	0,031
Modularity	0,121	0,093	0,163
Avg. clustering coeff.	0,88	0,875	0,877
Avg. path length	2,39	2,40	2,56
Nodes (No. of actors)	306	319	343
% of nodes connected	87,43 %	92,73 %	82,45 %
Edges	1538	1740	1800
% of edges visible in giant comp.	99,81 %	99,32 %	98,85 %

The perhaps most notable with these figures are that they are quite stable throughout the period. There are almost the same number of projects in each period. However, despite its relatively shorter timespan, the latter period has the highest amount of unique actors involved. More actors have thus been involved in projects in the last three years, indicating an increase in either resources for research and/or a more diverse set of research collaborators. The largest variation in the network statistics also occur in this period; between 2013 and 2015 we observe a decline in the average weighted degree and longer path lengths, which means fewer projects per actor and a more sparse graph.

The nodes in the three network graphs (see figure 1) are coloured according to type of institution; each colour represent one type of actor. The edges (connections or lines) follow the same colour codes, but they could also be a mix of two of the colours. For instance, a Norwegian oil company and a foreign oil company collaborate on a project, the edge will show a mix of the two colours orange and light pink. The positions of the actors vary over the years and by simply exploring the coloured networks graphs, it is apparent that the network change between the three periods. Although a large Norwegian company and two research institutes are the central nodes in all three graphs, the presence of other actors vary between the periods. There is a transformation in the area surrounding the most central actors. In 2005-2008 this part is dominated by connections between various forms of Norwegian companies (pink), then in 2009-2012 the foreign oil companies (brown) have high central positions and finally, in the last period Norwegian research institutes (orange) and foreign oil companies seems to be both better connected and positioned closer to the core of the research network. See figure 1.



In 2005-2008, the centre of the graph was dominated by a Norwegian oil company, which had several projects with two central Norwegian research institutes. Foreign oil companies and Norwegian research institutes dominated the surrounding areas of this triangle, Norwegian companies and foreign research institutes seemed numerous, but in more peripheral positions. Norwegian companies and foreign research institutions were scattered over the whole graph, reflecting that many of them participated only in one or two research projects. In 2009-2012, the network was dominated by the same actors, with the two research institutes being even more central and having more research projects between them than in 2005-2008. The other Norwegian research institutes seemed to have become more involved with each other, visualised by a more well-defined orange cluster compared to the 2005-2008 period (see the orange linkages). The stronger presence of purple nodes around the core indicates that more Norwegian companies participated in research projects with the most central actors in this period.

In the latter period (2013-2015), the graph has become less dense, with dislocated hubs farther from the core. Norwegian research institutes have been more active in projects with each other, represented by the orange cluster of nodes southeast of the core. It also looks like the most central Norwegian company moved further away from the two most central research institutes. The network is thus dissolving into a more diverse and dislocated collaboration structure.

There can be many reasons for the observed fluctuations in the compositions of the core actors from year to year. One is that it simply could be the nature of the research project calls – different programmes focus on different topics that is more relevant for a certain type of actors. In addition, some research programmes do not have constant project calls, but change throughout the years the programmes exist (see the next chapter for a breakdown of the programmes). Other possible reasons are the change in the actors' priorities due to external factors such as the oil price or the reach of "peak oil" on the Norwegian continental shelf in the early 2000s¹. To investigate the driver behind the change in actor structure, average score of centralities across actor types were calculated (table 2).

Table 2.

A comparison of the mean of normalised betweenness centralities of the different type of actors.

<u>Type of organisation</u>	<u>2005-2008</u>		<u>2009-2012</u>		<u>2013-2015</u>	
	<u>Mean</u>	<u>N</u>	<u>Mean</u>	<u>N</u>	<u>Mean</u>	<u>N</u>
Norwegian oil company	0,19447	2	0,15583	2	0,15461	2
Norwegian research inst.	0,01625	34	0,01934	38	0,02149	38
Foreign oil company	0,01118	18	0,01278	20	0,01105	26
Norwegian Company	0,00114	204	0,00051	162	0,00071	192
Foreign company	0,00037	37	0,00030	38	0,00001	39
Other	0,00018	18	0,00047	16	0,00022	21
Foreign research inst.	0,00018	37	0,00005	68	0,00017	98
Total average	0,00400	350	0,00410	344	0,00377	416

The oil company and two research institutes that represent the core of the network collaborate intensively with each other in all three periods. Table 2 show that the two Norwegian oil companies dominate the network, accounting for as much as 19% of all shortest paths between any two actors (0.39 the largest alone). Their betweenness centrality decline over the years, due to the large Norwegian oil company's decrease in projects. Its weighted degree, which denotes how many times it participates in a research projects, was reduced from 591 to 370 from the 2005-2008 to 2012-2015. This has influenced their betweenness centrality, which went from 0.39 to 0.29. On the other hand, the two most central research institutes both increase their betweenness in the network as time progresses, which is also visible in the overall averages of Norwegian research institutes. Based on this, we can conclude that academic actors increase their relative importance in the core of the graph.

While Norwegian companies have low betweenness centralities, they have important positions in the projects by being the project leader in half of the projects. Together with the research institutes, they take leading roles in the research projects. Of the top 20 actors in the research network, four petroleum suppliers are present.

Their position as project leaders could be due to the hierarchical structure of the upstream oil and gas industry: oil companies grants contracts to large service and supplier companies, which again have contracts with a vast number of subcontractors that supply specific equipment, technologies and services (Acha & Cusmano, 2005). The latter companies often own the technologies developed, with oil and gas companies as sponsors and the research institutes as contributing knowledge actors. As mentioned, the development of the periphery of the graph suggests that collaboration between two firms (purple edges) and collaborations between two research institutes (orange edges) seem to be more separated in the latest period. To understand what drives this we turn to the research excerpts in order to investigate whether there are changes in the research topics over time.

¹ <https://www.ssb.no/energi-og-industri/statistikker/ogprodre/kvartal/2014-11-21>

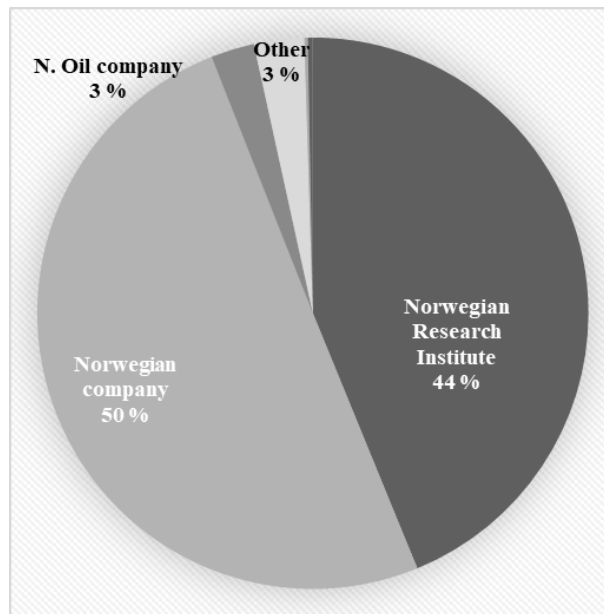


Figure 2. The type of actors that acted as project leaders in the research projects.

The context matters – evidence from the research programmes and topics:

Since calls in research programs could vary, they could affect the composition of the networks from one period to another. I thus investigate the calls and the content of the projects, to see if there are large fluctuations that can explain the patterns observed. There are six petroleum related programs that were included in the analysis, see figure 4. The largest of these are the programs named Petromaks 1 and Petromaks 2, where number two supersedes number one. Their objective is to “enhance the next 50 years of oil-related activity and secure gas production in a 100-year perspective²”. They focus on both basic and applied research and technology development in companies.

The occurrence of the Petromaks projects are largest in the two first years, and is then reduced and stabilised to ~ 40-60 each year. In figure 3, I have plotted the amount of projects in each program, and we can see it fluctuates to some extent, but seems stable enough for a comparative analysis (somewhat lower in the timespan 2009-2012).

² http://www.forskningsradet.no/prognett-petromaks/Programme_description/1226993690985

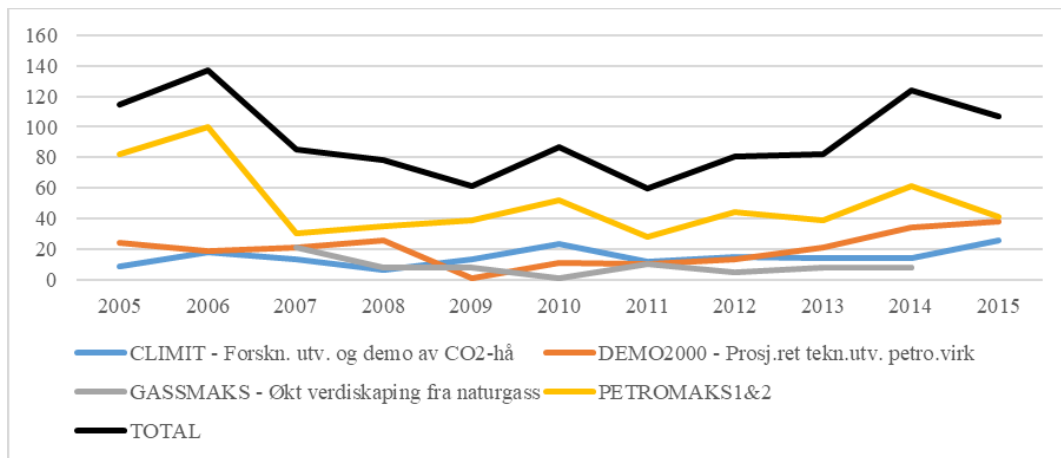


Figure 3. Amount of projects in the programmes in each year.

The other two large programs are DEMO2000 and Climit. They are smaller than the Petromaks, but their relative share to total projects increases throughout the period. DEMO2000 aims to develop technology development to enhance the competitiveness for Norwegian oil and gas related firms³. Demo2000 has a more direct technology development focus than the Petromaks programmes. CLIMIT is a carbon capture and storage program that started in 2005 but was expanded in 2008⁴. This program can be seen as a governmental response to the increased focus on climate change around the beginning of this period. In a New Year's speech in 2007, the Norwegian prime minister announced his "moon landing" project, which was the building of a full-scale gas power plant with carbon capture and storage (CCS). The project had thus top priority from the political level, leading to generous research funding on the topic.

Despite these developments, the number of projects and the mandate of the programs do not change over the period. I thus performed an analysis of the content of the research projects by analysing the research descriptions, searching for the occurrence of context-specific keywords, see table 3. The chosen keywords were selected based on a general reading of the project descriptions and through a list of most occurring keywords after a text analysis. In addition, relevant keywords for the industry and research were included. Not all of these keywords gave any results, and were thus excluded from the table. The most compelling changes relative to the amount of research projects is the increase in the two keyword "climate" and "CCS".

The other keywords do also fluctuate, but has not a significant change relative to the total amount of research projects. It is a clear rupture from 2005-2008 to 2009-2012 that coincides well with the contextual setting described in the previous paragraph.

³ http://www.forskningsradet.no/prognett-demo2000/Programme_description/1228296565509

⁴ <http://www.climit.no/en/about-us>

Table 3

Amount of projects in where the topics have been mentioned in the project description

<u>Term</u>	<u>2005-2008</u>	<u>2009-2012</u>	<u>2013-2015</u>
Climate / Klima	8	11	15
CO2	64	74	56
CCS	1	23	21
Recovery	47	40	46
Mature	10	8	15
Oil price / Oljepris	4	2	2
Safety / Sikkerhet	48	44	29
Technol...	204 (49%)	115 (39%)	132 (42%)
Total amount of projects	416	290	314

To assure that increase in budgets were not the obvious reason for the observed changes, we also tested whether there were more resources in the latter period. This was not the case, the total funding has rather declined during the period, but more actors have been involved.

Conclusions:

This paper contributes to a better understanding of the dynamics of the mature phase of knowledge collaboration networks. Furthermore, it contributes to a better understanding of the evolution of networks in non-manufacturing sectors. It is to the author of this paper's knowledge the first to take into account content of the ties in a non-static network analysis. The findings from this analysis indicate that different sectors and industries evolve differently depending on the demand for their goods in mature stages. Rather than seeing mature networks as declining and rigid, they do react to industry-related events as proposed by management literature 10-20 years ago (Koka, Madhavan, & Prescott, 2006; Madhavan, Koka, & Prescott, 1998). Hence, general findings from industry life cycle literature (ICL) are not generalizable for all types of sectors. The evidences in ICL come from the literature on product life cycle industry, often backed by studies of the competitiveness of European manufacturing clusters. However, I would argue that the majority of economic actors do not follow such stylistic evolutionary paths of rise and fall, but that mature phases can persist over long periods. Lastly, it is uncertain whether R&D networks really experienced a golden age in the 1990s and then declined (Tomasello et al., 2017). These findings might be more due to tendencies of publicly announcing R&D networks than a real decline. Evidence show that public R&D funding do not decline in this period.

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Abstract 103

MOBILIZING KNOWLEDGE-FOR-POLICY FOR SOCIETAL TRANSFORMATION: PRACTICES & CHALLENGES WITHIN DUTCH MINISTRIES

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Keywords: science-policy interface, evidence-informed policy, knowledge management, unstructured problems, societal challenges

1. Aim of the proposal:

In the past decades, Dutch ministries have witnessed a variety of developments, both inside their organizations as well as in their surroundings. Among these developments, such as the externalization of expertise under New Public Management and the decentralization of a number of issues to lower levels of government (Faasse & Koens, 2017; Karré et al., 2012), attention is increasingly focused on the emergence of complex societal challenges. These challenges are characterized by uncertainty and ambiguity, go beyond current divisions within government and lack clear-cut solutions. Therefore, it is argued that governments need to develop new strategies, networks and instruments to face these challenges (Fenger & Misdorp, 2015; Head & Alford, 2013; Kuhlmann & Rip, 2018).

As a result, governments face broader and changing knowledge needs. Dealing with complex challenges requires more open and experimental approaches, the involvement of a broad range of actors and the establishment of new networks to encourage systemic change. One of the pressing questions is therefore whether governments are equipped to mobilize and organize knowledge-for-policy in light of these complex challenges (Deuten & Van Drooge, 2018; Meuleman & in 't Veld, 2009). If complexity requires new forms of governance, what does this imply for strategies of mobilizing knowledge-for-policy? Some argue that policymakers need to take up less “traditional” roles in complex decision-making contexts (Fenger & Misdorp, 2015). Rather than managing a relationship with specific research organizations, policymakers could play a role in organizing and facilitating networks between different societal actors (including research organizations) to ensure that these networks have the means to develop and mobilize knowledge for the issue at stake. How do policymakers deal with these complex expectations?

In this paper we address these questions by exploring how Dutch ministries deal with the organization and mobilization of knowledge-for-policy in the context of complex societal challenges. We investigate how Dutch ministries have shaped and continue to shape the “management” of knowledge within their organizations and in their relationship with other societal actors (ranging from research institutes to implementing organizations to citizens). While there is no lack of (grey) literature dedicated to the science-policy interface and boundary work in the Netherlands (Derksen, 2013; Halffman & Hoppe, 2005; Hoppe, 2014), our aim is to study specifically whether and how ministries respond to complex challenges in the organization of knowledge-for-policy.

Our research question is therefore: how can we understand new practices for mobilizing and managing knowledge-for-policy in the context of complex problems within the Dutch ministries, and what challenges do they face? In answering this research question, we aim to

contribute to thinking about knowledge-for-policy in the context of complex challenges, and support evolving practices within the Dutch ministries.

2. Background:

2.1 Perspectives on knowledge-for-policy

The relationship between science and public policymaking has been of long standing interest of various STS scholars (Gieryn, 1983; Halffman, 2003; Jasanoff, 1990). Rejecting the idea of science as “speaking truth to power”, these scholars argue that science does not simply provide knowledge to the “demand” side of policymakers and politicians. On the contrary, the relationship between (scientific) knowledge and policymaking should be understood as a complex process in which the demarcations between the two are constantly negotiated. This process and the activities involved are often described and analyzed through the concept of boundary work (Gieryn, 1983).

The introduction of the concept of boundary work has spiked a lot of interest and research into knowledge/policy relations. This work mostly concentrates on studying boundary work on the micro level: for example in “boundary organizations” that position themselves in between science and policy and hence are constantly navigating between the two (Guston, 2001). As Halffman (2003) emphasizes however, boundary work also occurs on the level of policy problems (or policy agendas). Around a policy problem, a boundary configuration emerges. Depending on the issue, such a configuration or arrangement can be more or less institutionalized or stable. Hence, the concept of boundary work is also relevant within the broader perspective of a policy problem or policy agenda for which knowledge-for-policy needs to be organized and mobilized.

Following the perspective of boundary work, knowledge and policy are not two clearly demarcated concepts. Instead, there is a variety of knowledge(s). As Meuleman & in ‘t Veld (2009) put it, knowledge is relevant information – and what is considered relevant information, depends on the policy context and the values at stake. Therefore, different contexts or different policy issues, can demand different kinds of knowledge, such as

Scientific & practical knowledge;

Know what;

know how;

know who;

Alfa, beta & gamma knowledge;

Strategic & operational knowledge (Deuten & Van Drooge, 2018).

Hence, (scientific) researchers are not the only ones that can contribute relevant knowledge to policy processes. Instead, both researchers, policymakers and practitioners alike can contribute relevant information based on experience and practical knowledge (Edelenbos et al. 2010).

Likewise, a simplistic perspective on policymaking also turns out to be problematic. While it is common among policy analysts to depict the policy cycle as a clear sequence of phases, it is agreed upon that this is an analytical tool rather than a realistic display of the policy process (Cairney, 2016). In practice, the different phases of the policy process often overlap and intersect, and are hence not easily distinguished from one another.

Moreover, policymakers need to deal with a variety of (policy) problems. Hoppe (2010, 2014) distinguishes between different problem types, according to agreement on values and certainty on required and available knowledge. The construction of a policy problem is in this perspective not confined to policymakers and politicians. Instead, how a policy problem is perceived both depends on and influences which knowledge(s) is included in the process.

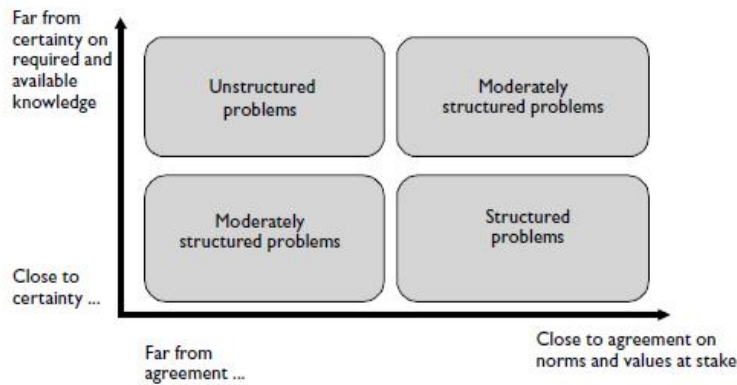


Figure 1. Problem types. Source: Hoppe (2010b)

Because both knowledge and policymaking are complex and heterogeneous, we use a systemic perspective on knowledge-for-policy (Deuten & Van Drooge, 2018). In a systemic perspective, demand and supply of knowledge are organized and mobilized around a policy agenda (cf. boundary configuration). Knowledge networks emerge around different policy agendas that consist of representatives from research, policy and practice. These knowledge networks both influences, and are influenced by (the structuring of) the policy problem at stake (Hoppe, 2014). Hence, the systemic perspective draws attention to the question of who is able to participate within these networks.

2.2 Knowledge-for-policy in the context of complex challenges

In this paper, we focus on the question of organizing knowledge-for-policy in the context of complex challenges. Deuten & Van Drooge (2018) distinguish between three types contexts in which ministries seek to mobilize and organize knowledge-for-policy:

1. Policymaking – a ministry seeks to ensure that its policy processes are evidence-informed;
2. Practice – a ministry seeks to ensure that its field – policy implementation, practitioners – have access to knowledge that enables them to improve their practices and innovate;
3. Transitions – in the context of societal transitions, such as the transition towards clean energy or a circular economy, a ministry can play role in organizing dynamic knowledge networks dedicated to the development of innovative solutions and the exploration of multiple pathways.

Complex challenges and the societal transitions believed necessary to address these challenges, thus require a less traditional role of governments in the organization of knowledge-for-policy. Transition processes call for the integration of both scientific knowledge and daily practice, in order to develop socially robust knowledge (Meuleman & in 't Veld, 2009). Moreover, transitions require the exploration of multiple pathways, as well as a multitude of actors and organizations to act and thus cannot be “solved” by policymakers

alone. Hence, instead of organizing knowledge for their own (demarcated) policy issues, ministries can potentially play a role in the governance of knowledge networks, by stimulating the involvement of various actors, aligning their agendas, and exploring innovative solutions.

2.3 Knowledge-for-policy in the Netherlands

Halffman & Hoppe (2005; Hoppe, 2014) discern three consecutive (not mutually exclusive) patterns of the organization of expert advice within Dutch government since the 1970s: neo-corporatism, neoliberalism and a more recent deliberative turn. According to Hoppe (2014), these trends of expert advice giving in the Netherlands reflects a shift: whereas policymaking used to be characterized by mainly structured problems, policymakers increasingly need to deal with more unstructured problems.

Neo-corporatist arrangements are characterized by expert-informed decision-making through consensus. In the Netherlands, the neo-corporatist tradition is marked by a rise of the number advisory councils and later the establishment and institutionalization of the Dutch planning bureaus. These advisory bodies or research institutes are traditionally perceived as reliable and independent, and provide government with state-of-the-art knowledge and relate this to policy developments and options.

The neoliberalist trend is visible in the governance of knowledge-for-policy through the externalization of in-house expertise of Dutch ministries. In the tradition of New Public Management, neoliberalist tendencies have led to increased “contractualization” of the relationship between supply and demand of knowledge. This trend is reflected in an increasingly structural approach towards the organization of knowledge-for-policy within ministries and characterized by an instrumental notion of knowledge/policy relations.

The third trend, “the deliberative turn”, has emerged in connection with public participation discourses and a call for the inclusion of non-scientific knowledge, in response to controversies and challenges, and awareness of the limitations of traditional expertise. This trend is reflected for example in the rise of “knowledge centers” that aim to combine expertise around a policy issue or domain to contribute to collective learning processes.

Concerning the “internal” organization of knowledge-for-policy within Dutch ministries, previous research shows that each ministry in the Netherlands mobilizes and manages knowledge in a distinct manner (AWTI, 2005; Rouw, 2011; van Twist et al., 2007). These different organizational structures are known to change overtime, although the motives for these changes are not always clear, but rather represent a continuous search for the “best” way to position (strategic) knowledge within the organization (van Twist et al., 2007). We therefore expect to find a diversity of practices of organizing and mobilizing knowledge-for-policy within the Dutch ministries.

3. Methodology/empirical base:

First, we conducted a literature study to develop a perspective on knowledge-for-policy, especially in the context of complex challenges. The insights from this literature study have been summarized in the previous section. Our empirical work consists of an in-depth study of government departments in the Netherlands. We conduct interviews with policymakers involved with knowledge management within ministries (first round). Applying a snowball method, we continue by interviewing policymakers responsible for specific policy agendas, as well as representatives of research organizations (such as advisory councils, research institutes, public knowledge organizations). This is supplemented by a study of key documents

provided by the different ministries, such as knowledge and innovations agendas (“SKIA’s”), and financial records.

Finally, we plan to organize three stakeholder-meetings, both to validate our findings as well as to facilitate exchange of experiences and practices among policymakers and stakeholders. We hereby aim to contribute to the formation of an (informal) “community of practice” to stimulate cross-ministerial learning.

4. First results:

The Netherlands currently has twelve ministries. In general, these ministries consist of different Directorates, which in turn consist of different departments. We observe that the responsibility for knowledge “management” can be assigned to different layers of the organization and in various ways: in some cases, there is a central department, such as the Knowledge Directorate in the Ministry of Science, Education and Sports. In other cases, each department or team has its own research budget and knowledge agenda. These different practices highlight how ministries, or departments or even individuals within ministries, have diverging perspectives on how to (best) position knowledge within the organization as well as how (and with whom) to arrange knowledge networks or research agendas.

One of the trends we observe is that various ministries increasingly formulate the need for a centralized, overarching body within the ministry to coordinate the articulation of knowledge needs, research questions, and the use of knowledge throughout the organization (as an add-on to existing knowledge structures within the smaller departments). Some ministries already have such a structure in place, and where this is, or was, not the case, efforts are made to create such a centralized body, for instance through the establishment of the position of “Chief Science Officer” (CSO).

An example is the appointment of a CSO last year by the Ministry of Health, Welfare and Sport, in response to a fragmented organization of knowledge throughout the Ministry and, due to this, a lack of attention to more complex and strategic cross-departmental policy issues. Because within this ministry each subdivision has its own research budget, knowledge needs are not integrated, leading to fragmented and even contradicting knowledge claims. One of the initiatives that has been introduced by the CSO are so-called “knowledge platforms”. These knowledge platforms are organized around key themes, which are considered relevant for the Ministry as a whole. In these platforms, researchers, policymakers and practitioners work on a strategic vision on these themes and by doing so, identify knowledge questions and gaps. Hence, through these platforms the ministry tries to address the above mentioned issue of fragmentation and lack of attention to complex issues that not fit within one “silo”.

In addition, the example illustrates the difficulty ministries encounter in articulating knowledge needs and questions related to mid to long-term, strategic and complex issues. Although, we see an (increasing) awareness of the importance of formulating knowledge needs in consultation with researchers and practitioners alike, it remains difficult for ministries to respond to this challenge in practice. This is substantiated by a variety of reasons: policymakers have little time for reflection in a rushed, political environment; there is a lack of “institutional memory”, meaning that policymakers often are not aware of the research that is already available or earlier experience with a policy measure; and it is difficult to articulate and distinguish knowledge questions from political ones, especially when an issue is characterized by uncertainty and involves and affects many stakeholders.

5. Conclusion:

Complex challenges cannot be transformed into narrow questions and straight answers. While we observe that ministries increasingly realize that complex agendas might need innovative knowledge networks that are able to embrace the complexity of contemporary challenges, the practical implementation of such a perspective on knowledge-for-policy is not self-evident nor easy. Moreover, these complex problems coexist with other, more structured, policy agendas. As a result, ministries have to organize and mobilize knowledge-for-policy in different ways to accommodate the variety of policy problems and responsibilities they face.

In the coming months, we will further explore and try to understand different ways of organizing and mobilizing knowledge-for-policy as well as stimulate and facilitate cross-ministry exchange of experiences. By providing insight into different organizational structures and strategies, and through creating the opportunity to learn and discuss issues beyond the boundaries of individual ministries, we aim to contribute both to thinking about and developing practices for the mobilization of knowledge-for-policy in the context of societal challenges.

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A3 SOCIAL INNOVATION 1

Wednesday 05 June 2019 from 11:00 to 13:00

PATRICIA LAURENS, Chair

Abstract 62

SDG10 (INEQUALITY) AND STI POLICIES

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Aim of the proposal:

Over the last decade, inequality has risen to a level of public attention it has not received since the Great Depression. The “top 1%” have come under criticism as the extent of their hyper-compensation has become visible (Essletzbichler 2015, Anand and Segal 2017). Economists have claimed that wages will lose the race to capital accumulation over the long run and that only a global wealth tax will reduce the tendency to polarization (Piketty and Goldhammer 2017). The Sustainable Development Goals reflect this new attention by incorporating a goal to “reduce inequality within and among countries” (SDG10). The goal applies to affluent as well as poor countries.

Does a field of research concerned with science, technology, and innovation policies need to pay attention to inequality? Decades of research answer “yes.” (See for example, (Arocena and Sutz 2006, Kaplinsky, Chataway et al. 2009, Cozzens and Thakur 2014).) In a critical analysis, this paper reviews the progress to date in identifying ways that science, technology, and innovation (STI) policies both increase and decrease inequalities, with emphasis on the kinds of STI policies and programs that contribute to narrowing the gap.

The first goal of the analysis is to unpack key terms in United Nations discourse, including STI, inequality, and within and among countries, into concepts that are more helpful in understanding the social and economic processes involved. The second goal is to evaluate STI policies strategically in relation to Goal 10: Are STI policies significant enough in the dynamics of inequality to make it worthwhile to try to reform them, or can the problem be left to tax policies? If working at the intersection is worthwhile, where are the strategic entry points within STI policy that offers the greatest leverage?

Background:

Unpacking Key Terms

STI in the SDGs

This section will describe how science, technology, and innovation appear in Agenda 2030, the core strategic document for the international development community for the coming decades. It will also identify analyses and deliberations undertaken by various U.N. agencies that address intersections of STI with SDG10, including several workshops and discussions of the implications of emerging technologies for development particularly artificial intelligence and robotics.

Inequalities in the Plural

This section will focus on what STI policy researchers have observed over the past 10-15 years on intersections between inequalities and research, innovation, human resource, and

regulatory policies. Following the concepts of Frances Stewart (Stewart 2008), it will distinguish vertical and horizontal dimensions of inequality. Put briefly, the vertical dimension is rich-poor and incorporates urban-rural differences, while the horizontal dimension captures differences in outcomes by culturally-defined categories such as gender and religion. Both dimensions are reflected in SDG10.

Within and Between Countries

The sub-goals of SDG10 contain an inherent tension between reducing inequalities at personal, household, and community levels and reducing inequalities in power in international negotiations. Much of the published literature on household inequality suggests that the “competitiveness” approach works against the human development approach. This section will review the evidence on how much global inequality (measured at household level) is associated with national conditions and link that observation to what the literature has claimed as the potential and pitfalls of STI policies for reducing inequalities.

Methodology and empirical base:

Literature review and critical analysis

Results:

TBD

Conclusions:

The second part of the paper will address the strategic issue: Do STI policies matter with regard to global inequalities? It will review available evidence on the size of the gaps, not just in income but also in outcomes such as health and hunger. It will compare the magnitude of the gaps to the effects of gap-reducing policies and programs that the STI policy literature has identified so far, including grassroots, frugal, and social innovation. The analysis will take into account a qualitative understanding of the forces that generate the inequalities and the current assessment of the effects of movements in the “science and technology for development” family. The goal is to locate leverage points where changing practices might be most effective in producing a world that “leaves no one behind”.

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Abstract 98

UNDERSTANDING SOCIAL INNOVATION ECOSYSTEMS: IN SEARCH OF A CONCEPT

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TU Dortmund University ~ Dortmund ~ Germany

Aim of the proposal:

While social innovation research has experienced an impressive boost in recent years, the concept of social innovation ecosystems is still largely underdeveloped (Domanski/Kaletka 2018). On the one hand, social innovation research does not originate from a systemic concept of innovation, but mainly from rather isolated, often uni-sectoral perspectives or actor-centred approaches. For decades, scientific work in the field of social innovation predominantly focused on social economy and on social entrepreneurship as the main topics. This almost exclusive view failed to recognize other key aspects of a comprehensive concept of social innovation, such as social innovations in the public sector and the role of business economy as well as of academia.

On the other hand, the need for better understanding the complexity and systemic character of social innovation as well as its embeddedness in surrounding environments (Hochgerner 2018) can also be stressed by taking a closer look at the field of Innovation Studies. While social innovation research has been strongly characterized by focusing on the third sector as the main societal sector and driver of social innovation or on the social entrepreneur as its protagonist in order to explain how social innovations emerge in societies, concepts such as innovation systems or the triple helix are based upon different components, among them almost always a conceptual operationalization of drivers, barriers and governance (even if these might be labelled differently). Both concepts recognize appropriate constellations of key actors (i.e. in particular universities, industries and governments) and complex interactions among them as important for developing technological innovations.

Background:

A systemic approach to social innovation focuses on the interfaces and collaborations of the so far differentiated and largely separate self-referential societal sectors of state, business, civil society and academia, of their corresponding rationalities of action and regulation mechanisms and at the associated problems and problem-solving capacities (Howaldt, Domanski, & Schwarz, 2015).

Such collaborations are picked up by at least two different heuristic models, the quadruple helix (see Carayannis & Campbell, 2009; Wallin, 2010) on the one hand, where government, industry, academia and civil society work together to co-create the future and drive specific structural changes and the social innovation ecosystem (see Sgaragli, 2014) on the other hand, which also asks for interactions between the helix actors, adds the notion of systemic complexity and looks at both the serendipity and absorptive capacity of a system as a whole. Furthermore, the social innovation ecosystems approach explicitly acknowledges the meaning of surrounding environment for social innovations. This is especially important regarding the question of how social innovations diffuse, how they are adopted, imitated and translated to other contexts. Following Tarde, we focus on the social embeddedness of inventions in a

dense network of imitation streams. This allows for a shift in perspective: unlike Schumpeter, for whom the innovator in the social figure of the entrepreneur is the focus of interest, for Tarde (2009) it is inventions which are understood to be the central 'driver' of social development. In this context, the idea of a social innovation ecosystem helps to overcome a strict actor-centred approach and the strong concentration on the social entrepreneur as the key agent of change. The view on the environment in which social innovations are introduced opens up the perspective on different dimensions.

Management theory points to the importance of networks as source of competitive advantage emphasising relation-specific assets such as knowledge sharing routines or effective governance structures for cooperation. Such a supportive environment is crucial for the development and imitation of social innovations. The perspective on actors, their functions in the innovation process and their ability and willingness to cooperate has to be sufficiently complex in order to adequately describe actors and actor constellations of social innovation ecosystems.

Methodology and empirical base:

The empirical analysis of the research project 'SI-DRIVE – Social Innovation: Driving Force of Social Change' provides insights into systemic complexity. Within this project, a large-scale analysis of social innovation initiatives was conducted, creating a database of 1005 cases of social innovation initiatives, covering about 80 countries on all world continents in seven thematic policy fields (education, employment, environment, mobility & transport, health & social care, poverty & sustainable development).

One of the central insights of this global mapping is that "a clear majority seeks to satisfy a concrete social demand (68%) and/or tackle a societal challenge (59%), whereas a minority (31%) strives for systemic change" (Howaldt et al., 2016, p. 42). Initiatives seek to solve very concrete and often local problems. This shows how important it is to better understand the local context in which initiatives flourish or fail.

This is further supported by the fact that, while 66% of the initiatives have transferred their solution (Howaldt et al., 2016, p. 130), the constellations under which such successful transfer and scaling processes take place are very diverse. Furthermore, the majority of social innovation initiatives remains local (41%) and happens within one local ecosystem. 33% cases transfer their solutions at the regional, 37% on a national scale, with the international level's 22% ranking fourth. However, in each specific initiative, the constellation of participating actors and sectors is different, as are the societal and governance systems in which the social innovations are embedded, the political frame and the resources initiatives can draw upon.

Results:

In such diverging settings, where a reconfiguration of social practices can hardly be achieved by copying solutions but only by highly adaptive imitation and transfer, a better understanding of sectoral involvement and collaboration becomes increasingly important. This is especially supported by the fact that it is not only the social economy and the civil society, which drives social innovation, but it is about all societal sectors innovating and collaborating on an almost equal footing (Howaldt et al., 2016, pp. 88ff).

Hence, the SI-DRIVE project makes an important contribution in terms of liberating social innovation from the silo of the third sector and opening up to other areas of the society. Furthermore, it emphasises the necessity for research and practice of facing the issue of

different rationales and interests that diverse actors from different societal sectors usually have when participating in innovation processes. In this context, Scoppetta, Butzin and Rehfeld (2014) point to the need of what they call “constructive partnerships between the sectors (economy/social economy-state-society)” (Scoppetta, Butzin, & Rehfeld, 2014, p. 91) in order to reap the full potential of social innovation.

Conclusions:

Developing a scientific concept of social innovation ecosystems requires both addressing the recent findings in international social innovation research and connecting to concepts, which have been developed and used in Innovation Studies in order to better consider and understand the systemic character of innovation. The concept of innovation systems (Freeman 1987) offers an explicit perspective on interactive learning and focuses on the relations between the different elements of the system rather than just the elements themselves. Knowledge is seen here as the most important input factor for innovation. While SI-DRIVE’s global mapping of social innovation initiatives has identified knowledge gaps as one of the main barriers for their development, social innovation research rarely focuses on the meaning of knowledge. Innovation ecosystems is another concept, which deserves more consideration towards a better understanding of social innovation ecosystems. It focuses on collaborative purposeful arrangements for value creation and strategical network building for developing innovative solutions (Adner 2006). SI-DRIVE reveals that networks are particularly important for social innovations, which often result from strategic alliances and not just individual efforts. Then there is the concept of triple helix (Etzkowitz/Leydesdorff 2000), which shows that university plays an enhanced role in innovation. It opens up a new perspective on the meaning of universities as actors in innovation systems. SI-DRIVE’s global mapping detects a relatively low participation of universities and research centres in social innovation activities which is, however, not due to lack of potential, but because their role in social innovation process is often not understood.

At the same time, established concepts, which highlight the systemic character of innovation, have limitations when applying them to social innovation. They mainly focus on technological innovations and not on social innovations in terms of new social practices. In addition, they only consider innovations, which create economic value. According to SI-DRIVE’s global mapping, there is a variety of social innovations with some of them achieving economic impact, while others not. This variety is also reflected by the participation of very different actors, which are not considered by concepts mentioned above and go beyond university, industry and government. This does not only refer to NGOs and communities, but also to hybrid organizations, which cannot be categorized within the typical classification of societal sectors and play an important role in social innovation ecosystems (Howaldt et al. 2016). Furthermore, SI-DRIVE’s findings confirm an increasing “replacement of existing governance models with ones that are more open, inclusive and participatory” (Sgaragli, 2014, p. 9). And they show that new ways of developing and diffusing social innovations are necessary (e.g. design thinking, innovation labs etc.) as well as the new role of public policy and government for creating suitable framework and support structures, the integration of resources of the economy and civil society as well as supporting measures by science and research.

Against the background of the main results of the first global mapping of social innovation initiatives, the paper reflects upon the key learnings regarding the development of the concept of social innovation ecosystems. It explores connections to prominent concepts from the field

of Innovation Studies which have significantly contributed to a better understanding of the systemic character of innovation.

Abstract 108

CREATING A KNOWLEDGE BASE FOR CO-DESIGN FOR SOCIETY IN INNOVATION AND SCIENCE

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Aim of the proposal:

This abstract contains the results of a quantitative determination of cases of co-creation within the project SISCODE. SISCODE was initiated to deliver insights into the use and landscape of collaborative approaches of problem solution in order to stimulate the openness towards co-creation in Policy Making and Responsible Research and Innovation (RRI). In SISCODE's lifetime, several research efforts from different character are carried out to understand contexts of co-creation in specific environments as well as insights into the opportunities these practices can hold and outcomes that can be expected. In this abstract we present the SISCODE "knowledge base" which is a quantitative study based on a European survey about co-creation ecosystems. In SISCODE's further course the database will be exploited increasingly, depending on emerging new questions and arising adaptations of research patterns.

Background:

SISCODE's focus is on the process of co-creation. The project partners define co-creation as a non-linear process that involves multiple actors and stakeholders in the ideation, implementation and assessment of products, services, policies and systems with the aim of improving their efficiency and effectiveness, and the satisfaction of those who take part in the process. Co-creation ecosystems are necessary for the development of social innovation as new social practices, which change the way we live together, work, consume, handle crisis and make the most of opportunities, and its contribution to Public Engagement (PE) and Responsible Research and Innovation (RRI). PE and RRI have emerged, in the last decade, as the results of policies and initiatives demanding the early involvement of multiple actors, including the public, in science and innovation. Nevertheless, the early engagement of actors is facing many challenges, and PE rarely goes beyond the stage of consultation. On the other hand, the integration of co-creation in European STI policy and programmes faces barriers such as scarce understanding of co-creation among researchers and policy makers; "sectorialised" approaches to STI policy making and lack of effective knowledge to cope with constraints that hamper the co-creation-process.

Methodology and empirical base:

The introduction of design methodologies and tools is emerging as a valuable approach to deal with these problems, as design has been already recognized as key to operationalize co-creation in different fields. Thanks to an iterative process centred on prototyping – co-design effectively supports co-creation to move from the ideation of new solutions and policies to their implementation. SISCODE was initiated to deliver insights into the use and landscape of collaborative approaches of problem solution in order to stimulate the openness towards co-creation in Policy Making and Responsible Research and Innovation (RRI). In SISCODE's lifetime, several research efforts from different characters are carried out to understand

contexts of co-creation in specific environments as well as insights into the opportunities these practices can hold and outcomes that can be expected. The project aims to better understand co-creation as a bottom-up and design-driven phenomenon that is flourishing in Europe (fab labs, living labs, social innovations, smart cities, communities and regions), to analyze favorable conditions that support its effective introduction, scalability and replication, and to use this knowledge to cross-fertilise RRI practices and policies.

This aim is articulated along three main operational objectives:

1. SISCODE will create a European study of existing local, regional, national and international co-creation ecosystems and describe effective dynamics and outcomes of the integration in society in science and innovation. The study will analyze and compare the following: the different cultural, organizational, institutional and regulatory conditions under which co-creation flourishes, the diversities among actors and stakeholders involved (gender, culture, education and backgrounds) that favour co-creation, the typologies of challenges and the citizens they affect (including vulnerable groups, women, children, migrants etc.), and the characteristics of the co-produced solutions.
2. The project will experiment with design as a new system of competences capable to support the development of implementable RRI and STI solutions and policies,
3. and will understand the transformations needed to embed co-creation in STI policy making, overcoming barriers and resistance to change and considering organizational transformation. The project is conceived as a connector that aims at (re)constructing the missing links between strategic objectives, topics and communities, and the activities on the ground (research and innovation), which are currently often disconnected. SISCODE will then draw lessons from past and current experiences in public engagement for STI policy making, and from experimentation and action research, to develop knowledge and practical recommendations on how to ensure that research and innovation outcomes serve society better. Given this context, there is a strong rationale for configuring the project as a comprehensive European investigation of single initiatives and policy frameworks to understand what outcomes co-creation is achieving in science and innovation, and provide knowledge to better integrate it in the design of solutions and policies.

This investigation will combine two complementary processes:

- a multi-faceted analysis and interpretation of diverse cases across Europe – triangulating results of desk and field research processes – will create the opportunity to discover and examine best practices of co-creation in STI, drawing the most effective approaches, practices and tools, and
- a pilot experimentation – involving 10 paradigmatic co-creation projects and initiatives (SISCODE Co-creation Labs) spanning across Europe and selected within the three networks of the living labs, fab labs and science centres/museums to become project partners – which will function as a system of transnational laboratories and arenas in which to test and assess the effectiveness of the above-mentioned co-creation approaches, processes and tools.

Overall, SISCODE follows a mixed-methods approach to examine co-creation in contexts to better understand the co-creative ecosystems.

In order to initially describe the landscape of co-creation ecosystems and allow for a quantitative description based on variables, a case selection plan and a list of possible sources (containing e.g. databases from other projects), was developed at the beginning of the project to guarantee a uniform approach amongst the project partners. In order to establish appropriate, easy-to-apply criteria, a communication process with all consortium members was conducted during several events. The consortium agreed on four criteria that have to be met in order to be included as a case in SISCODE:

A case is an initiative/project/organization, that...

1. follows one or more principles of co-creation and is defined as a 'case' by the researchers,
2. offers sufficient data to hold the potential to be turned into a case study,
3. follows design principles, either ex- or implicitly,
4. has a special focus in the Policy Making and / or RRI.

Furthermore, a distinction between optional and non-optional criteria was made. The first two criteria are not optional while the last two are optional.

The case selection plan was the basis for the subsequent case collection in the following work step that was created in order to take stock of co-creation in contexts and to generate a knowledge base for the project to enrich the experimentation process and the playgrounds for Policy Making in the further process of the project. To fulfil these tasks, the phase of the collection, analysis and comparison of the co-creation cases consists of three major steps: at first, a database of at least 100 cases of co-creation is created that delivers a quantitative stocktaking of co-creation in contexts. Secondly, 40 cases that will be examined in-depths via a case-study approach, decisively based upon participative research maxims. A third step is the integration of results of this mixed-methodological approach via a further development of an innovation biography methodology.

For the quantitative stocktaking 138 cases were collected by 20 multisector SISCODE partner institutions and were filled in an online-questionnaire (November 2018 - January 2019). The data collection is based upon seven main categories (basic information concerning the case, networks and partnerships, pathway, drivers and barriers, processes and practices of the process of co-creation, tools and instrument used, and lessons learned from practicing co-creation), that were reduced to the four themes: 1) Basic information, 2) Context information, 3) Co-creation activity, 4) Lessons learned and experiences. In the survey single and multiple choice questions were used as well as some open questions, for specifications e.g. on methods and tools. The respondents made rich use of several opportunities to give qualitative answers in free text form within the survey.

Results:

Key findings of the SISCODE survey regarding basic characteristics of the cases (e.g. geographical distribution, societal challenges and crosscutting-themes):

- The territorial scope is quite balanced between the EU regions (North EU, East EU, southern EU, and western EU). There are cases that are related to more than one EU region or operate in all over Europe, but also cases that are located in non-EU countries like Canada.
- The initiatives address especially health, demographic change and/or wellbeing issues (62,2 % of cases), but also issues of climate action and environment, food security and sustainable resources, while efficient energy, smart transport and secure societies are a rarer subject to the cases.
- A very equal share amongst the cross-cutting themes is visible. The three most cross-cutting themes are: 1) Social Science and Humanities, 2) Gender/Diversity/Inclusion/Intersectionality, 3) Small and medium sized enterprises.

In general, co-creative practices are from very heterogeneous character on various levels – from the aims over the motivations to the scope of the initiatives and the involved stakeholders the numbers are very equally spread. The cases collected are foremost timely limited projects (71,9 %). Also most of the cases have a relation to the main topics of SISCODE, RRI and Policy Making, either to one or both of these areas.

Co-creation seems to decisively rely on personal motivation and high interest of like-minded

people or groups and innovative environments – the combination of these two factors are a good starting point for co-creation. Especially societal challenges like the demographic/ climate change, a single new, innovative idea and a pressing social demand are the triggering factors that led to the cases founding. Regarding networks and partnerships of the cases it can be sad that the majority is characterized through a wide cooperation with multiple partnerships in a broad network. Co-creation also depends upon purposeful and needs-driven support, e.g. in the form of knowledge or funding– gaps are visible between what is provided and what is needed.

There seem to be some pivotal moments in co-creation that decide upon the further success of the process (e.g. initial involvement of stakeholders, first meetings, feedback loops). While pressing local social demands are important for launching the initiative, the original impetus is seldom anchored in the local community itself. In the immediate process of co-creation, hampering factors are especially an insufficient integration of users' perspectives and a certain inappropriateness of tools and instruments and not having enough time for the single steps. This reflects structural barriers, hindering co-creation to unfold: the divergent conceptions towards crucial concepts might be a consequence from lack of time and opportunities to sufficiently integrate the users' perspectives.

There seems to be a deep gap between the expectations and claims about inclusive stakeholder management and the factual inclusion that is to be seen in practice. Co-creation is not only a cross-sectoral process but in many cases it involves all four sectors of society (civil society, academia, the public and the private sector). The tools that were used in the co-creation process were especially co-design tools, prototyping and testing, visual/ tangible outputs (e.g. audio clips, drawings, writing) and interview techniques (e.g. focus group interviews, narrative interviews with end-users). Regarding the stages of co-creation, it can be noted that most of the cases are applied to nearly all four phases (problem identification/ understanding, ideation, prototyping, verifying/ testing). Issues of diversity, inclusion and intersectionality are cross-cutting themes for many of the initiatives. In general, diversity in all facets is seen as a necessary precondition for successful co-creation processes as solutions are considered to work best, if they can adapt the heterogeneity of needs in society. But little information is provided concerning the tactics followed to create diversity from the very beginning of the initiative.

Conclusions:

In general, the database is supposed to function as an interactive instrument and tool of data generation, open and transparent to the whole community of the project. The descriptive analysis from the database of examples of co-creation compiled by the SISCO community holds various entry points for further examination. The database describes the landscape of co-creation in several contexts, e.g. networks/ partnerships, tools and method used, and serves as a starting ground to dig deeper into practices of co-creation through the upcoming qualitative research efforts. In the case studies the focus will be on the framework that enables the initiatives to set up a multi-sectoral playground for Policy Making and the barriers that hinder the initiatives in other settings from doing so. An in-depth analysis of the partnerships (e.g. their function) is also necessary just as the analysis of the needs of the co-creative activities and the provision of resources they (often) cannot provide in their own (e.g. knowledge and qualifications, infrastructure, mentality, attitude). Furthermore, the case studies should include a diversity mainstreaming approach in their overall research strategy, maybe with a further analysis within the biographies of co-creation. The prevalence of four-

sector cases is a remarkable result in itself, but raises also further questions for the upcoming case studies (e.g. what is the specific potential of such cases?). Also, the specific role of academia in co-creation initiatives should be examined closely in the next empirical steps of SISCODE.

To examine the landscape further and to draw conclusions to better exploit co-creation as a social practice the results of this deliverable point, inter alia, at the following research questions for the upcoming research process:

- What are the relational networks behind power asymmetries in processes of co-creation? How can mismatches between stakeholders be tackled? How do they interact with normative, structural, functional and role-contexts? What is the specific role of drivers and barriers?
- How are the partnerships organized: What types of support are delivered in the different phases of co-creation? Do they learn from each other? What?
- What happens exactly while engaging stakeholders? How do the stakeholders see the process? How do they want to be approached? Are there role-taking processes?

Remark: SISCODE (Co-Design for society in innovation and science) is led by Politecnico di Milano and governed by a multidisciplinary consortium of 18 partner organisations across Europe (2018-2021). This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under grant agreement No 774088.

A4 DISRUPTIVE TECHNOLOGIES

Wednesday 05 June 2019 from 11:00 to 13:00

CARLOS MONTALVO CORRAL, Chair

Abstract 29

THE SUSTAINABLE START-UP PARADOX: PREDICTING THE BUSINESS AND CLIMATE PERFORMANCE OF START-UPS

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Aim of the proposal:

To understand how to create viable climate-focused start-ups, we study what factors predict climate performance, and if these contradict business performance. A critical factor to consider in this context is technology, which is commonly at the root of climate performance.

Background:

New sustainable technologies and business models are necessary for the transition to a climate neutral economy (Bjornali & Ellingsen, 2014; Gerlach, 2003; Gibbs, 2006; Stirling, 2010). These are likely to be introduced by sustainable entrepreneurs (Cohen & Winn, 2007; Shane & Venkataraman, 2000; Tiba et al., in press), which makes entrepreneurship a critical component for the development of a climate neutral economy (Dean & McMullen, 2007; Gibbs, 2006). To be able to grow, and significantly contribute to climate mitigation climate-focused start-ups need to maintain a healthy business performance (Bjornali & Ellingsen, 2014; Calel & Dechezlepretre, 2013; Meyskens & Carsrud, 2013). Business performance and climate mitigation are thus both crucial performance indicators for climate-focused sustainable start-ups (Schaltegger & Wagner, 2011; Stubbs, 2017).

The business performance of start-ups is a widely studied topic in entrepreneurship (Shane & Venkataraman, 2000; Song, Podoyntsyna, van der Bij, & Halman, 2008). In contrast, no research has yet studied what factors determine the climate performance of start-ups (Bjornali & Ellingsen, 2014; Meyskens & Carsrud, 2013). However, studies on corporate firms show that climate performance easily goes at the expense of business performance (Dean & McMullen, 2007; Pinkse & Kolk, 2010). At the same time, business performance is required to contribute to climate mitigation (Bjornali & Ellingsen, 2014). There thus appears to be a paradox between the two performance dimensions.

To understand how to create viable climate-focused start-ups, we thus need to understand what factors predict climate performance, and to what extent these inhibit business performance. A critical factor to consider in this context is technology, which is commonly at the root of climate performance (Bjornali & Ellingsen, 2014; Gerlach, 2003; Stirling, 2010; N. Zhang, Zhou, & Choi, 2013), and also considered a key source of a start-up's competitive advantage (Aharonson & Schilling, 2016; Debackere et al., 1999; Zahra, 1996). However, technology has so far received little attention as an independent variable in the start-up performance literature. We aim to fill this research gap by considering two aspects of a technology, the type of technology and the novelty of the technology.

This leads to the following research question: What is the influence of the technology characteristics of climate-focused start-ups on their business and climate performance?

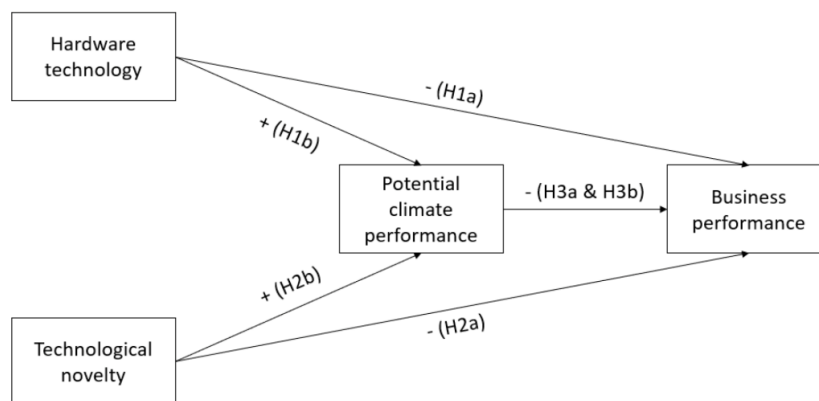
We quantitatively test the influence of these variables on performance using a sample of 197 Western-European start-ups. Because start-ups are small in the first years of their business, their emission reductions will inherently also be small during these years (Hyytinen, Pajarinen,

& Rouvinen, 2015). We therefore consider the potential climate performance rather than the achieved climate performance (Bjornali & Ellingsen, 2014; Rasmussen et al., 2012).

This study has two key contributions to the literature. First and foremost, by including the climate dimension of start-up performance this study takes a new step towards a more holistic evaluation of performance, which includes their societal contributions as well as their business performance (Tiba, van Rijnsoever, & Hekkert, 2018). Second, we focus on the important but complex role of technology in start-ups by using arguments from the technological trajectory literature (Fleming and Sorenson, 2001).

From a managerial perspective, this study helps managers of incubators and accelerators to understand the influence of start-ups' technologies on the business and potential climate performance of the start-ups. As such, these managers can make more informed decisions in selecting start-ups for their program. For policy makers, the use of potential climate performance as a performance dimension helps them to better evaluate the societal contribution of these climate-focused start-ups.

The hypotheses are displayed in the conceptual model (figure 1) and below we shortly explain how two technology characteristics, the type of technology and the technological novelty, are expected to influence business and climate performance.



In the start-up practice a differentiation is often made between digital, software, technologies and physical, hardware, technologies. Digital technologies have unique characteristics that make them fundamentally different from physical technologies (Nambisan, 2017). We therefore study the difference in performance between these technology types. We expect software start-ups to have a higher business performance because software technologies are considered to be more easily scalable, have faster learning curves and require less capital (Nambisan, 2017; J. J. Zhang, Lichtenstein, & Gander, 2015). As such, we arrive at the following hypothesis:

Hypothesis 1a: Start-ups with a hardware technology have a lower business performance than software start-ups

We argue that hardware climate technologies are often replacements of the existing process or product, while software technologies are often ways of making the existing processes and products more efficient. While efficiency increase is important, it cannot completely reduce CO2e emissions. This is the case because CO2e emissions are very much driven by physical processes such as fossil fuel burning and industry (Raupach et al., 2007). Furthermore, Moore

and Wüstenhagen (2004) show that most of the opportunities for innovation in the electricity value chain concern hardware technologies. We thus hypothesise that hardware technologies have a higher climate potential:

Hypothesis 1a: Start-ups with a hardware technology have a higher potential climate performance than software start-ups

Start-ups with a more novel technology are at the beginning of technological trajectories, which increases the risks associated with developing the technology (Fleming, 2001; Hyytinen et al., 2015). Customers are often reluctant to adopt these high risk technologies which reduces the firms' business performance (Fleming, 2001; Marra, Pannell, & Abadi, 2003; Verhoeven, Bakker, & Veugelers, 2016). This leads to the following hypothesis:

Hypothesis 2a: Start-ups with a more novel technology have a lower business performance

For novel technologies which are at the start of technological trajectories learning effects have not yet occurred (Nemet, 2006; Rogner, 1998; Yu et al., 2011). Besides high risk, novel technologies, thus often also have a high reward potential. Because the risks associated with exploring distant technological options are high, start-ups only explore distant technological options with a high potential. Because we study climate-focused start-ups, we expect these start-ups to have a larger potential to mitigate climate change (Aghion et al., 2012; Aghion et al., 2014; Bjornali & Ellingsen, 2014; Nemet, 2009).

Hypothesis 2b: Start-ups with a more novel technology have a higher potential climate performance

Research on corporates shows that the climate performance of firms influences their business performance (Ong, Soh, Teh, & Ng, 2015; Pinkse & Kolk, 2010; Qiu, Shaukat, & Tharyan, 2016). Linder, Björkdahl, & Ljungberg (2014) find that environmental oriented firms have lower economic performance than their counterparts. This indicates that the two performance dimensions are not independent. Therefore we, argue that the potential climate performance functions as a mediating variable on business performance.

Hypothesis 3a: Part of the relation between a start-up's type of technology and its business performance is mediated by the start-up's potential climate performance, such that hardware relates positively to potential climate performance, which subsequently relates negatively to business performance.

Hypothesis 3b: Part of the negative influence of a more novel start-up technology on start-up business performance is mediated by the start-up's potential climate performance.

Methodology and empirical base:

To test our hypotheses, we collected data from 197 start-ups that participated in the Climate-KIC accelerator program in. The start-ups in this program are especially suited for this research because the program only selects young entrepreneurial ventures with a positive climate impact (Climate-KIC, 2017).

We collected data from three sources: (1) The Climate-KIC evaluation surveys are used as the data source for the business performance variables. (2) The application forms to the accelerator are text-mined to collect information for the independent, the control and the climate potential variables. (3) A combination of public sources, such as the Chamber of Commerce and LinkedIn, are used to fill in missing information.

Business performance is a multidimensional concept because start-ups take different paths in their aim of growing their business, they prioritize different dimensions of business performance at different points in time (Davidsson, Steffens, & Fitzsimmons, 2009). Hence, no single dimension can sufficiently capture the performance dimension (Daily & Dalton, 1992; Murphy, Trailer, & Hill, 1996; Wiklund & Shepherd, 2003). Therefore, we use both firm size and investments as dimensions of business performance. We operationalize firm size through a count of the number of employees who are employed by the start-up in the year of the performance survey and we operationalize the investments as the cumulative amount of external investments made into the company, which is measured on a four-level ordinal scale (1 = €0-250,000, 2 = €250,000-500,000, 3=€500,000-1 million, 4 = > 1 million).

We operationalize potential climate performance as the potential reduction in CO₂e emissions caused by a start-up's technology in comparison to the conventional alternative (Bjornali & Ellingsen, 2014; Rasmussen et al., 2012).

As part of their application to the Climate-KIC accelerator the start-ups provide a description of their business idea and on how their business will contribute to reducing the emission of greenhouse gases. We use these descriptions to assess start-up's potential to reduce CO₂e emission. This assessment takes place in the form of expert coding by the authors and industry experts (Hallgren, 2012). We reviewed each start-up's potential to reduce CO₂e emission if their business idea becomes successful. We then scored this potential on a 5-point scale, in which a one stood for a very low potential and a five for a very high potential.

To increase the reliability of the measure we verified the author assessments with those of a group of experts from Climate-KIC.

To operationalize both technology characteristics we use the technology and product descriptions from the start-ups application form to the Climate-KIC accelerator. To measure technology type, we coded whether or not the start-up uses hardware (physical) technology. We measure the second aspect of the technology, technological novelty, through the technological diversity change. This is the change in "the evenness in a distribution of elements among a number of categories in a system" (Van Rijnsoever, Van Den Berg, Koch, & Hekkert, 2015, p. 1096). In this study, technological novelty is thus a start-up characteristic which resembles how the technological diversity of the system changes due to the introduction of that particular start-up's technology.

Previous studies have shown that text-mining is a particularly well suited approach to map technological systems because it can be used to accurately assess a technology's complex features and identify patterns between different technologies (Aharonson & Schilling, 2016; Arts et al., 2013; Blei, 2011; Pérez-Avilés et al., 2016). We therefore use the latent Dirichlet allocation probabilistic topic model (LDA) (Blei, 2011; Lee, Kihm, Choo, Stasko, & Park, 2012; Steyvers & Griffiths, 2007). LDA is a text-mining approach which analyses the words of documents to discover the themes that run through the documents and the connections between these themes (Blei, 2011). To run the LDA we first performed the necessary data transformation steps (Feinerer, 2017; Meyer et al., 2008). We then use the Gibbs sampling algorithm to run the LDA (Blei, 2011; Srivastava & Shami, 2009; Su & Liao, 2013). To determine the appropriate amount of topics, we estimate multiple models (Blei & Lafferty, 2009; Su & Liao, 2013). The appropriate amount of topics is determined by the first time where the rate of perplexity change (RPC) is smaller than the following number of topics (Zhao et al., 2015). This is the case for the model with 14 topics. The LDA gives 14 topics (clusters of words) and

for each document (start-up technology) the proportion with which they fit each topic. To calculate the diversity we follow the approach of other studies who use the Shannon-Weaver entropy index, which contains variety and balance (Páez-Avilés et al., 2016; Shannon, 1948; Van Rijnsoever et al., 2015). To test the hypotheses, we perform multiple regression analyses. The number of employees, is an overdispersed count variable for which we use a negative binomial model. The investments and climate performance variables are ordinal by nature. Therefore, we use an Ordinal Logit Model (OLM) for these dependent variables. We use the McFadden Pseudo R² to report the performance of the respective models (Hoetker, 2007; Jackman, 2017; Zeileis & Hothorn, 2002). Furthermore, we study the mediating effect of the potential climate performance using the 'mediate' package in R.

Results:

We find that the McFadden pseudo R² values for the firm size model (0.06), the investments model (0.15) and the climate model (0.07) indicate acceptable to good model fits (McFadden, 1974). The results show that start-ups with a software technology perform significantly better than their hardware counterparts for firm size ($p < 0.05$). We therefore find that software start-ups have a higher growth than hardware start-ups. However, software technology start-ups do not yield more investments. This might be due to the fact that the capital requirements of hardware firms are also higher. Hypothesis 1a is therefore partly accepted. Start-ups with a software technology have significantly lower potential to reduce CO₂e emissions than their hardware counterparts ($p < 0.01$), which confirms hypothesis 1b.

The technological novelty variable does not have a significant influence on firm size and investments of a start-up ($p < 0.05$). The results of the business performance analyses with firm size and investments as the dependent variables therefore do not provide evidence to support hypothesis 2a. The influence of the technological novelty variable on the potential climate performance is significant ($p < 0.05$), which supports hypothesis 2b.

Mediation model

The results of the mediation models show that the direct, positive, effect of the type of technology on firm size ($p < 0.01$) is significant. The mediation effect is negative, but only significant at $p < 0.1$. For the investments model the direct effect is positive but not significant. We do find a significant negative mediation effect ($p < 0.05$). The potential climate performance thus serves as a mediator on the relation between technology type and both business performance measures. We thus find support for hypothesis 3a.

The mediation analyses of technological novelty shows that the mediation effect is not significant for firm size. The mediation effect is significant for investments as there is a significant positive effect ($p < 0.01$). The direct effects of technological novelty on business performance are negative and not significant for both the firm size and the investments, hypothesis 3b is thus partly confirmed.

Conclusions:

We find support for the notion that the business and climate dimensions of performance for start-ups are fundamentally different from each other. First, the results show both negative and very low correlations between the climate and the business dimensions of performance indicating that they are not related. Second, the technology characteristics have opposite effects on the performance dimensions and the potential climate performance is a significant

partial mediator in the effect of technology on business performance. Finally, none of the control variables, which origin from the entrepreneurship literature on business performance (Song et al., 2008), have a significant effect on potential climate performance.

Technology (and other variables) thus have a contradictory effect on potential climate performance and business performance. On the other hand business performance is necessary to translate potential into actual climate performance (Bjornali & Ellingsen, 2014; Calel & Dechezlepretre, 2013; Meyskens & Carsrud, 2013). Our results thus confirm the existence of a paradox between the climate and business performance of climate-focused start-ups. The negative influence of climate performance which corporates encounter (Linder et al., 2014; Pinkse & Kolk, 2010), is not a result of corporates relying on existing routines (Van Mossel et al., 2018). Instead the tensions between economic and sustainability objectives are also encountered by climate-focused start-ups (Jolink & Niesten, 2015; Smith et al., 2013; Stubbs, 2017).

Furthermore, we find that technology characteristics are a key variable in research on start-up performance, and particularly for climate-focused start-ups. We thus encourage fellow researchers to include these, and other, technology characteristics in future studies of start-up performance.

A core limitation relates to our climate measure. The climate measure in the form of the potential to reduce CO₂e emissions proved reliable using expert scores as a verification measure. Nevertheless, it would be preferable to have quantitative numbers, or an ex post measure for climate performance. However, this requires extensive calculations on and individual collaboration from each start-up regarding the exact features of their business. It was therefore not possible to include such a measure in this research. Nevertheless, this is an avenue for further research. By combining these estimations with the revenues of the start-ups, future studies can also calculate the realized climate performance.

Regarding the practical implications our results show that achieving (1) climate mitigation and (2) business performance simultaneously is not a straightforward process. Policy makers and incubator managers thus face a tough challenge to balance the different societal impacts of start-ups. It is important to, explicitly discuss how to balance and prioritize these different impacts and to consider this within the start-up selection procedure.

This research shows that there are fundamental differences between start-ups based on their technology, thus supporting the argument that these start-ups also require different types of support when establishing their business (Soetanto & Jack, 2013). Future research could focus on these differences, to better understand how the needs of start-ups differ based on their technology. The increased understanding of this topic could help incubators and accelerators to better support start-ups with a different nature.

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THE ADOPTION PATTERNS OF BUSINESS INTELLIGENCE TECHNOLOGIES IN CANADA

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Aim of the proposal:

The research was focused on the local context of business intelligence technologies in Canadian firms. The key research question we are trying to address is why Canadian firms have a low rate of technology adoption, especially BI technologies.

Background:

Technology adoption has multiple benefits including productivity increase and higher quality of products, which in return can lead to increased economic and innovation performance. In a study conducted by Baldwin and Lin (2002), Canadian manufacturing firms reported improvement in productivity and product quality as the most important benefits to the adoption of technology. Using the 2014 edition of the Survey of Advanced Technology (SAT), we attempt to study the local context of Canadian firms and their technology adoption behavior. In total, 7912 firms from various sectors responded to the survey. Advanced and digital technologies are present in every sector and are divided into 5 main categories: manufacturing, business intelligence, processing, design and green technologies. This short summary will focus on advanced Business Intelligence (BI) technologies.

Methodology and empirical base:

Our methodology uses the apriori algorithm, which looks for patterns in technology adoption. The main results we find is that firms are adopting a bundle of advanced technologies, thus justifying the market basket analysis using the apriori algorithm. We use the values of support, confidence and lift to interpret our results. The other methodology we adopted is to add the temporality aspect by using the cspade algorithm. In fact, firms use a specific strategy when it comes to choosing which technology to adopt and when they want to adopt it. In addition to finding bundles of technology adoption, the cspade algorithm allows us to mine sequential patterns to understand in which order technologies are adopted.

Results:

Considering BI technologies are common to all sectors, we would expect to find a high rate of adoption. However, our results show that only 31% of firms have adopted at least one BI technology. Before we dive-in into that, we need to explain the different BI technologies. We will refer to the letters A-B-C-D-E in the following order in the rest of this summary:

- a. Executive dashboards for data analytics and decision making
- b. Software for large scale data processing (e.g. Hadoop)
- c. Live-stream processing technology or real-time monitoring

d. Software as a service (SaaS) and cloud computing software¹

e. Infrastructure as a service (IaaS) and cloud computing hardware¹

The most popular bundle of technologies is C-D-E with 13.5% of firms having adopted it. In the practical world, firms are using a lot of SaaS (D) and IaaS (E) mainly because usually one goes with the other. Many companies want to keep their data private and have their own hardware to run cloud applications. Real-time monitoring (C) on the other hand is a direct application of the last two technologies so it's not surprising to see them combined together. Furthermore, when C-E are adopted, there is a 89% chance that firms would also have adopted D. This also makes a lot of sense because as we mentioned, C is a software that is a direct application of D. In fact, if a firm already has the infrastructure (E) to run cloud computing (D), there is high probability that they will also cloud software such as real-time monitoring capabilities (C). The other results that we find is that 5% companies are adopting all of these technologies together, which could mean that only companies with high capital can afford them. When technologies A-B-C and E or D are adopted together, there is respectively a 98% to have adopted D and 81% to have adopted E. The key fact here is that the more technologies firms adopt, the higher the chances of having SaaS (D) and or IaaS (E) together. Consequently, the more technologies adopted, the more infrastructure and cloud-computing capabilities become essential.

Conclusions:

The study confirmed the low uptake of key digitally enabled technologies, specifically the BI technology family, which include "big data" technologies; and showed that adopting digital technologies might be a complex process as firms usually, must adopt not only one technology but also a bundle of technologies. Some potential policy implications combining these two results include external and internal talent management as well as a capital investment strategy to ensure the right technologies are adopted are the right time.

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HOW POLICY ENTREPRENEURS' EXPECTATIONS ABOUT DEVELOPMENT SHAPE DIFFERENT APPROACHES TO INNOVATION: EVIDENCE FROM A LOCAL AGRI-FOOD INDUSTRY SYSTEM IN MEXICO

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Aim of the proposal:

The Yucatan Octopus Fishing Industry (YOFI) is a traditional system characterized by a massive regime of production, distribution and consumption. Actors employ traditional technology and practices and compete using strategies based on efficiency or lowering costs and prices. Despite some sporadic incremental innovations, the system has remained almost unchanged over the last few decades, similarly to many others production systems in the Global South agri-food industry (Pauly, 1997; Katz et al., 2011; Pedroza and Salas, 2011; Salas et al., 2011). However, some actors recently (e.g. since 2016) started adopting new strategies for developing and eventually transforming the regime of the YOFI system (Giachi and García Lara, 2018). These experiences are interesting because they represent a shift towards innovation for sustainable development. Adopting the classification proposed by Schot and Steinmueller (2018), we could say that we observed first a move away from regulation, knowledge production and commercialization ('Framing 1') toward a policy based on innovation systems, networks and entrepreneurship ('Framing 2'). Then, we also observed emerging the idea of transformative change (Weber and Rohracher, 2012) and sustainability transitions (Kivimaa and Kern, 2016) supporting a Third Framing for Innovation Policy (Chataway et al., 2017; Schot and Steinmueller, 2018; Schot et al., 2018).

The aim of this research is to explore and deepen the shift in the approaches towards innovation for development influenced by key policymakers and stakeholders within the YOFI. The research identifies some activities and processes attempted to moving from Framing 1 towards Framing 2 and eventually Framing 3. Specifically, we focus on the role of the cognitive factors – like expectations and visions – underpinning the new policy frame adopted by key policy entrepreneurs (Mintzberg and Norman, 2009).

Background:

Explaining policy change through system functions and policymakers' expectations

Our research combines two explanatory approaches. On one hand, we use the literature on functions of Technological Innovation Systems (Hekkert et al., 2007; Bergek et al., 2008; Hekkert and Negro, 2009) to position the shift in policy framings in accordance to other functions and processes of an innovation system. We also justify this choice because of the capability of the system functions approach to track the contribution of policy of delivering radical transformations at the system level like transformative change (Janssen, 2019).

On the other hand, we use the contributions from the Sociology of expectations applied to science and technology studies (Brown and Michael, 2003; Borup et al., 2006; Selin, 2008), to study the role of expectations and visions in those processes of foresight, anticipation and

negotiation that can influence the policy-making (Bakker et al., 2012; Van Lente, 2012). We consider that this is a purposeful approach because of the demonstrated importance that expectations and visions showed for explaining innovation policy and sustainability transitions (van Rijnsoever et al., 2014; Konrad and Alvial-Palavicino, 2017; Alvial-Palavicino and Opazo-Bunster, 2018; Beumer and Edelenbosch, 2019). Specifically, we analyse the role of expectations and visions of policymakers and stakeholders in framing innovation policy, i.e. for transforming the YOFI towards sustainable directions.

Following the system-functions literature, we treat actors' expectations and visions as specific processes of some functions of the system, like knowledge creation, guidance of search, and/or entrepreneurial experimentation (Hekkert et al., 2007). We recognise that policymakers and stakeholders have visions about the way policy affect innovation towards specific aims or directions for change, anticipating outcomes and impacts. These visions shape the framing of the innovation policy, for instance the adoption of Framing 2 instead of Framing 3 measures. The origin of these visions is rooted in several factors, including the legitimacy of different activities, processes or mechanisms in a given context, the type of knowledge available in the policy arena, or the dominant rules for search used within the system. These processes can be tracked by formal and informal expectations of actors. Specifically, we are interested in the visions (and underlying expectations) of those individuals who dedicated more resources and capacity to policy definition and implementation and played a crucial role, i.e. policy entrepreneurs.

Policy entrepreneurs as agents of change within the system

In the literature, policy entrepreneurs can be defined as "people willing to invest their resources in return for future policies they favour. They are motivated by combinations of several things: their straightforward concern about certain problems, their pursuit of such self-serving benefits as protecting or expanding their bureaucracy's budget or claiming credit for accomplishment, their promotion of their policy values, and their simple pleasure in participating" (Kingdon 1984: 214). Another influential study defines policy entrepreneurs as "political actors who promote policy ideas" and "people who seek to initiate dynamic policy change" (Mintrom, 1997: 739) or, more generically, "advocates of policy change" (Mintrom and Norman, 2009: 649). Based on this background, Brouwer and Huitema (2018) recently highlighted that policy entrepreneurship is directly involved into the policy change process, instead of providing ideas or solutions for policy problems.

Hence, we can define policy entrepreneurs as those policymakers that take advantage of the opening of a problem window in the policy making process to put forward their policy proposals. They link solutions to problems and push for getting them accepted by decision makers. Policy entrepreneurs are characterised also as 'boundary workers', 'policy advocates' and 'visionary leaders' but overall, they are characterised for being change agents in the policy making process (Huitema and Meijerink, 2009). They usually invest significant resources in policy change because they have relevant policy making capabilities, including networking skills; and perseverance (Meijerink and Huitema, 2010). Policy entrepreneurs can be found across different institutional settings, including not only public bureaucracies, but also universities, scientific communities, private companies, NGOs, voluntary associations, etc. (Kingdon, 1995).

For the purposes of our research, policy entrepreneurship is a relevant concept because it

provides the proper locus for our analysis. Policy entrepreneurs play a key role in the policy change process influencing the potential streams of policy making (Mintrom, 1997; Mintrom and Norman, 2009). This is especially true for the case of policy change aiming at radical transformations of the current regimes of production, management and consumption of natural resources like water. In these cases, policy entrepreneurs significantly contributed not just at formal policy change ('on paper') but also their effective implementation on the ground. For this type of change, often complementarities between different types of policy entrepreneurs are needed, i.e. collective policy entrepreneurship (Meijerink and Huitema; 2010).

In the case of transformative innovations for transitions towards sustainability, like the YOFI in recent times, transformations affect collective goods or systems, like water, mobility, energy, food, etc. In these cases, 'policy transitions' use to take the form of collective entrepreneurship through coalition building, forum manipulation, or strategic framing of issues (Meijerink and Huitema, 2010). However, how such policy transitions do occur is still quite unclear. The reasons and processes undermining the shift from a policy approach or strategy to a new one is "highly political game" where the relation between actions and institutions is very complex and contingent (Huitema et al., 2011; Brouwer and Huitema, 2018).

Research questions and expected contributions:

Our research questions for guiding the data collection and analysis:

1. What types of visions about innovation policy can be identified in the policy changes that occurred in the YOFI system since 2004-2007? For instance, the shift from a strategy based on funding research infrastructure to a strategy based on strengthening heterogeneous networks; or the shift from marketing-based strategies to greater reflexivity, learning, experimentation and community inclusion.
2. How existing (competing) visions between policy entrepreneurs within the YOFI are influenced by their expectations about innovation policy? And how these expectations are tied to specific system characteristics and functions?

Our research aims to contribute to generating evidence for the classificatory scheme based on the Three Frames and, specifically, the emerging Framing of Transformative Change (Schot and Steinmueller, 2018). We provide the evidence by describing the role that policy entrepreneurs' visions and expectations play in shaping specific approaches towards innovation (Meijerink and Huitema, 2010; Alvial-Palavicino and Opazo-Bunster, 2018). We combine the system-functions approach and the sociology of expectations to carry out the empirical analysis for understanding the cognitive base of policy entrepreneurs towards innovation. Finally, we aim that our framework helps to shed light on the process of policy change that took place in the YOFI, explaining the visions that motivated policy entrepreneurs' different approaches towards innovation.

We are aware that expectations and visions are only a specific process within the system functions, with a limited scope for delivering innovation and system transformation (Janssen, 2019). Therefore, we do not expect that our research can fully explain the policy-making process of innovation policies, and even less addressing the system impact of the policy. By understanding policy entrepreneurs' expectations, this research provides a guide for interpreting changing visions about innovation policy, and to relate such expectations and

changes to specific system dynamics and outcomes. For instance, in the YOFI system, policy entrepreneurs promoting major changes in the innovation policy approach carried with them a different vision of the role of science and innovation for development, e.g. in terms of economic productivity or environmental sustainability. In turn, policy entrepreneurs' visions were based on their expectations about the capability or effectiveness of science, research or innovation to deliver solutions to different types of problems (i.e. economic, societal or environmental). Finally, we expect that policy entrepreneurs have these expectations due (among other factors) to some specific dynamics of the system they are embedded in, like specific events, trends, loops, or path dependency mechanisms. These elements provide the contextual background for explaining the relation between expectations, visions that led innovation policy of key policy makers' entrepreneurs; which might explain some of the changes in the YOFI.

Methodology and empirical base:

We carried out an extended case study of the YOFI system for the period from 1970 to 2018 (almost 50 years), eventually focussing on the changes experienced during the last years 15 years, especially 2016-2018. We draw on a documentary search and a fieldwork, both performed by a team of three researchers and three Mexican policy makers, from January to November 2018 (Giachi and Garcia-Lara, 2018).

We used three research methods to develop this case study:

- a) An extensive literature review of secondary sources (i.e. scientific publications, government documents, reports, meeting minutes, official databases, etc.).
- b) A set of 9 interviews to policymakers (4), researchers (2), representatives from the industry (2), and a private consultant, being policy entrepreneurs for the selected case.
- c) A participatory workshop with policymakers and other stakeholders (i.e. national and regional policymakers, researchers, NGOs, and representatives from fishermen and industry associations) was carried out locally to co-produce the evidence for this research.

These research methods provided the information that built the case study based on: a) a detailed description of the evolution of the YOFI from 1970 to 2018, and b) the current YOFI system and the main innovation policy and regulatory reforms that have been undertaken in the period 2004-2018. These includes: restructuration of the actors and their relationships, emergence of technologies; and the role of internal and external pressures of the system.

Results:

Octopus fishing is a key economic activity for the region providing both a significant source of incomes and a symbolic identity for local fisheries (e.g. Mayan Octopus). The YOFI system experienced a significant growth from the 1990s, mainly led by increasing exports facilitated by stipulating international trade agreements. By contrast, few innovations were developed or introduced in the system during this period, maintaining the features of a traditional agri-food industry.

We identified several types of pressures on the systems, either exogeneous or endogenous in nature. Consequences of climate change, pollution and increasing global competition pose serious threats to the YOFI altogether with local challenges like overexploitation of the biomass, clashing perspectives about sustainability, increasing competition between fishermen, illegal fishing, local migration from the inner areas of the peninsula toward the coast, and the

social inequality of the industry structure.

Regulation, law enforcement and trade agreements have been the main policy tool both at the Federal (national) and regional level for tackling the social, economic and environmental problems that fishery get to local communities. Science, research and innovation played a minor role in supporting the development of the YOFI, at least until the 2000s. During the last 15 years, regulatory reforms have been giving increasing attention to scientific evidence, while researchers experimented with Mayan Octopus in their labs in order to deliver new products. Since the period 2004-2007, new platforms and programs for protecting the product and developing the system have been launched, involving both public and private partners. While regulatory change maintained its dominant position as main policy tool, new strategies and actors emerged.

This became especially evident with the launching of a set of initiatives during the period 2016-2018 aiming at increasing the competitiveness of the sector through cluster-based approaches, and supporting networking, capabilities, entrepreneurship and user knowledge (Framing 2):

- Creation of a denomination of Origin (D.O.)
- Competitiveness Reinforcement Initiative (CRI)
- Creation of a technology platform and experimental lab

These actions involved a heterogeneous set of actors from different sectors, through collaborative platforms coordinated by a team funded by the regional government. The key policy entrepreneurs involved into these actions shared a vision where innovation for fisheries do not come from scientific knowledge produced by universities or laboratories, but from developing new strategies, capabilities and partnerships through collaboration and training. This seem to be based on the expectation that science is not delivering effective solutions to existing problems, but new problems. In turn, there is the expectation that innovation, through increased competitiveness and productivity, can generate positive returns in terms of social welfare or environmental sustainability in the long run. The entrepreneurial experimentation by a small set of entrepreneurs, the shift in guidance of search and knowledge creation by public researchers and increased legitimacy and allocation of resources supporting this vision probably developed or reinforced these expectations.

We contrast this interpretation with the analysis of an innovative experience launched in 2004 and still standing, although outside the formal policy arena. This is the case of the Mayan Octopus lab for socio-technical experimentation in Sisal (Yucatan). This grassroots innovation led by a local university lab in collaboration with fishermen wives is following an approach aiming at transformative change of the fishery system. The underlying vision of the key innovators/entrepreneurs is that the primary goal is not enhancing the efficiency or effectiveness of the fishery but generating an alternative for local communities that is not threatening social cohesion and the conservation of the species. This is addressed through the aquaculture of Mayan Octopus. This vision is based on the expectation that increasing exports and competitiveness of the YOFI system is not delivering returns in terms of community well-being. In turn, this expectation is based both on the knowledge of the local context and the scientific and technical evidence provided by a previous collaboration between FAO experts and local researchers from the public sector about the potentialities of aquaculture for sustainable development.

Conclusions:

In conclusion, our provisory findings show that the approaches towards innovation seem to respond to different visions and, therefore, expectations. However, while the visions about innovation policy and strategy seem to be relatively easily to illustrate and relate to the scheme developed by Schot and Steinmueller (2018) – the Three Frames –, expectations about innovation seem to be a complex issue. This is because the link between expectations about development and visions about innovation is not so linear as expected, as showed by comparing the 2016-2018 governmental innovation policy with the aquaculture case:

1. First, similar expectations can carry to different visions (and, therefore, approaches). This is the case for concerns about sustainability and perceived limitations of market-oriented approaches, also manifested by a couple of policy entrepreneurs for the innovation policy in the period 2016-2018.
2. Second, it is not clear to what extent a specific vision would derive to a specific (set of) expectation(s). It is likely that other factors are playing a key role in this relation. In this sense, it seems that the system-function framework can help to explain how policy entrepreneurs forms their visions. It is possible that a more detailed and complex analysis of the system could lead to a better determination of policy entrepreneurs' expectations. For instance, we need a better specification of factors like institutional learning or the importation of strategies by foreign countries that can have a great relevance for systems that are local/rural but also connected to global networks like the YOFI system.

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A5 GEOGRAPHY

Wednesday 05 June 2019 from 11:00 to 13:00

THOMAS SCHERNGELL, Chair

Abstract 156

DISTANCE IS NOT DEAD: 21ST CENTURY GEOGRAPHY OF UNIVERSITY-BUSINESS RESEARCH COOPERATION

Robert Tijssen ^{*}, Wouter van de Klippe ^{*}, Alfredo Yegros ^{*}

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Background:

Playing a key role in many contemporary science-innovation ecosystems, the organizational mission of universities is create and disseminate knowledge and skills for the benefit of its students, staff and other users. University teaching and training, as well as academic scientific research, are increasingly designed to create longer-term socioeconomic impacts and sustainable societal benefits. A university's geographical outreach has become a major issue, in an era where higher education and science have become increasingly affected by the pervasive megatrends of internationalization and globalization in science (Waltman et al., 2011; Ahmad, 2014). More and more students and academic staff are of foreign origin, while research partners and users are more likely to be located in other countries or far away continents.¹ In our 'flattened world' globalization has become a dominant feature of geographical 'space/place' views and models of developments in science-innovation systems (e.g., Storper, 2000; Florida, 2005; Friedman, 2005; OECD, 2010; Ghemawat, 2011).

In the current era, where knowledge and human resources became more geographically distributed and universities more interconnected, many research-intensive universities are increasingly engaged in R&D partnerships with business enterprises abroad. Academia is no longer only about creating stocks and flows of scholarly knowledge, the transfer of technical expertise or advanced skills for economic utilization and commercialization has become a vital 'third mission'. Many universities are now also subjected to government pressures and political desire to contribute more to local and domestic economic development (e.g., Clark, 1998; Mejlgaard and Ryan, 2017). According to several high-profile policy documents that were released over the last 10 years, including the European Commission's Lamy report (Lamy et al., 2017), neither science-based university education nor research-based knowledge are flowing sufficiently rapid or effectively from research-intensive universities to R&D-active, innovative firms.

Aim:

It is unclear and under-researched how 'localization' and 'globalization' processes have impacted on university research portfolios and priorities, particularly on their university-business R&D interactions. Since universities operate in a dynamic system of (conflicting) push and pull factors, those impacts will be university-specific – in part a result of their own organizational capabilities and constraints, partly because of external infrastructures and opportunities. How are the localization and globalization 'pull factors' affecting the way research-active universities are engaging with R&D-active firms? Can we measure and monitor changes in terms or geographic proximities? And if so which factors are major contributors to

¹ Rather than using 'internationalisation' and 'globalisation' interchangeably, or defining them separately, we adopt 'globalisation' as the single term to denote a process where an increasing large share of interactions or collaboration involves partners located in other countries.

the evolving preferences for either local and/or global research partners in the business sector?

Methodology and empirical base:

Building on the findings of abovementioned studies we focus on one element of UBI that are both captured in large bibliographic databases and measurable with empirical information: university-business research cooperation. More specifically, the university-business co-publications (UBCs) that reflect productive and successful research partnerships where the organizational affiliations of participating researchers were extracted from the author address(es).

Our current analytical framework is based on a 'successful science' logic and an associated 'research output' perspective; we focus on university-driven research-based knowledge creation. Using the affiliate address information made available in research publications opens up possibilities for designing metrics and associated indicators that enable large-scale, quantitative 'bibliometric' analysis of UBC patterns and trends (Lundberg et al., 2006; Tijssen et al., 2009; 2011). We extracted those publications from our in-house version of Thomson Reuters' Web of Science Core Collection database (specifically, the SCI, SSCI and ACHI indexes within this collection).² The majority of those publications are produced by academic researchers and represent 'basic' discovery-oriented science. These researchers need to publish for career purposes and to share major achievements with colleagues and peers worldwide. So many of their successful joint research projects, also those involving active cooperation with corporate R&D staff,³ eventually lead to publications in journals, conference proceedings or other (printed or online) outlets.

UBCs present a wealth of empirical information on collaboration patterns and trends between universities and businesses worldwide. Ponds et al. (2010) examine the relative importance of social proximity, as proxied by being partners in producing such co-authored research publications. These co-publications implicitly represent two intertwined dimensions of knowledge transfer mechanisms that occur with research cooperation arrangements. The 'knowledge stock' dimension represents capabilities, both in terms of inputs of the partners, the ability to cooperate (successfully), as well as joint results that are published as co-authored research publications. The 'knowledge flows' dimension represents interactions and processes before and during the research effort, which becomes partially manifest in the content and structure of the publication and the list of authors.

These knowledge creation processes obviously imply some degree of (in)formal research partnership, but also reflect associated knowledge exchanges and spill-overs of research-based components between universities and the business sector. As such, these co-publications can be seen as both an indicator of collaborative activity as well as impacts of academic 'brain power' on knowledge-intensive economies and economic sectors.

As a source of statistical data, UBCs offer a range of possibilities for studies of patterns and trends within higher education sectors and individual research-intensive universities. UBC volumes and patterns are often affected by spatial proximity between firms and universities. One may assume that the ability to produce large quantities of UBCs reflects their attractiveness of specific universities as sources of research-based knowledge for science-intensive industries. Since corporate partners will engage in joint research with academics if

² Henceforth, our database will simply be denoted as the truncated acronym 'WoS'.

³ But only if the topic, the joint research activities and major findings are still in a pre-competitive stage far removed from possible commercial applications.

they are sufficiently convinced of their research capabilities - in terms of quality, potential utilization value, and (cost) effectiveness - UBCs therefore also partially reflect the degree in which universities are able to comply with quality standards and specifications imposed by industrial R&D.

UBC counts provide statistical data for comparisons between universities. However, UBC frequency data are often size-dependent: large research universities tend to have many UBCs. When correcting for the size of the university, i.e. the total research publication output, the share of UBCs within that total output presents us with high-quality data that enable more meaningful comparisons across universities with regards to their UBC intensity.

A single UBC may include more than one university and more than one industrial partner, in these cases we have assigned a complete publication to each of the involved organizations. In the UBC counting scheme, the frequency counts refer to the quantity of pairwise interactions that each university has had with businesses as represented through university-business co-authored publications. For sake of simplicity, we refer to those counts as 'UBC publications'. Multiple counting will occur when there are multitude of business sector affiliations are mentioned in the author addresses on the same UCB publication. As a result, a UBC can be assigned to several distance-categories simultaneously if the author addresses mention two or more firms based at different geographical locations. Calculating the geographic distance between a university and each of the co-authoring business enterprises, is done means of geo-coding and subsequent classification of companies according to their physical location.

The scale and scope of a university's UBC profile, and the quality of that research (either 'discovery oriented' or 'applied') makes difference. Being a large research-intensive universities, with a 'powerhouse' reputation among firms, clearly with raises the likelihood to produce large numbers of UBCs. Universities with an industry-aligned research specialization profile have a much higher chance of successfully engaging with the business sector. On the business sector side, UBCs in general tend to arise from cooperation with large, R&D-intensive firms in industrial or manufacturing sectors⁴, or local science-based spin-off or start-up companies in a local science park. UBCs are also more likely to occur when universities cooperate with larger firms (and less so with small and medium-sized firms); the data therefore are biased in favor of successful science-based cooperation with large R&D-intensive firms. Some UBCs represent 'one-off' small-scale interactions, while others relate to large-scale R&D efforts in longstanding international consortia; some of those joint publications are co-authored with one or more colleagues in the business sector, others may carry multiple affiliate addresses of the author.

UBC globalization is driven and shaped by the interplay between macro-level trade-offs between close proximity partnerships and long-distance connections, and micro-level processes of mutual attraction and integration between cutting-edge academic science and innovative corporate R&D (e.g. Bjerregard, 2010). The propensity to collaborate successfully with foreign corporate partners, and the chances of success, still heavily depends on the right R&D framework conditions, notably research capabilities, and pivotal positions in global R&D networks (e.g. Gertler and Levitte, 2005). The major advantage of publication-based information is the ability to produce tangible and objective data that allows for large-scale, multi-level analysis and comparisons at the level of entire universities.

In this paper we report on a large-scale empirical study in which we examine the UBC patterns of universities worldwide. The universities were selected from the 2017 edition of the Leiden

⁴ Academic studies worldwide have shown that research partnerships with industry, and UBC numbers, tend to concentrate a few 'science-dependent' industrial sectors (biotechnology and pharmaceuticals, chemicals, IT and telecommunications).

Ranking. This source refers to the publication years 2013-2016. In doing so, we assembled quantitative data on tens of thousands of research publications where these university have co-authored with research partners in the business sector.

Table 1. Distance-based classification system of geographical zone

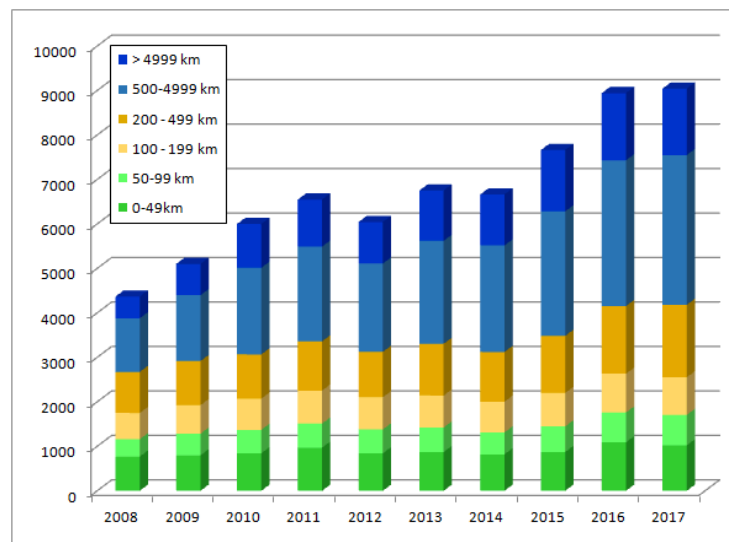
Distance zone	General description
0-49 km	local – ultra short distance
50-99 km	local – short distance
100-199 km	local – intermediate distance
200-499 km	local – long distance
500-4999 km	global – very long distance
> 4999 km	global – ultra long distance

The UBC profiles are broken down by distance categories. Focusing on the spatial proximity between each university and each of those partner firms, we collected our empirical data from the author affiliate addresses listed on UBCs, and used the physical distance between pairs of university-business addresses to define a series of expanding ‘UBC zones’ depending on where industry is located. Table 1 displays those zones, which range from ‘local UCB’ at ultra-short distance (0-49 km from the university’s city center) to ‘global UCB’ at ultra-long distances (more than 4,999 km away).

Results:

We introduce a novel performance indicator of universities – local University-Business Cooperation (local UBC) that will be implemented in the 2019 edition of U-Multirank (www.u-multirank.org). We will present the latest empirical findings of our global comparative studies among 788 ‘UBC-intensive’ universities from the 2017 Leiden Ranking with at least 80 UBCs (an average of 20 per year for the years 2013-2016). The latest general trends will be shown the degree to which universities are either localizing, globalizing or ‘glocalizing’ their UBC activities. A distinction will be made between the ‘UBC powerhouse’ universities with large numbers of UBCs and those that are less active in cooperating with R&D-intensive business sectors.

Figure 1. Annual trends in the number of UBCs in UK universities by distance zone*



* The UBC data include multiple counts of publications corresponding to the number of firms mentioned in a publication's author addresses and whether or not those firms are located in different geographic areas.

The final part of the analysis concerns the 48 largest research-intensive universities in the United Kingdom where we conducted an in-depth study of the UBC patterns and trends during the years 2008-2017. Our main goal was to identify the major factors that determine UBC activity in the UK. The results show remarkable differences across the various distance zones, and reveal some significant differences between globalizing or glocalizing universities. Figure 1 shows the annual trends in UBC quantities for these UK universities.

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Abstract 60

CURRENT AND POTENTIAL USE OF COMPLEXITY MEASURES FOR DECISION-MAKING: THE CASE OF TRANSNATIONAL RESEARCH PROGRAMS IN EUROPE

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Aim of the proposal:

While there is a growing literature on the national funding schemes devoted to transnational research (Reale et al, 2013), there are few contributions in this field using approaches focusing on interactions and relationships between agents, such as social network analysis (SNA) and spatial analysis, that are techniques that fall within the broader concept of "Complex System". The aim of this paper is to discuss the contribution and the benefits of using these different methodological approaches (SNA and spatial analysis) to the transnational research programs starting from a case study, namely ERA-Net programs.

Background:

Studying the transnational research activities is not easy. Emphasis is no longer placed only on policy makers, but also on the way in which policy makers are in interaction with environment (mutual influence). The transnational research context is composed of many actors with different interests where policy is the result of the interactions between mutual dependent actors in both public and private networks. The increasingly widespread availability of data on characteristics and funding related to joint R&D programs between European countries represents a key element to shed light on the process of Europeanization of research activities. While there is a growing literature on the national funding schemes devoted to transnational research (Reale et al, 2013), there are few contributions in this field using approaches focusing on interactions and relationships between agents, such as social network analysis (SNA) and spatial analysis, that are techniques that fall within the broader concept of "Complex System". "Complex System" understood as the study of a phenomenon composed of many parts and many possible relationships between these parts (Albert and Barabási, 2002; Zinilli, 2016). Studying complex systems of transnational research can contribute to the achievement of a broad range of research and innovation objectives. The question is: how can complexity theory help us understand the ways in which R&D policy affects the research activities. Complexity theory is essentially a theory of change with particular emphasis on evolution, adaptation and survival (Morrison, 2002). Instead of using linear models, the complexity theory embraces holistic approaches and particularly emphasises networks. The growing acknowledgement of non-linearity and, therefore, uncertainty, discontinuity, irregularity, unpredictability of real phenomena leads us toward an approach based on social complexity. By this, complex network systems indicate a large number of interconnections and variability over time. Social relationships among agents are an example of complexity, where nodes can be people, programs, projects etc., and links represent their interactions (Cilliers, 1998; Zinilli, 2016). This dynamic relationship is the cornerstone of complexity theory. These approaches are likely to provide important insights into communication and knowledge flows, in addition to the effects of proximity and similarity between the units of analysis; for instance, spatial methods allow

us to account for proximity dependence among several funding agencies (Reale et al., 2017). However, the contribution based on the reciprocal interaction in the process of Europeanization of research activities at the level of political decision-making process (policy design and implementation) remains little debated. In fact, most of the studies have been focused at performer level related to research projects, (Barber et al, 2011; Hoekman et al. 2013; Scherngell and Barber 2009; Zinilli, 2016). From the perspective of a political decision-making process, we may observe for instance the underlying strategies of alliance between policy makers. By changing the level of analysis from the performer to the policy level, we expect to achieve an understanding of the decision-making network and its evolution over time. The aim of this paper is to discuss the contribution and the benefits of using this different methodological approaches to the transnational research programs starting from a case study, namely ERA-Net programs.

Methodology and empirical base:

We observe a 2-mode network to explore the diversity, or complexity, inside the transnational research programs. Among the different types of transnational research, we focused on the participation and investment in a specific program, namely ERA-NET programs. We chose this type of program because it is relevant in fostering mutual collaboration in the process for overcoming the fragmentation of research within the ERA. We investigate the complexity observing the relationship among the agencies that fund the same research programs. Into ERA-Net context there is the possibility that an agency invests in more programs in the same year, for this reason in our case the analyzed matrix is not a binary matrix, but a matrix whose edge weights are count.

The effect of geographical proximity and relationship on the level of agencies engagement in joint transnational research programs has been studied using data extracted from RISIS-JoREP 2.0 database, one of the facilities available through the distributed research infrastructure RISIS (Research infrastructure for research and innovation policy studies). Using RISIS-JoREP data it is possible to understand the modes of relation of the actors involved in the transnational research activities, the national preferences of participation and funding mobilization. In this way is possible to show the importance and potential use of network/spatial analysis for decision-making. RISIS-JoREP database is a unique data archive on this kind of funding instruments, which allows monitoring the modes of relationships and the functions performed and the amounts allocated by the actors involved in the ERA dynamics (Reale et al, 2013). For our study, we observe data from 2010 to 2014 (five years), since for that period the database provides reliable data on funding characterized by a large geographical – EU-28 countries plus four associated countries (Norway, Switzerland, Israel, Turkey). We will show empirical analysis about the interactions of funding agencies. Furthermore, we will analyse the contribution of a set of information belonging to several levels of analysis, agency level, country level (country of origin of the agency) and funding program, compare to the creation or not of a research relationship.

As our data make it possible to investigate and compare the position of funding agencies, we will explore their centrality and the similarities/dissimilarities in their strategic patterns. After an overview of the main descriptive analysis of the network, we have explored how country and agency attributes influence the network structure through an Exponential Random Graph Model (ERGM) with count edges (Krivitsky, 2012). Furthermore, we show spatial interactions among the agencies, with the purpose of mapping the agencies on the base of the most

important characteristics. A thorough insight in the present and absent ties agencies reveal the structural properties of ERA network.

Results:

Transnational research programs are tools where the importance of national policies toward Europeanization is likely to emerge as the result national strategies or following academic communities and research traditions in a specific field of study that create a favourable environment to transnational joint research activities.

Conclusions:

This study shows that focusing the attention on the relationships among agencies is possible to observe strategies by decision-making that are otherwise not evident with traditional approaches. Using techniques such as social network analysis or spatial analysis (geographical proximity) can be useful to understand the roles that the agencies play in the network and how they influence other agencies, as well as understanding the motivations for investing in a specific collaborative network rather than in another. Analysing decision making in transnational research programs is crucial from both performers (researchers, public-private organizations) and for structural perspective generated by the relationships. By changing the level of analysis from the performer to the policy level, we expect to achieve an understanding of the decision-making network and its evolution. We will end the paper with a discussion of the surplus value of the elaborated interaction variables and with recommendations for further research using complexity approaches in research policy theory.

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Abstract 135

WHAT DOES PLACE MEAN FOR ADDRESSING GRAND CHALLENGES? EXPLORING THE EVOLUTION OF REGIONAL INNOVATION POLICY

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Aim of the proposal:

The paper explores the main factors that justify a place-based approach for new innovation policy approaches aiming to address grand challenges through related and/or unrelated diversification

Background:

The last few years have witnessed a major shift towards a greater consideration of societal challenges as a driver for innovation policy (Mazzucato 2011; Weber and Rohracher 2012; Schot and Steinmuller, 2018). Proponents of challenge orientation have argued that innovation policies built on market and system failure rationales pay too little attention to the content or direction of innovation - and have therefore been ineffective in solving so-called 'wicked' societal problems such as poverty, aging, climate change, etc. (Weber and Rohracher, 2012; Coenen et al, 2015). Generic innovation policies promoted under systemic rationales have also had limited impact in supporting economic renewal and transformation (Frenken, 2017).

Generic interventions seeking to address systemic failures often have the effect of deepening existing interconnections rather than expanding and broadening the range of innovation specialisms. One of the attractions to policy-makers of systems rationales in recent decades has surely been the intellectual cover it provided for the shift away from more interventionist technology and industrial policies and towards generic innovation and enterprise support policies under what some have called neoliberalisation.

But no policy is ever sector- or place-neutral in practice, and generic innovation policies are likely to further reinforce relationships between strong incumbents in existing supply chains, at the risk of reducing variety and generating systemic lock-in (Narula, 2002; Herstad et al, 2012). They also focus on strengthening collaboration within the 'triple helix' of university, industry and government while neglecting the role of users.

More recent views seemingly break away with traditional systems rationales, advocating a greater challenge or mission orientation and directionality in innovation policy and, consequently, a stronger role for the State (Schot and Steinmuller, 2016; 2018; Mazzucato, 2013; 2018). As Boon and Edler suggest, the role of the State goes beyond supporting the capability and connectivity of and within systems to innovate to become "a major actor in shaping the directionality of innovation". It also supports more targeted policies and a move away from supply side policies and towards the articulation of new needs at the demand side in order to create new markets (Boon and Edler, 2018).

However, this literature neglects the importance of contextual factors influencing the possibilities for overcoming 'directionality failures' (Weber and Rohracher, 2012) and implementation challenges. Both problems or challenges and their potential solutions are often framed in local arenas of contestation, negotiation and compromise and are thus context-specific by nature. It also tends to focus on an idealized State 'policy-maker', downplaying the fact that policies are designed and implemented at multiple levels of governance, in messy and complex policy mixes. Perhaps unsurprisingly, then, the role of regions in challenge oriented or transformative innovation policy has been little explored (Coenen et al, 2015) and have just been advocated to be considered 'spaces for experimentation'.

Meanwhile evolutionary economic geographers have contributed to a better empirical understanding of the dynamics of structural change and helped us to see the growth of economies as a branching process driven by endogenous diversification mechanisms. This stream of work cautions against the uncritical adoption of policy recipes that are not aligned to or supported by regional specialization and institutions, and instead advocate interventions that are sensitive to the economic specialization, developing capabilities and needs of different places.

At the same time, economic geography has paid surprisingly little attention to innovation for transformative change (Coenen et al. (2015)). Much of the regional innovation policy literature has a strong bias towards success stories and the advantages of agglomeration (Eder, 2018), and is characterized by an implicit assumption that innovation and diversification are positive per se.

It has been argued that territorial differences, and discontent in the 'places that don't matter' are a key factor behind the rise in populism in Europe and a key variable (over age, and social and economic status) explaining the UK Brexit referendum and the US 2016 presidential elections, developments which "threatens to derail the very economic and social stability at the heart of the prosperity of the most dynamic cities and regions" (Rodriguez-Posé, 2018). The debate on the role of the State in regions has, according to Feldman et al, too narrowly focused on counts of innovations, firms and jobs, and too little on how the well-being and prosperity of citizens in those places can be advanced. Indeed, policy agenda is normally divided into regional economic development policies for growth (including innovation policies) and policies for distributing growth aiming at social objectives.

Evolutionary economic geography lacks a comprehensive and co-evolutionary perspective on related and unrelated diversification in regions that recognises a role for human agency. While research has mainly focused on the notion of 'related variety' and diversification through exploiting existing knowledge bases into adjacent possibilities, radical innovations tend to stem from recombining more distant pieces of knowledge (Castaldi et al, 2015). Generic innovation policy interventions are more likely to lead to related diversification, whilst unrelated variety requires a different approach and, potentially, a more proactive role on the part of the State (Frenken, 2017). We can find a mixed approach in the recent regional innovation policy spread by the European Union (smart specialization strategies). They clearly support directionality for innovation policy based on regional capabilities and a sound regional innovation system and even plead for a mission-oriented policy (Foray, 2015). However, there is not a clear discussion about how to address societal challenges and fostering unrelated

variety (Boschma, 2017).

Addressing societal challenges could provide regional policies with the needed directionality both to drive structural change and to lead to welfare-enhancing innovative solutions. This suggests a need not only for efforts to expand the capabilities of economic actors but also a closer look at the demand side. We believe there is a need to build a more positive policy agenda that considers the need to address societal challenges through innovation policies, the structure of regional economies shaping the growth of knowledge and the need to take a genuinely place-based and place-sensitive approach to policy. Geography of innovation needs to be incorporated in the policy agenda, not only for the inherent characteristics of innovation, but also for adopting a more realistic view on policy implementation.

Methodology and empirical base:

This is conceptual paper

Results:

We introduce concepts that have been acknowledged by geographer scholars, which shape innovation direction (nature of knowledge, power and agency and the intrinsic link between policy and resilience). Secondly, we discuss the different meanings challenges and transformation might have in a regional context. Finally, we deepen into the concept of implementation of these new approaches to innovation policy.

Conclusions:

We argue that implementation has a strong local component and therefore not considering the role of places and their constellation of actors in the assumptions made by Schot and Steinmuller (2018) for example in their 'transformative innovation policy' will lead to implementation failures.

B1 EVALUATION

Wednesday 05 June 2019 from 14:00 to 16:00

EMANUELA REALE, Chair

Abstract 42

THE PLURALITY AND CONTEXTUALITY OF RESEARCH QUALITY NOTIONS

Langfeldt L.^[1], Nedeva M.^[2]

^[1] NIFU ~ Oslo ~ Norway,

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Aim of the proposal:

1) MOTIVATION AND RELEVANCE

Research quality is a key concern across the research policy realm. In terms of the need to generate information about the effectiveness and value of research policies and funding schemes, notions of research quality are overarching arguments. It is a key argument in ensuring that tax payers' money is spent wisely (allocated to e.g. excellent/world-leading groups) and serves to solve the challenges our society confronts (e.g. allocated to world-leading researchers/the most promising projects).

Even if regularly operationalized for the purposes of assessing project proposals, candidates for academic positions, manuscripts for publications, and local and national research assessment exercises, and similar, the content and meaning of 'research quality' remains opaque. In this paper we interrogate the plurality of the notions of research quality. More specifically, we explore the diversity within and between disciplines in what researchers perceive to characterise the best research. We hope the analyses can contribute to providing the research policy realm with a more nuanced understanding of research quality and important differences between disciplinary areas, as well as to inspire further research on field specific notions of research quality.

Background:

2) RESEARCH AIM, THEORETICAL FRAMEWORK AND RESEARCH QUESTIONS

The theoretical backdrop includes previous studies of research quality notions, of disciplinary differences and of peer review. The literature trying to capture the elusive content of 'research quality' concludes that it is a multi-dimensional concept. Both empirical and theoretical studies point to three main types of attributes of research quality: (1) plausibly/reliability/rigor of research; (2) its originality/novelty; and (3) its value/usefulness (Polanyi 1962; Gulbrandsen 2000). These are all composite categories of attributes considered as essential for consensus of what is good research, and they may be valued from different perspectives and have different meanings in different contexts. Two main perspectives relate to whether assessments are anchored within, and hence quality notions originate in, the scientific field (internal to the field), or in more general concerns, e.g. in policy and funding research spaces (Nedeva, 2013). For example, research may be (1) reliable/trusted within the scientific field, in an interdisciplinary context, or in society at large, and it may be perceived (2) original in terms of new knowledge, methods or theories to the scientific field or to users outside the field; it may be (3) valuable/useful for advancing research within the field, across fields, in or society at large. Here we explore the diversity of research quality notions across research fields/disciplines which has clear implications for policy and the shaping and implementation of research evaluation regimes.

Academic disciplines differ along many dimensions. According to Whitley (1984), two central dimensions are the degree of task uncertainty in research (i.e. uniformity and stability of research outcomes and of research goals and strategies) and degree of mutual dependence between researchers (i.e. reliance on others in order to make valid claims, and the need to coordinate research strategies and aims). He identifies seven major types of scientific fields along these dimensions (and their subdimensions) and explains how the differences have implications for how the knowledge production is organised, standardised, controlled and valued.

In our study we will cover disciplines which represent three of Whitley's categories: Cardiology as a representative of 'professional adhocracy'; economics as a representative of 'partitioned bureaucracy'; physics as a representative of 'conceptually integrated bureaucracy'. According to Whitley (1984:246-258) these differ greatly in terms of their degree of reputational autonomy and their audiences for reputation. Hence, we may expect that notions of research quality, and how they develop, vary substantially. Cardiology is to a large part clinical or lab-based research. According to Whitley (1984:187-190) tasks and skills are highly specialised, but the significance of problems and goals are not ordered into a single hierarchy and include employer and state influence. In economics, research is done by individuals or in non-formalised networks around specific topics and funding opportunities, and knowledge production is organised around key international journals and conferences. According to Whitley (1984:206-7) theoretical work is much higher valued than empirical work, and the 'theoretical core' of the field controls intellectual boundaries and reputation. Physics consists of a variety of research fields. It may rely on labs, equipment and materials in the researchers' home organisation (e.g. surface physics) or outside their organisation/in transnational facilities (e.g. particle physics). Research is controlled and directed through a standardised reporting system, and subfields compete over significance of their problems within the dominant theoretical framework (Whitley 1984: 208,205).

Based on our literature review and Whitley's framework we expect originality, reliability and usefulness to be central in notions of research quality across disciplines, but their relative emphasis to be different and the content of the notions to differ substantially between disciplines as well as between their various research fields. In the paper we ask: To what extent do research quality notions vary according to key disciplinary characteristics – more specifically, according to how knowledge production is organised and what are the key audiences for reputation?

Methodology and empirical base:

3) EMPIRICAL FOCUS AND METHODOLOGY

The paper will analyse data from a web survey about researchers' notions of, and conditions for, good research. The data covers researchers in physics, economics and cardiology in five countries (Denmark, the Netherlands, Norway, Sweden and the UK). The invited survey sample included all researchers active in the three disciplines at major research organisations (the major organisations and units in the three disciplines were identified from Web of Science data, as well as from the organisations' websites). In total, 2587 researchers replied, which were 28.6% of the sample invited to the survey. Economics and physics are covered in all five countries, and cardiology in the Netherlands, Norway and Sweden.

To explore researchers' notions of research quality, what they perceive good science to be, is not a straight-forward task. Quality notions are rarely codified and often tacit, and rather than asking general questions about research quality, we asked contextualised questions. The respondents were asked 'Think about the research you consider to be the best in your specific field/speciality. Why do you consider this the best research?' The reply alternatives covered various characteristics relating to the originality, plausibility/reliability, and the (intra - or extra-scientific) value/usefulness, as well as proxies for good research (citations and journal impact factor). The survey is part of a larger project (www.r-quest.no) and provides data on what researchers think characterises the best research, what they emphasise when assessing grant proposals and candidates for positions, as well as several questions on what characterises their research activity and research environment.

Results:

4) PRELIMINARY RESULTS

The preliminary analyses indicate that notions vary along multiple dimensions, and that part of the disciplinary differences can be understood in terms of characteristics outlined by Whitley (1984). In cardiology, which aims at applications and where there are some employer and state influence over priorities, researchers more frequently (than in physics and economics) found that the best research in their field is research that benefits society. In physics, where subfields compete over significance within a dominant theoretical framework, contributions to the theoretical core and methodological breakthroughs were highly valued. In economics, where theoretical work is highly valued and knowledge production is organised around a hierarchy of key journals, contributions to the theoretical core and methodological breakthroughs was highly valued, as in physics. Moreover, citations and journal impact factors were more frequently indicators of the best research in economics than in the two other disciplines.

Notably, analyses also indicate similarities across the disciplinary areas. In all three areas, field internal value in terms of solving key challenges in the research field was the most frequent answer. Moreover, what researchers perceived as the characteristics of the best research varied much within the disciplinary areas. There were important differences between researchers located at universities and those located at research institutes: those at universities seem to attribute much higher value to research that change the theoretical framework of the field, whereas those at research institutes attribute higher value to research that benefits society. Also those whose research relies on insight from many different disciplinary areas value benefits to society higher. Further analyses will explore these and other differences within the disciplines.

Conclusions:

5) IMPLICATIONS/POLICY RELEVANCE

The topic has high relevance for all kinds of research evaluations and a wide range of research policies. Awareness that research quality is a multi-dimensional concept and insight in how it varies between and within disciplinary areas is important. One-dimensional evaluations and evaluations using fixed criteria across multiple disciplines and fields cannot capture the plurality and contextuality of research quality notions. Moreover, it implies that the selection of evaluators and criteria, and the categorisation of disciplines and research fields may have

large impact on the outcome. In this respect, the evaluation of multi-disciplinary, interdisciplinary and mission-oriented research poses specific challenges.

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EVALUATING FOR A TRANSITION – A SYSTEMATIC APPROACH TO ALIGNING RESEARCH AND POLICY EVALUATION

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Aim of the proposal:

The objective of this study is to investigate how the fields of research evaluation and policy evaluation may strengthen each other in the pursuit of supporting a transition towards a more sustainable society. By investigating the extent to which the evaluations performed today rely on theoretical foundations, or employ key concepts from relevant research literature, we seek to assess their ability to provide essential learning about the performance of research and policy in relation to a transition. We use the field of energy efficiency in buildings as our focus area, seeking to assess whether research and policy evaluations within this field together are supporting a holistic and progressive view on the alignment of research and policy.

Background:

The advancement of energy efficiency in the built environment is identified as key for cutting CO₂-emissions and reaching global climate commitments (IEA 2017a,b; Lucon et al. 2014), and the sector still holds great energy saving potential to be harnessed (IEA 2017a; OECD/IPEEC 2017). The realization of this potential, however, calls for large-scale transformations of the current energy system (IEA 2017b; OECD/IEA & IRENA 2017), which is depending on new innovations and technology to be developed and adopted. Such a transition towards a more sustainable energy future will require both deliberate research and deliberate policy pressure that, if properly arranged and performed, is able to provide new solutions and drivers for change (European Commission 2014; IEA 2017b; OECD/IEA & IRENA 2017).

Evaluation of both research and policy instruments plays an important role for realizing an energy transition (World Energy council 2016), as a tool for providing timely and effective learning from past experiences, as well as projecting outcomes from future implementations. But, in order for evaluations to be informing about transformative efforts, we argue that more flexible and innovative evaluation approaches are needed. Such an evaluation approach should be based in relevant literature, including e.g. evaluation theory, policy analysis and sociology of science, but should also be able to identify and assess transformative contributions of the evaluand, e.g. outcomes or processes that can support large-scale changes.

In the case of Sweden, the field of energy efficiency has been, and still is, receiving notable attention in terms of resources for research and policy instruments. Over some four decades, the field has hosted a range of state financed research programmes (Government bill 2012/13:21), along with an impressive combination of policy instruments spanning legislation, financial, and informative instruments (MURE 2018; Swedish Government 2017). Evaluation of these efforts has not been overlooked, with multiple prospective and retrospective evaluations undertaken over the same period of time. However, since research and policy are

two essential and intertwined components of realizing and supporting a transition towards a more sustainable energy system, their evaluation ideally needs to come together in greater evaluation schemes to provide insights on how the combination of research and policy is performing from a transition perspective. Yet, the evaluation of research and policy is largely treated as two separate fields, each with their own bodies of theory and practices, and systematic evaluations targeting the research-policy nexus are still scarce.

Methodology and empirical base:

This study presents a qualitative and comprehensive systematic review of both research and policy evaluation practices in Sweden, following a theory-based framework. We argue that robust evaluation approaches need to rest on theoretical underpinnings, yet they need to cater for the context of the evaluand. Therefore, the theory-based framework builds on the fields of evaluation theory and policy analysis to inform about the evaluation practices for policy instruments, while sociology of science informs about evaluation practices for research evaluations. In order to also be able to inform about the evaluand's potential to contribute to a transition of the energy system, the framework is completed with a set of key concepts adapted from the field of transition research, identified as crucial for a transition process. These concepts are: a systems, scale and multi-actor perspective, visioning, experimentation and learning. By assessing the extent to which these concepts are acknowledged or incorporated in the evaluation designs, insights regarding the ability of the evaluations to capture transformative efforts can be provided.

The framework is arranged around the categories operationalization, analysis and assessment of evaluations, each of which is equipped with a number of sub-categories to guide the systematic review. Data is extracted from the evaluations through a close reading of existing evaluations. The review has been conducted seeking minimal interpretation of the contents of the evaluations, and the assessments have solely been based on data drawn from the systematic review.

The sample amounts to a total of 53 evaluations: 20 evaluations of research initiatives, and 33 evaluations of policy instruments for energy efficiency in buildings. All evaluations have been commissioned in Sweden from 2005 and onwards. Collection of evaluations was made through interpersonal contacts with relevant authorities (the Swedish Energy Agency; the National Board of Housing, Building and Planning), with external organizations and consultancies performing evaluations, and via state web pages and web searches. The criteria for the evaluations to be included in the sample were that they needed to be proper evaluations, and that they concerned energy efficiency in the built environment. All evaluations that met the criteria were reviewed.

Results:

Operationalization

In the first category, operationalization of the evaluand, we look at the boundaries set for the evaluation, and how the evaluand is aligned with other governance areas, such as research, policy, and markets. We also address the overarching question of whether the operationalization of the evaluation allows capturing of transformative contributions of the evaluand.

Our review reveals that system boundaries set for the evaluations in general were following program goals for both research and policy evaluations, which in effect gives a rather narrow focus on outcomes and processes on program levels. Some evaluations stretched the boundaries of inquiry to include side effects or rebound effects, as was seen in two policy evaluations. In the case of research evaluations, two evaluations showed a focus on assessing effects that were not in themselves main objectives of the program or institutions, such as the added value delivered to stakeholders from research programmes through e.g. collaboration, wider competencies, and networks.

As for alignment with other governance areas, we found 16 research evaluations that thoroughly articulated interconnections between such, by specifically looking at how the research projects or platforms aided alignment by increasing cooperation and establishing joint platforms for actors representing both markets and research. Among policy evaluations, alignment between governance areas was seen in discussions that put the policy instrument in relation to overarching regulations. Such discussions were, however, often held on a rhetorical level, aimed at presenting the policy instrument in relation to a societal context.

Lastly, to support an operationalization that is able to capture transformative efforts, we emphasize the need for evaluations to set boundaries that allow a systems approach, incorporating different system components, levels and scales. Although the evaluations largely focused on outcomes on a program level, some discussions were seen in both strands regarding how the policy or research was contributing to effects on a societal level. For example, one research evaluation of a programme for developing energy efficiency solutions, explicitly incorporated assessments of effect from the research on the energy system and on societal development. Moreover, visioning – the guiding outlines of a transition - is another concept that is relevant in this regard. Visioning can be operationalized through a continuous evaluation approach that combines ex-post and ex-ante assessments, as was seen in both policy and research evaluations, albeit not very frequently. Altogether, the review suggests that the operationalization of evaluations, both for research and policy, can become more deliberate in allowing a transition approach if boundaries are taking a systems perspective, and if temporal boundaries are extended to consider the time needed for upscaling of innovation and policy practices that may support a transition.

Analysis

The second category of our framework, analysis, refers to the methods and criteria used for analysis, and the agency and forms of commissioning. It also encompasses an assessment of whether the analysis includes key concepts for assessing transformative contributions of the evaluand.

The methods applied for analysis within the reviewed evaluations were predominantly qualitative in both evaluation strands, mainly building on document studies and interviews with selected stakeholders. Quantitative approaches were also applied, but took different shapes for research and policy evaluation respectively, where quantitative methods for assessing policy impact entailed e.g. calculations of saved units of energy, while the equivalent for research entailed e.g. bibliometry that sought to quantify scholarly output and quality. Although both of the evaluation strands showcased a frequent application of multiple methods for analysis in the same evaluation, they were commonly not applied for triangulation, for validating and cross-checking results.

Regarding the criteria used for assessment in the two strands, the review showcased some differences. Research evaluations applied between two and seven criteria, with an average of four criteria per evaluation, while policy evaluations applied one to four criteria, averaging approximately two criteria per evaluation. While general criteria concerning impact and effectiveness were rather frequently applied in both strands, along with assessments concerning administrative issues and instrumental feasibility, there were also criteria exclusively used by one strand or the other. These were cooperation/interdisciplinarity, quality, and knowledge dissemination for research evaluation; the counterparts for policy evaluation were coordination with other policy instruments, acceptability and predictability. A criterion to be highlighted is relevance, the relationship between the objectives of a research program or policy instrument and societal needs and targets. Although it is recognized by the EU as a key criterion to be considered when evaluating environmental policy instruments, it was applied only in one policy evaluation out of the reviewed 33. It was all the more often applied in the research evaluations, seen in 14 evaluations. Thus, it seems that research evaluation practices to a larger extent is asking whether the initiatives in fact are coherent with, or are targeting concerns on a societal level, whereas this tends to be underrepresented in policy evaluation. Why this is the case is not apparent as far as can be discerned from the evaluation reports, but possible explanations are that there is a preconception in policy evaluations that the policy is accurate in this regard, or that relevance is not a part of the commission.

Turning to assessments of the agency behind the evaluations, the majority of the evaluations reviewed in this sample were commissioned by authorities, mainly by the Swedish Energy Agency, with the exception of three research evaluations commissioned by non-governmental research institutions. Some evaluations were also performed by authorities, but were predominantly conducted by external consultants in both strands of evaluation. Agency in terms of actor involvement was, similarly for both strands, limited to actors that were involved in, or affected by, the research or policy initiative, commonly represented in the evaluations as respondents in interviews or surveys.

Lastly, we assess whether the methods, criteria and agency can capture transformative contributions of the evaluand. To do so, we place focus especially on a multi-actor approach for a wide incorporation of actors, along with the acknowledgement of experimentation within the evaluation to capitalize on learning for both policy outcomes and future policy designs. Our review reveals that a multi-actor approach (i.e. the inclusion of two or more actor groups in the evaluation) was fairly common in both strands, seen in approximately half of the reviewed evaluations in both strands. The actor groups represented were for example academia, authorities, businesses or beneficiaries. As for acknowledging experimentation, the two strands indicate a difference as experimentation often was implied within research evaluation, and hence not at the focal area of the inquiry; while it within policy evaluation was less commonly seen and hinging on the type of policy instrument that was being evaluated. Arguably, there is room to extend discussions concerning experimentation in both research and policy evaluations, and to more actively seek to provide concrete learning about how a research or policy program is contributing with new and innovative outcomes, or how their designs in themselves can provide learning for stronger program designs that can yield transformative effects.

Assessment

In the last category, assessment, we look at how the evaluation ascertains alignment between the evaluand and other areas of governance, along with an outlook to processes concerning utility and dissemination of evaluation results.

Looking at how the evaluations assessed linkages between research and policy and other elements of meta-governance, our review does indicate a difference in the evaluation practices. This was mainly seen in that research evaluations were more extensive in outlining and assessing the interlinkages between the evaluand and adjacent areas of governance, while policy evaluations tended to contextualize the evaluand in connection with overarching institutions and other areas that concerned the policy instrument, while then proceeding with assessing workings on the policy level. This can be explained by research evaluations having to navigate the interstices between different areas of governance (e.g. policy, markets, and regulations) and other dimensions such as funding agencies and other involved organizations, in which a research program operates. More concretely, this was expressed to varying extents through discussion related to funding and co-funding of research, a feature central in more than half of the reviewed research evaluations, which discussed whether different models of funding/co-funding enabled or disabled important linkages between research and market or private sector actors. Assessments regarding linkages were, moreover, seen in discussions on how different governance areas were affecting or facilitating research projects and programmes, through collaboration and cooperation between academia, markets and authorities.

Lastly, concerning the processes of utilization of the evaluation results, both strands commonly outlined the intended utility of the evaluations in terms of their providing knowledge about the implementation that could be used for decisions regarding continuation of the research or policy initiative, or for improving current or future program designs. Intended users were thus actors that were involved in the implementations, often described as authorities or project leaders. Although no other clearly stated strategies for extending use beyond intended user were seen in the remits of the evaluations reports, we acknowledge that such may have been outlined at other stages of the evaluation process. To close this category, we conclude that there yet is potential to facilitate further use - and in doing so, support further learning - by allowing a wider cooperation with stakeholders when commissioning and conducting an evaluation.

Conclusions:

This study of the Swedish evaluation practices for research initiatives and policy instruments for energy efficiency in buildings, gives rise to certain key areas where combining experiences from research and policy evaluation may be of particular value when evaluating for a transition.

First, an assessment of effects on the energy system level needs to be supported by evaluations of both research and policy. Our review shows that there are numerous evaluations conducted, and that there is an overlap between evaluators and commissioners, in that the same actors or authorities are commissioning or conducting evaluations of both research and policy. We see this as an opportunity to capitalize further on learning between evaluations, and as a means to facilitate alignment between research and policy initiatives for

an energy transition.

Secondly, we note that an operationalization of evaluation boundaries that allow a systems perspective are seen to varying extents in the reviewed evaluations, mostly by incorporating side-effects and outlining of system components. Thus, while we see a foundational practice for a systems perspective being applied, the means and conduct of doing so can still be further developed for both research and policy evaluation. Concrete measures to do so include the application of assessment criterion relevance, as is commonly seen in research evaluations, as well as presenting and assessing the evaluand's alignment in relation to other areas of governance.

Third, the review shows that key concepts for assessing a transition are applied within the evaluation designs, yet, none of the reviewed evaluations have a stated purpose of assessing transformative efforts. Thus, we argue that if evaluation commissions are deliberately aimed towards capturing transformative efforts, a development of the practices for assessing the evaluand's contributions to an energy transition can be prompted.

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EVALUATING RESEARCH PORTFOLIOS

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Aim of the proposal:

Evaluating whether a portfolio of funded research projects (of a research council), or a portfolio of research papers (the output of a university) is relevant for science and for society requires two-dimensional mapping of the project portfolio: (i) projecting the portfolio on a science map showing how the portfolio fits into and possibly shapes the research fronts, and (ii) projecting the portfolio on a map of societal challenges, showing where the portfolio links to societal challenges or innovation. This requires evaluating the portfolio in two different 'languages': a technical language relating projects to the research front, and a societal language relating the projects to societal challenges. In this paper, we demonstrate a method for doing so. The advantage is that the method is much less dependent on subjective classifications by single experts or a small group of experts, and that it is rather user-friendly.

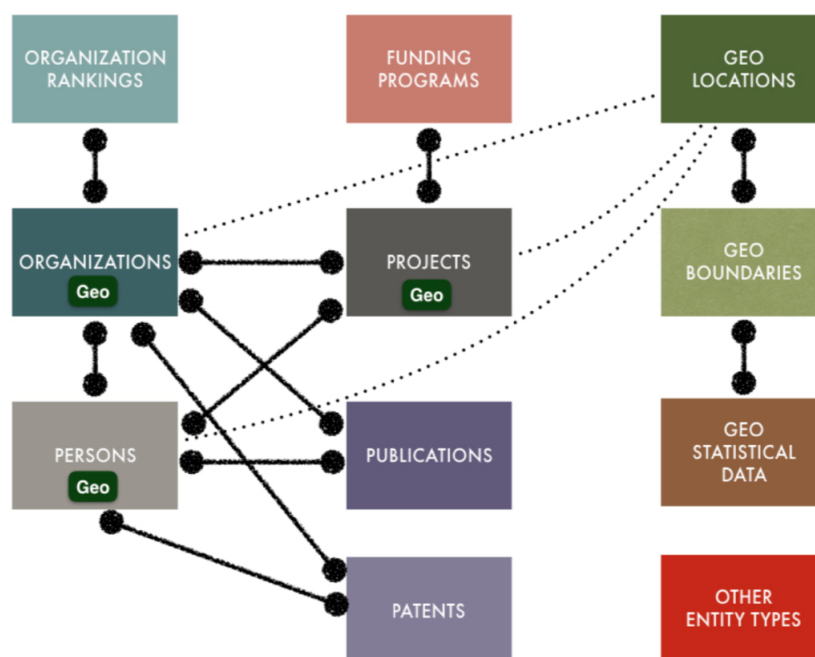
Background:

Evaluating funding programs of research councils, or research output of universities has at least two dimensions: is the portfolio adequate in (i) scientific and (ii) societal terms. A way to do this could be through a double annotation process, where project descriptions or academic papers are annotated using a knowledge base with a taxonomy for the science fields involved, and a knowledge base with a taxonomy for one or more societal challenges addressed by the portfolio. Using those knowledge bases – which are generally not an individual but a collective product – overcomes the problem that individual experts that would annotate the projects or papers are always biased and may select a biased set from the list of terms extracted from the material. This holds for technical keywords related to research fields as for technical terms relating to the societal challenges. Furthermore, annotating by experts is a time-consuming task, and therefore an automatic procedure would be helpful. The approach is based on the SMS (www.sms.risis.eu) platform, and it makes use of the increasingly rich sphere of Linked (Open) Data. We use the projects funded in H2020 as example, but a similar approach could be used for e.g. the paper production of a university – using full text or abstracts of the papers.

SMS is a 'big data' platform where 'big' is mainly used in the meaning of being 'heterogeneous'. The platform integrates a variety of datasets of different types and formats. The platform is currently focusing on data relevant for science, technology and innovation studies, including science policy studies and research evaluation studies. Although the platform is primarily developed to support research in this area, it is also useful for evaluation exercises, as we will illustrate. In terms of technology, the SMS platform is based on principles of semantic web, and linked open data. The platform consists of three layers: (i) the data layer, in which data are converted into a standard format, linked with each other and included in a data store (figure 1); (ii) the service layer for enriching and harmonizing the data, and (iii) the application layer which provides a set of user interfaces on top of one or more services. In the

data store, some dozens of datasets about researchers, R&D organisations, funding schemes and granted R&D projects, and R&D output (publications, patents) are linked. Additionally, the data store contains (links to) geographical and statistical data which are used for enriching the STI related data. Several of the data sets included are open data, others are private or confidential.

Figure 1. Main interlinked entity types for data integration in SMS platform



A core application within SMS is the faceted browser, which enables the user to browse the linked data. In the browser we can reduce the data by selecting properties. E.g., one may select within the larger set of all R&D intensive organizations (about 75000) only the higher education institutions, or the hospitals, and continue with that subset only. Most figures in this paper are screenshots of the browser. The browser help to get acquainted with the data, and gives a first qualitative idea about the project portfolio, the research topics and the societal issues addressed. By selecting the relevant projects (using the relevant annotated terms – see next section), a SPARQL query (fig 12) is produced for retrieving the relevant data from the data store for further analysis and visualization.

Another application is the annotation tool, that can be used to annotate text fields using (existing) knowledge bases. Currently we deploy the DBpedia Spotlight tool which contains a few knowledge bases, such as DBpedia, Yago and Schema.org, but we are planning to have more knowledge bases integrated, with rich concept taxonomies for different knowledge domains. The more specific the taxonomies, the better one describe texts field through these annotations. Obvious candidates for annotation are summaries/abstracts of projects and papers. The better the taxonomies, the more precisely the content of a paper portfolio or of a project portfolio can be described.

These tools are used for the evaluation of the portfolios.

Methodology and empirical base:

For evaluation both tools are useful. To illustrate this, we use the Cordis open dataset with H2020 projects (version December 2016). The data were downloaded from the EC website, and converted into RDF format – the standard for linked data. This enables us to inspect (in the faceted browser) and analyse the data. The browser shows the relevant characteristics of the projects, such as organizations involved, the organization type, and the program the project belongs to (figure 2). The CORDIS dataset contains among others a text summarizing the content of the projects. This is a relatively short text, but it would not be difficult at all to couple full project descriptions (e.g., all full text granted applications) to the SMS platform. It would be useful to experiment with this, and try to find out what textual information leads to the most accurate representation of the projects. One may also add the rejected applications, to compare the portfolio of accepted applications with the rejected applications. This would help evaluating the selection process: are relevant topics systematically rejected?

Figure 2: Finding projects on ‘diseases’

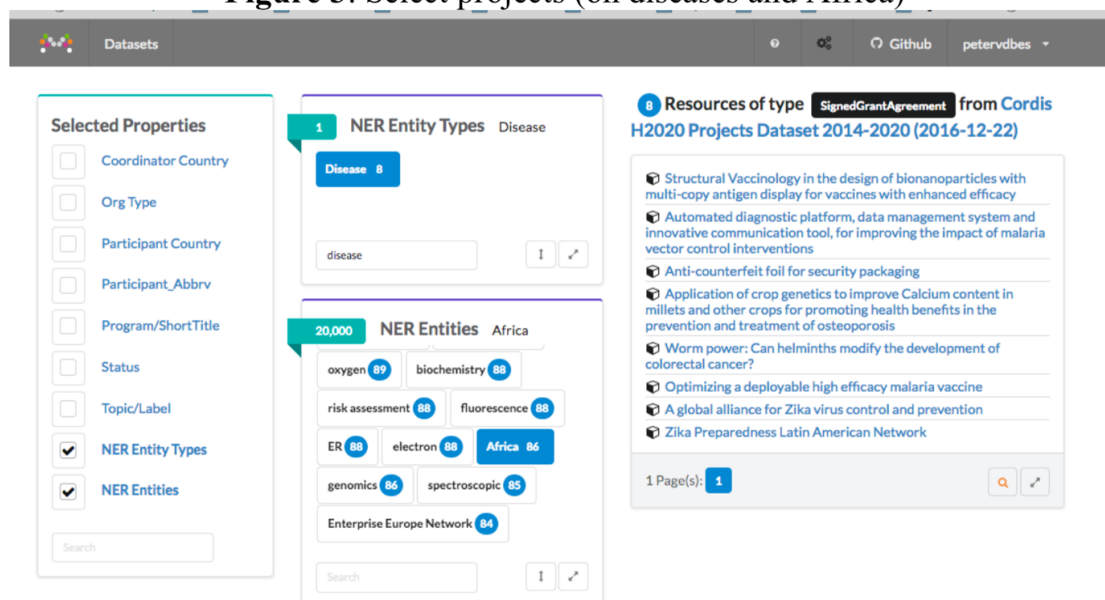
The screenshot displays the 'Cordis H2020 Projects Dataset 2014-2020 (2016-12-22)' interface. On the left, a 'Selected Properties' sidebar lists various filters, with 'NER Entity Types' checked. In the center, the 'NER Entity Types' panel shows 'Disease' with a count of 1742. Below this is a search input field containing the word 'disease'. On the right, a list of project titles is displayed, including 'Reverse engineering sensory perception and decision making: bridging physiology, anatomy and behavior', 'PROVIDing smart DELivery of public goods by EU agriculture and forestry', 'Releasing Prisoners Of The Paradigm: Understanding How Cooperation Varies Across Contexts In The Lab And Field', 'Gut Microbiota in Nervous System Autoimmunity: Molecular Mechanisms of Disease Initiation and Regulation', 'Functional materials from on-surface linkage of molecular precursors', 'Legitimation of European cultural heritage and the dynamics of identity politics in the EU', 'Tracking the cognitive basis of social communication across the life-span', 'New Easy to Install and Manufacture PRE-Fabricated Modules Supported by a BIM based Integrated Design ProceSS', 'Common Oncogenic Mechanisms in Multi-Partner Translocation Families in Acute Myeloid Leukemia', 'Building energy renovation through timber prefabricated modules', 'Theory of Stein Spaces in Berkovich Geometry', 'Uncovering the Role of Cancer Associated Fibroblasts in Facilitating Breast Cancer Metastasis', 'Robots learning about objects from externalized knowledge sources', and 'Individualized treatment planning in chronic back pain patients'.

We use as knowledge base the open DBpedia dataset, a standard in the open data community. This is the database under Wikipedia, in a useful (machine readable) format, and functions here as the knowledge base to annotate the project descriptions. The advantage is that the knowledge base is a product of communities improving its quality, and not the product of individual experts. As said we are planning to add specific field related taxonomies.

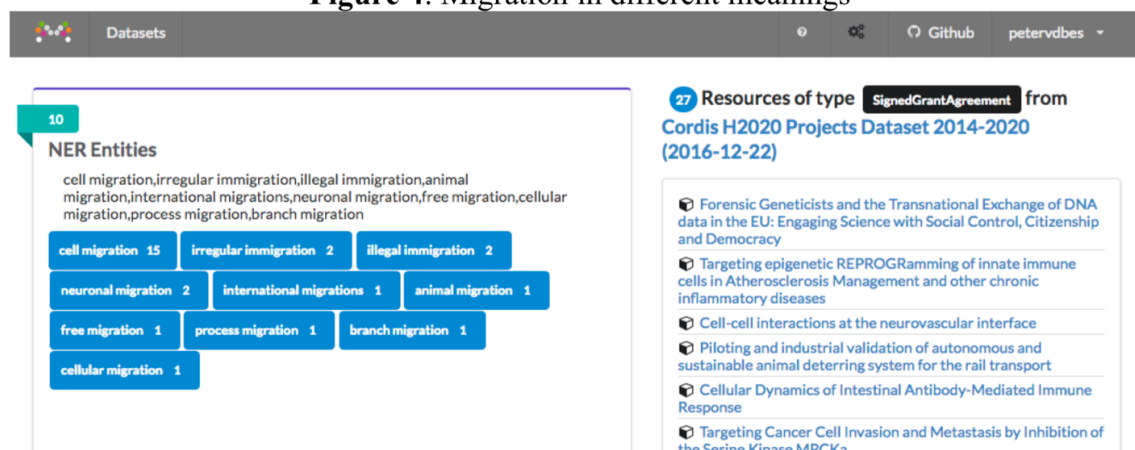
Named Entity Recognition: The SMS system has an ‘entity recognition’ functionality using DBpedia. Entities included in DBpedia are recognized in the project descriptions. This may need some pre-processing as the process is case sensitive. As DBpedia is a knowledge graph, the projects are linked to specific places in the knowledge graph, and though the graph systematically related to each other. In the current version of SMS, entities are partly subsumed under higher level Entity Types, and partly single Entities. We can use the knowledge graph to select projects. For example, by selecting a main category, e.g., disease,

we only get projects that have in their description a term referring to a disease (figure 2). As these projects are also annotated with other terms, one may add a different dimension, e.g., the geographical dimension of diseases. By selecting within diseases, the category continent and within that Africa, we get all projects on diseases and (in) Africa (figure 3).

Figure 3: Select projects (on diseases and Africa)



This combining of terms has a great advantage, as we can combine technical research terms and policy related terms to retrieve the relevant projects. This may solve the problem of finding how research links to the grand societal challenges. This is a core problem in assessing relevance of research (described in technical terms and policy related terms). Because the resulting set for a very specific topic is generally not too large, we can even manually inspect the policy-science link. Combining terms also helps to separate texts with similar terms. For example, migration appears in only a small number of H2020 projects. However, it appears in many different meanings, such as cell migration, neuronal migration, animal migration, branch migration, next to legal and illegal migration of people (Figure 4). One can then easily select the papers with the intended meaning of migration. This goes much quicker than we experienced when using searching the excel version of H2020.

Figure 4: Migration in different meanings

The other information available within Cordis makes more insight in the portfolio easy: after having selected a set of projects, we can easily find out see who is involved (organizations, countries), where the selected projects are located in the larger H2020 program (work program; sub-program), the funding level, etc. (figure 3).

Furthermore, we can use the advantage of a linked data approach: by linking the Cordis dataset with other data sets, we can find other properties of the organizations participating in the project. Linking to the geo-services enables to geo-locate the projects. Linking to the Web of Science may be used to find out what other specialties the project partners have, and how they collaborate. Linking the project partners to patent databases gives more information about the innovative activities, which the can be used for investigating a part of the impact.

A crucial point is the quality of the knowledge bases, of the taxonomies. The larger the set of terms in the taxonomy, and the better the structure of cognitive links between the terms, the better the annotation works, and the better we can represent the project portfolio.

Results:

EXAMPLE CASES

1. Chemistry for agriculture

We now look at chemical research in H2020 projects, related to one of the societal challenges. One could take e.g., Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bio-economy. This is rather broad, and therefore one may take smaller topics, such as agriculture, water, of sustainability. To investigate the portfolio, we have annotated all H2020 projects using DBpedia. We now first select all main entries (NER entries). In fact, there is one: chemical substances. We select this one (figure 5). We identify 976 projects that refer to chemical substances out of in total 11069 projects that up to now are funded in H2020. NER entity types are the main 251 categories, but there are many (20.000) detailed sub-categories: the NER entities. By clicking this in the faceted browser, we can see what other annotations these 976 projects did get: in total, some 7000. One can then relate the projects on chemical substances with other NER entities, for example agriculture. This is covered by three NER entities, and by selecting those in the browser, we see that this

relates to only 19 granted projects, as figures 5 and 6 show. One may now easily browse through these projects to further find out where they are about.

Figure 5: Selecting the projects on chemical substances

The screenshot displays a web interface for selecting projects. On the left, a 'Selected Properties' sidebar lists various filters, with 'NER Entity Types' checked. The main area shows 'NER Entity Types' with a count of 251 and a list of selected types: 'ChemicalSubstance' (976), 'ChemicalCompound' (927), 'Biomolecule' (485), and 'Work' (668). A search bar is located below the list. On the right, a list of project titles is shown, starting with 'Motivating Motor Learning: The Role of Reward, Punishment and Dopamine'.

Selected Properties

- ☐ Coordinator Country
- ☐ Org Type
- ☐ Participant Country
- ☐ Participant_Abbrev
- ☐ Program/ShortTitle
- ☐ Status
- ☐ Topic/Label
- ☒ NER Entity Types
- ☐ NER Entities

Search

NER Entity Types ChemicalSubstance

251

ChemicalSubstance 976

ChemicalCompound 927

Biomolecule 485

Work 668

Search

976 Resources of type SignedGrantAgreement from Cordis
H2020 Projects Dataset 2014-2020 (2016-12-22)

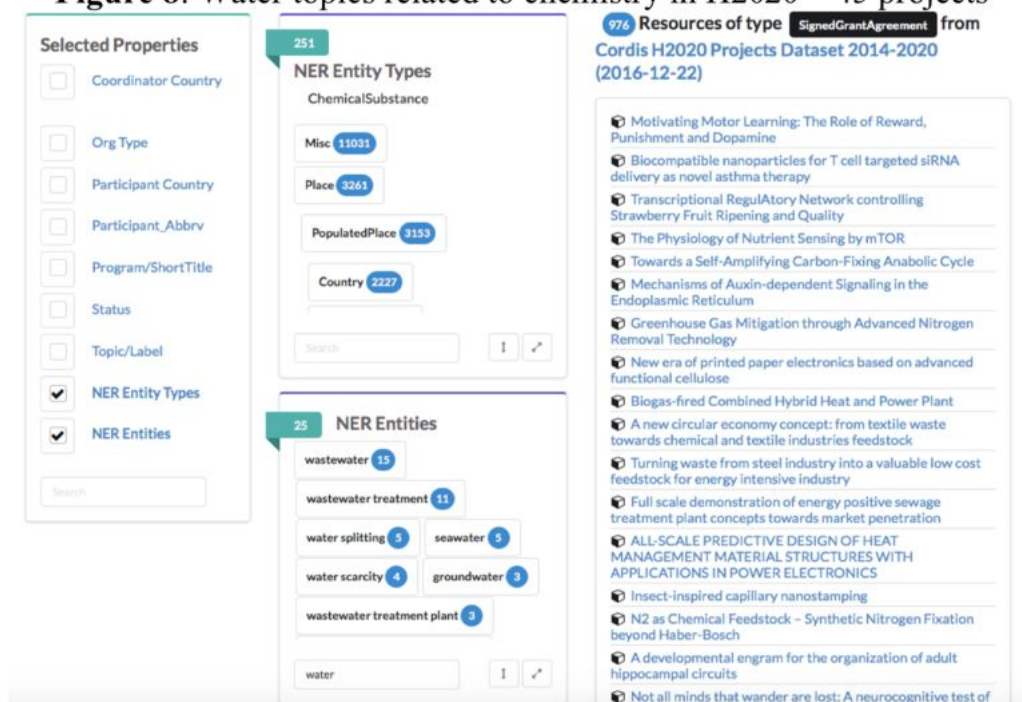
- Motivating Motor Learning: The Role of Reward, Punishment and Dopamine
- Biocompatible nanoparticles for T cell targeted siRNA delivery as novel asthma therapy
- Transcriptional Regulatory Network controlling Strawberry Fruit Ripening and Quality
- The Physiology of Nutrient Sensing by mTOR
- Towards a Self-Amplifying Carbon-Fixing Anabolic Cycle
- Mechanisms of Auxin-dependent Signaling in the Endoplasmic Reticulum
- Greenhouse Gas Mitigation through Advanced Nitrogen Removal Technology
- New era of printed paper electronics based on advanced functional cellulose
- Biogas-fired Combined Hybrid Heat and Power Plant
- A new circular economy concept: from textile waste towards chemical and textile industries feedstock
- Turning waste from steel industry into a valuable low cost feedstock for energy intensive industry
- Full scale demonstration of energy positive sewage treatment plant concepts towards market penetration
- ALL-SCALE PREDICTIVE DESIGN OF HEAT MANAGEMENT MATERIAL STRUCTURES WITH APPLICATIONS IN POWER ELECTRONICS
- Insect-inspired capillary nanostamping
- N₂ as Chemical Feedstock - Synthetic Nitrogen Fixation beyond Haber-Bosch
- A developmental engram for the organization of adult hippocampal circuits

Figure 6: Identifying chemistry for agriculture

The screenshot displays the H2020 Projects Dataset interface. On the left, the 'Selected Properties' panel includes checkboxes for Coordinator Country, Org Type, Participant Country, Participant_Abbrev, Program/ShortTitle, Status, Topic/Label, NER Entity Types (checked), and NER Entities (checked). Below this is a search bar. The 'NER Entity Types' panel shows counts for Misc (11031), Place (9261), PopulatedPlace (3153), and Country (2227), with a search bar and a '1' button. The 'NER Entities' panel shows counts for agriculture (17), organic agriculture (1), and agricultural sciences (1), with a search bar and a '1' button. The main panel on the right, titled 'Resources of type SignedGrantAgreement from Cordis H2020 Projects Dataset 2014-2020 (2016-12-22)', lists 19 project resources. The first resource is 'Up-scaling, demonstration and first market application of Hydrokemos' patented technology as the most eco-efficient and cost-effective solution for nitrate polluted water treatment'. The last resource is 'Vegetable ozone therapy for the defense of greenhouse crops'. At the bottom, it shows '1 Page(s): 1' and a search bar.

2. Water research

There are quite some water related topics in the H2020 projects, and in the UN sustainable development goals. As figure 7 shows, and the 65 NER Entities identify some 200 projects. This can be easily refined to chemistry related project. Figure 8 shows the resulting list of 45 projects. Of the 65 water-related NER entities, some 25 NER entities are also related to chemistry, with about 45 projects. Going a little deeper into this case may show the multidisciplinary character of the water related research in H2020, and what disciplines are more and what are less important in the portfolio.

Figure 7: Identifying water topics in H2020 – 200 projects**Figure 8: Water topics related to chemistry in H2020 – 45 projects**

3. Chemistry for sustainability:

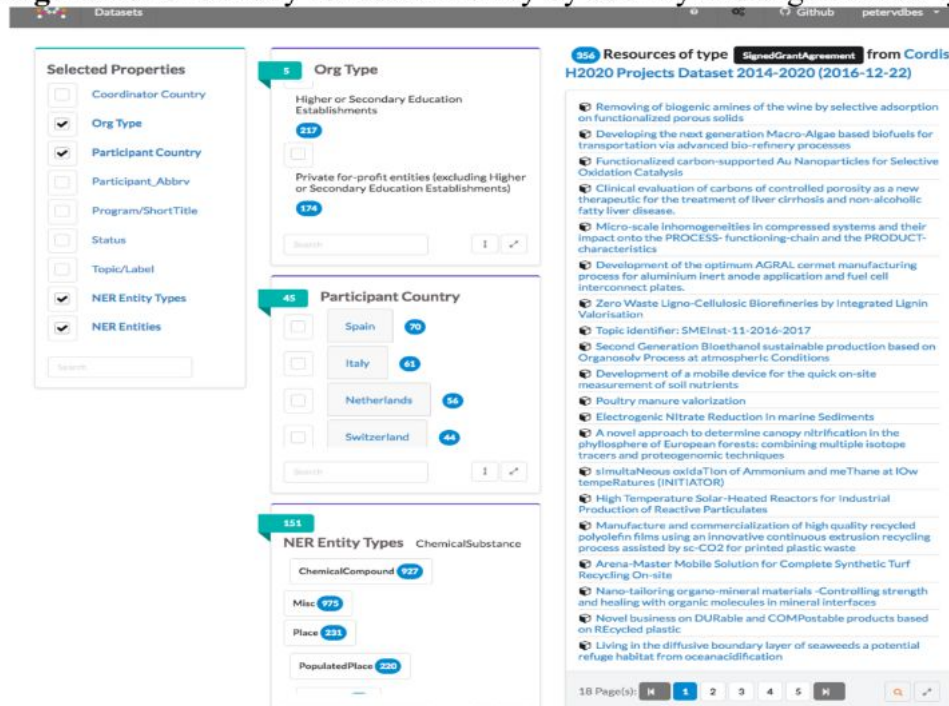
This is another 'cross section' of a research domain and a societal priority. We take the 976 chemistry projects as starting point. The browser gives than all NER entities that are linked to the chemistry projects: 8963 NER Entities in a sequence of decreasing occurrence (figure 9)

Figure 9: Identifying chemistry for sustainability by using the NER Entities

The screenshot displays the 'petervibes' Datasets browser interface. The top navigation bar includes 'Datasets', a search icon, a GitHub icon, and the user 'petervibes'. The main content area is divided into three panels:

- Selected Properties:** A sidebar on the left with checkboxes for various properties. 'NER Entity Types' and 'NER Entities' are checked.
- NER Entity Types:** A panel showing a list of entity types with their counts: ChemicalCompound (927), Misc (975), Place (221), and PopulatedPlace (220). A search bar and a '1' button are at the bottom.
- NER Entities:** A panel showing a list of entities with their counts: energy efficiency (14), renewable energy (14), CO2 (14), carbon (14), sustainability (14), climate change (14), carbon dioxide (14), ecosystem (14), greenhouse gas (14), combustion (14), solar cells (14), ecosystems (14), global warming (14), solar energy (14), obesity (14), rural (14), biogeochemical (14), metabolites (14), Cu (14), solvent (14), progressive (14), and O2 (14). A search bar and a '1' button are at the bottom.
- Resources of type:** A panel on the right showing a list of resources. The first resource is 'SignedGrantAgreement' from Cordis H2020 Projects Dataset 2014-2020 (2016-12-22). The list includes 18 items, each with a brief description.

The bottom of the interface shows a pagination bar with '18 Page(s):' and a set of navigation buttons (1, 2, 3, 4, 5, H, Q, ✓).

Figure 10: Chemistry for sustainability by country and organization type

By comparing the NER Entities distribution between countries, one may be able to show differences in research activities between countries. The faceted browser produces on the background a sparql query (Figure 12 left side) which can be used to retrieve the selected data for further analysis (Figure 12 right side). This needs some editing and therefore some computer skills. We did this for the chemistry for sustainability portfolio, and then it is possible to use the existing tools for analysis and visualization to come to an assessment in terms of fields covered and societal issues addressed – and in terms of gaps in the portfolio.

Figure 11: Chemistry for sustainability by country and organization type – Netherlands

Selected Properties

- ☐ Coordinator Country
- ☒ Org Type
- ☒ Participant Country
- ☐ Participant_Abbv
- ☐ Program/ShortTitle
- ☐ Status
- ☐ Topic/Label
- ☒ NER Entity Types
- ☒ NER Entities

Org Type

- ☒ Higher or Secondary Education Establishments (47)
- ☐ Private for-profit entities (excluding Higher or Secondary Education Establishments) (43)

Participant Country NL

- ☐ Spain (70)
- ☐ Italy (63)
- ☒ Netherlands (56)
- ☐ Switzerland (44)

NER Entity Types ChemicalSubstance

- ☒ ChemicalCompound (927)
- ☐ Misc (775)
- ☐ Place (331)
- ☐ PopulatedPlace (230)

Resources of type SignedGrantAgreement from Cordis H2020 Projects Dataset 2014-2020 (2016-12-22)

- Greenhouse Gas Mitigation through Advanced Nitrogen Removal Technology
- Full scale demonstration of energy positive sewage treatment plant concepts towards market penetration
- New constraints on the Amazonian carbon balance from airborne observations of the stable isotopes of CO₂
- Production technology to achieve low Cost and Highly Efficient photo-voltaic Perovskite Solar cells
- Preparing R2 extension to 300nm for BCD Smart Power
- Developing the next generation Macro-Algae based biofuels for transportation via advanced bio-refinery processes
- SUNlight-to-LIQUID: Integrated solar-thermochemical synthesis of liquid hydrocarbon fuels
- Development of a fuel flexible and highly efficient ultra low emission residential-scale boiler with coupled heat recuperation based on flue gas condensation
- Low Emissions Intensity Lime and Cement
- The supercritical CO₂ Heat Removal System
- PROcesses for Value added fibres by Innovative Deep Eutectic Solvents
- Combined Ultrasonic and Enzyme treatment of Lignocellulosic Feedstock as Substrate for Sugar Based Biotechnological Applications
- Microbiology of extremely acidic terrestrial volcanic ecosystems
- Cost-effective CO₂ conversion into chemicals via combination of Capture, Electrochemical and Bio-chemical CONversion technologies
- Weaving Technology based Automated Production Processes in the Composite Industry (We TAP IN)
- PILOT PLANT PRODUCTION OF CONTROLLED DOPED NANOPOROUS CARBONACEOUS MATERIALS FOR ENERGY AND CATALYSIS APPLICATIONS
- Functionalized carbon-supported Au Nanoparticles for Selective Oxidation Catalysis
- Online DEposition over Oceans: Modeling the effect of air pollution on ocean bio-geochemistry in an Earth System Model
- Monitoring Atmospheric Composition and Climate -III
- PROcessing Diluted Aqueous Systems

Figure 12: Chemistry for sustainability: query (partly) from the selection made in the browser, and resulting data table (partly)

```

PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX dct: <http://purl.org/dc/terms/>
PREFIX void: <http://rdfs.org/ns/void#>
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
PREFIX risis: <http://risis.eu/cordisH2020/vocab/>
PREFIX ldr: <https://github.com/allik/ldr-reactor/blob/master/vocab/>
SELECT DISTINCT ?projectID ?orgAbbrv ?orgPIC ?orgCountry WHERE {
  GRAPH <http://risis.eu/cordisH2020> {
    {
      SELECT DISTINCT ?s ?projectID ?objective ?orgAbbrv ?orgPIC ?orgCountry
      GRAPH <http://risis.eu/cordisH2020> {
        ?s rdfs:type risis:SignedGrantAgreement .
        ?s risis:id ?projectID .
        ?s risis:objective ?objective .
        ?s risis:participants ?participant .
        ?participant risis:abbreviation ?orgAbbrv .
        ?participant risis:id ?orgPIC .
        ?participant risis:country ?orgCountry .
        ?s ldr:annotations/ldr:surfaceForm ?v1 .
        ?s ldr:annotations/ldr:uri/ldr:type ?v2 .
        FILTER (str(?v1) IN ("energy efficiency","renewable energy","carbon","sustainability","sustainable energy","solar cell","ecosystem","ecosystems","combustion"))
      }
      ORDER BY ASC(?projectID)
    }
    OPTIONAL {
      ?s dct:title ?title .
    }
  }
}

```

Showing 1 to 50 of 1,702 entries (in 3.515 seconds)

	projectID	orgAbbrv	orgPIC	orgCountry
1	"633080"^^xsd:int	CNRS	"999997930"^^xsd:int	FR
2	"633080"^^xsd:int	CNRS Lyon	"999997930"^^xsd:int	FR
3	"633080"^^xsd:int	CNRS-IPSL	"999997930"^^xsd:int	FR
4	"633080"^^xsd:int	JRC	"999992304"^^xsd:int	BE
5	"633080"^^xsd:int	VUA	"954530344"^^xsd:int	NL
6	"633080"^^xsd:int	VU/VUmc	"954530344"^^xsd:int	NL
7	"633080"^^xsd:int	DLR	"999981731"^^xsd:int	DE
8	"633080"^^xsd:int	IPMA	"953379924"^^xsd:int	PT
9	"633080"^^xsd:int	AEMET	"996472271"^^xsd:int	ES
10	"633080"^^xsd:int	SRON	"997901663"^^xsd:int	NL
11	"633080"^^xsd:int	STICHTING SRON	"997901663"^^xsd:int	NL
12	"633080"^^xsd:int	DWD	"998059094"^^xsd:int	DE
13	"633080"^^xsd:int	EAA	"999452014"^^xsd:int	AT
14	"633080"^^xsd:int	SMHI	"999507983"^^xsd:int	SE
15	"633080"^^xsd:int	METEOROLOGISK INSTITUTT	"999510893"^^xsd:int	NO
16	"633080"^^xsd:int	KNMI	"999518944"^^xsd:int	NL
17	"633080"^^xsd:int	CERC	"999574428"^^xsd:int	UK
18	"633080"^^xsd:int	METEO-FRANCE	"999578890"^^xsd:int	FR
19	"633080"^^xsd:int	FMI	"999591306"^^xsd:int	FI
20	"633080"^^xsd:int	IASB - BIRA	"999642134"^^xsd:int	BE

Conclusions:

The procedure and tools shown in this paper enable the evaluation of a project portfolio (such as H2020) or an output portfolio (publications or patents of a research institution), in terms of its focus. One may e.g., clarify the size of the part of a project portfolio that is mainly aimed at developing specific research fields (stimulating excellent research) and how big the part devoted to specific societal challenges is (societal impact). As the research fronts and the societal challenges change over time, one may do the analysis for time slices of projects and evaluate the change of the quality of the portfolio over time: are the things addressed that one would want to? For example, in figure 4 we searched for all projects on 'migration', and show that only a few are related to today's increased migration flows from poor and war regions. Or one may evaluate the output of a research institute by annotating publications. What parts of the research front are covered, and where does the output relate to important societal questions. Are these overlapping sets of papers, or are these completely disjoint? And, is the output related to societal issues also of a good scholarly quality?

FURTHER WORK: This paper demonstrates the potential for analyzing in detail the structure of a project or paper portfolio in terms of its scholarly and its societal profile. What would be the next steps?

- Inclusion of more knowledge graphs is needed: specialized ontologies/taxonomies representing research domains and societal challenges.
- Full text use for annotating, and testing parts of the text are important;
- Standard queries for retrieving parts of the portfolio for further inspection (e.g. using statistics or visualization); these standard queries would help the user without the computer skills needed to edit the automatically generated queries;
- When the dataset is very large, selecting in the browser takes time; further work on increasing the speed of querying in the browser would be useful.

PRESENTATION AT THE CONFERENCE: Currently we are developing the ontology for climate change research, and we will apply that on project portfolios of research councils (H2020 and FP7) and on output portfolios of universities (in Netherlands and Sweden). We will show how societal impact and scholarly impact can be analyzed in terms of those portfolios.

Abstract 125

TOWARD POLICY EVALUATION FROM R&D PROGRAM GROUP EVALUATION

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Aim of the proposal:

South Korea is one of the largest OECD countries in terms of government budget allocations for R&D (GBARD). The Korean government's R&D investment system has three main levels: policy, program, and project from top to bottom levels. Regarding the evaluation of these three levels, while program and project evaluations are well established and very active, policy evaluation is rarely done. As Korean government budget for R&D has reached a significant level, the need for the development of R&D policy evaluation method is increasing.

One of the approaches to develop evaluation method for the Korean R&D policies is to improve and utilize existing program group evaluation, which has been carried out as in-depth evaluation more than 10 years since 2008. In program group evaluation, multiple government R&D programs with very similar goal are grouped and assessed in the program evaluation framework.

One of the main purposes of program group evaluation is to analyze and evaluate overlap or linkage among the grouped programs, which suggests the Korean program group evaluation has a potential to be upgraded a policy evaluation. Its first step is to analyze and evaluate the programs in the group not at a program level but at a program group level. The purpose of our study is to discern in a systematic way limitation of the current program group evaluation of the Korean government's R&D.

The current Korean program group evaluation consists of four perspectives, relevance, effectiveness, efficiency, and system nature, which are originated from the assessment method for a single program of the Korean government. Our specific research question is how well these four perspectives can be applied to a program group evaluation as a group. In other words, we examine whether the four perspectives can be applied to the programs within their program group at a program-group level, not at a program-level. To answer this question, this study meta-analyzes 8 reports of R&D program group evaluation.

The employed meta-analysis framework is derived through relevant theory and its pilot application. Our study discovered that only relevance is evaluated at program group level evaluation in most cases among the four perspectives, while the other three are mainly evaluated at a single program level. That is, the evaluation of the three perspectives is the mere aggregation of the evaluation of each program within the program group. Especially, we find that efficiency issue is not to even be set as an evaluation issue in the most cases of program group evaluation.

A solution for program group evaluation to be policy evaluation is discussed with an application of the suggested solution to an actual program group evaluation conducted in the second half 2018.

Background:

The in-depth evaluation has been adopted since 2008 in accordance with performance management and evaluation law in Korea. The main target programs are the long-term and grand R&D programs and programs requiring collaboration for the improvement of R&D investment efficiency.

The program group evaluation contains from the genome R&D programs, university research programs, equipment/facility programs in 2008 to the HR training programs for industry, international joint research programs and programs against human body infection in 2016 and regional industrial technology infrastructure building in 2017.

Programs against human body infection consist of five programs from three ministries and HR training programs for industry and international joint research has 11 programs from 6 ministries and 5 programs from 4 ministries respectively. In the case of R&D program (in-depth) evaluation, the four aspects of evaluation are used in terms of relevance, effectiveness, efficiency and systematic nature (MSIP and KISTEP, 2015). Each R&D program evaluation is performed using modified basic framework of program evaluation.

Table 1 Basic framework of program evaluation

Evaluation perspective	Evaluation contents
Relevance	• Compliance with higher level plan or strategy / relevance of strategic objective
	• Relevance of investment strategy
	• Appropriacy of government R&D support
Effectiveness	• Achievement over objective
	• Economic and social effect
Efficiency	• Efficiency of performance
	- Output over input analysis
	- Qualitative analysis of excellent performance
Systematic nature	• Performance management and utilization
	• Possibility of overlapping and the necessity of collaboration

Source: 2017 action plan of National R&D program in-depth evaluation

Each program has been planned and performed according to their own objectives and then the evaluation of program group is being carried in the necessity of control of overlapping and link between relevant programs with similar goal. In this circumstance, each individual program has nothing wrong with the compliance with higher level plan / strategy and the relevance of strategic objective. But there is few higher-level plan / strategy well fitted to the program group such as the human body infection, education and training HR for industry and vitalization of international joint research and so on. The relevance of investment strategy has limitations for the analysis of relation between programs in the group for the efficient budget usage due to the lack of sharing higher level plan / strategy. The recommendations on the program group have also difficulties for the effective policy implementation due to the absence of proper government officials in charge of the multi-departmental recommendation.

A previous research studied the “strategic review” being performed in US OMB (Office of Management and Budget) for finding implication on the application of policy level unit of evaluation to the in-depth evaluation. According to the US OMB Circular No. A-11, all the federal organization should confirm the strategic objective in accordance with strategy plan and respond its results to the performance plan. European countries are carrying the performance evaluation to review the priority of fields or sectors for saving the budget. This previous research suggested that the “policy relevance” should be placed as an important item on the Korea’s performance-oriented evaluation (Ko and Han, 2016).

That’s why the main objective in this research is finding the problem as program group level evaluation in the current government R&D program group evaluation system in Korea using meta-analysis method. At first, the literature about meta-evaluation is reviewed for the application of this method to this case study. Then, the meta-analysis is adopted to the R&D program group to find limitation of current program group evaluation in terms of relevance, effectiveness, efficiency and systematic nature. Finally, the new framework for group program evaluation is discussed to bridge the gap between program evaluation and policy evaluation.

Methodology and empirical base:

The scope of meta-evaluation can be divided into highly narrow, narrow and wide sense. In the highly narrow sense, meta-evaluation can be defined as evaluation synthesis, which is the re-evaluation of evaluation results (Chelimsky, 1985). It can be defined as empirical comprehensive evaluation, which contains analysis of error, manipulation and validity of evaluation in the narrow sense (Cook and Gruder, 1978) and also defined as evaluation of evaluation system in the wide sense (Stufflebeam, 1981, Larson and Berliner, 1983)

In this research, the re-evaluation of evaluation results, so called as highly narrow sense, was adopted for the focus on the limitation of current government R&D program group evaluation. The items of meta-evaluation for the application to previous program group evaluation are needed. The items for the meta-evaluation were studied by many authors (Larson & Berliner, 1983, Scriven, 1991, Leslie and Valerie, 2005, Hong, 2002, Yi, 2003, Ryu and Choi, 2007, US Foreign Assistance, 2011, Korea National Assembly Budget Office, 2012).

The items reviewed in the previous researches can be divided into 3 categories, the environment of evaluation, practice of evaluation and result of evaluation. The items of meta-analysis in table 2 below are modified and set up as a result of pilot application of international joint research program group evaluation regarding relatedness of program group evaluation.

Table 2 Main items of meta-analysis

Categories	Items of Meta-analysis
Evaluation Environment	1) Relevance of evaluation objective 2) Selection criteria of object to be evaluated
Evaluation Practice	3) Proper evaluation issue in accordance with evaluation objective 4) Concreteness of evaluation contents in accordance with issue 5) Appropriacy of evaluation contents as program group evaluation 6) Validity of evaluation methods
Evaluation Result	7) Logic of drawing evaluation result 8) Practicality of policy recommendations

The unit of program group was considered for the meta-analysis of the evaluation practice, which consists of evaluation issues, contents and methods. The main point is whether the program group evaluation is performed on the basis of unit of program group or not. Evaluation environment and result are related to the boundary of program group and practicality of pan-departmental recommendation respectively.

This meta-analysis was performed to the previous program group evaluations, which have been carried since 2008. The in-depth evaluation started from 2008 and the program group evaluation also as in-depth evaluation. 17 program group evaluations have been performed since 2008 and here 8 program group evaluations were selected as target cases for meta-analysis, which is based on the similar topic related to HR and support firms and specific issues. The target program group evaluations are as follows.

Table 3 targeting program groups of meta-analysis

Program group evaluation (year)	Topic
1) Research capacity of SMEs ('12)	Support of firms
2) Going abroad of venture and SMEs ('14)	Support of firms
3) Support of start-up ('14)	Support of firms
4) HR in science and engineering sector ('13)	HR
5) Industry HR training ('16)	HR
6) Regional industry infrastructure building ('17)	Region
7) Human body infection ('16)	Specific issue (infection)
8) Disaster ('15)	Specific issue (disaster)

8 program group evaluations were undertaken under meta-analysis in terms of environment, practice and result of evaluation.

Results:

<Environment of evaluation>

1) Relevance of evaluation objective

The program group evaluation is performed as a sort of in-depth evaluation in accordance with performance management and evaluation law and then the objectives of evaluation are for the link between programs in the group or emerging issues such as infection disease, natural disaster and regional industry.

2) Selection criteria of object to be evaluated

Five objectives of in-depth evaluation are suggested in the performance law as follows: ① long-term and big investment, ② necessity of link between programs, ③ multi-departmental program, ④ national or social issues and ⑤ the other necessity in the decision of ministry of science and technology. First 6 cases were performed for the necessity of link between programs and the last 2 cases correspond to the national and social issues. The main issues is the boundary of corresponding programs in the group responding the evaluation objective.

<Practice of evaluation>

3) Proper evaluation issue in accordance with evaluation objective

In the program evaluation, in-depth evaluation has autonomy of evaluation framework, while the other program evaluations follow the guideline of each evaluation. That's why 8 cases of in-depth evaluation shown in table 3 have their own evaluation issues on the base of evaluation objective.

4) Concreteness of evaluation contents in accordance with issue

Evaluation issues are based on the evaluation perspective in the shown table 1 such as relevance, effectiveness, efficiency and systematic nature. The evaluation contents are set up in accordance with evaluation issues, which can be modified due to the evaluation objective. Most evaluation contents in the 8 case are specified with modified evaluation issues.

5) Appropriacy of evaluation contents as program group evaluation

This item is main topic in this paper showing the limitations as program group evaluation framework applied to 8 cases. In the perspective of relevance, evaluation contents were dealt as program group unit in terms of alimnet of goal of program group to the higher plan or strategy in the 7 cases. In the case of disaster, the relevance of policy was dealt using the portfolio between the sort of disaster and disaster management stage. In the perspective of effectiveness, most evaluation contents were dealt with program unit without program group unit except 2 cases. The effectiveness of program group was only performed in the part of regional industrial infrastructure and disaster program group. In the perspective of systematic nature, just two program groups, regional industrial infrastructure and human body infection, were applied to the unit of program group as suggesting the link between programs in the group. Most evaluation contents dealt partially in other issues not as the perspective of efficiency. The lack of efficiency in the evaluation seems that targeting program groups do not have the same performance indicators in individual programs. The application of program group unit in the cases of program group evaluation was shown in table 4.

Table 4 Application of program group unit in cases of the program group evaluations

Program group evaluation (year)	Relevance	Effectiveness	Efficiency	Systematic nature
1) Research capacity of SMEs ('12)	○	×	-	×
2) Going abroad of venture and SMEs ('14)	○	×	△	-
3) Support of start-up ('14)	○	×	△	×
4) HR in science and engineering sector ('13)	×	×	-	×
5) Industry HR training ('16)	○	×	△	×
6) Regional industry infrastructure building ('17)	○	△	△	○
7) Human body infection ('16)	○	×	○	○
8) Disaster ('15)	○	△	△	×

* Efficiency (△) was not dealt as the perspective of efficiency but was partially in other perspectives

** Effectiveness (△) was dealt in the some programs in program group, not the whole program group

6) Validity of evaluation methods

The perspective of effectiveness and efficiency can contain the delicate evaluation methods to resolve the evaluation contents. While there is few case dealing with in the case of efficiency, effectiveness is dealt as program unit through indirect way for measuring the achievement of program goal. In the perspective of relevance, the alignment of program group goal to the higher plan or strategy was dealt using the comparing their policy direction. Systematic nature was mainly dealt in the existence of performance management system in the level of program unit. Regional industry infrastructure building dealt with systematic nature suggesting the management of commercialization and technology transfer in part of program group, and human body infection handled with suggesting the portfolio between publicity and research stage. In case of disaster, the portfolio was used to show the investment data of programs in the perspective of policy relevance.

<Result of evaluation>

7) Logic of drawing evaluation result

The evaluation result can be drawn as a result of analysis contents and is normally finalized after modification regarding the opinion of evaluated institute to the draft of evaluation result. In this process, the logic of evaluation result was improved.

8) Practicality of policy recommendations

As mentioned in the introduction, the recommendations for the improvement in the program group unit has low practicality due to the ambiguous authority to implement these recommendations. On the other hand, the recommendations in each program are followed up by the corresponding ministries.

As a result of meta-analysis of previous R&D program group evaluations, many limitations of program group evaluation were found including the boundary of program group and practicality of policy recommendations. Main limitation is the evaluation unit resulting from the lack of program group unit in the program group evaluation except of perspective of relevance. Program group is just combination of similar programs, there is few corresponding

policy of program group for evaluation. Each program was designed separately by relevant ministries with their own objectives / goals. New framework of R&D program group evaluation can be suggested in the direction of the improvement of limitations of program group evaluation.

Table 5 New framework of R&D program group evaluation

perspective	Program unit evaluation	→	Program group unit evaluation
Relevance	- Alinement of higher plan/strategy - Relevance of program goal	→	- Relevance of higher plan/strategy - Alinement of higher plan/strategy
Effectiveness	- Achievement of goal - Long-term effect	→	- Achievement of sharing group goal
Efficiency	- Efficiency of performance	→	- Delete (In case of sharing performance indicator, separate discussion)
Systematic nature	- Systemicity of program operation - Potential of overlapping	→	- Hierarchical Structure of program - Link between programs in the group

The prerequisite of new framework is the set-up of portfolio axes corresponding to shared evaluation issues. The portfolio analysis was used in the human body infection and disaster program group evaluation. Case of disaster program group shows the portfolio matrix is as follows: 1) one axis, policy instruments (prevention, preparation, action, restoration) & 2) the other, policy targets (national disaster, social disaster, combined disaster) as shown in fig 1. This sort of portfolio can show the information about the comparative position between programs in the group, the balance of investment and the way to link between programs.

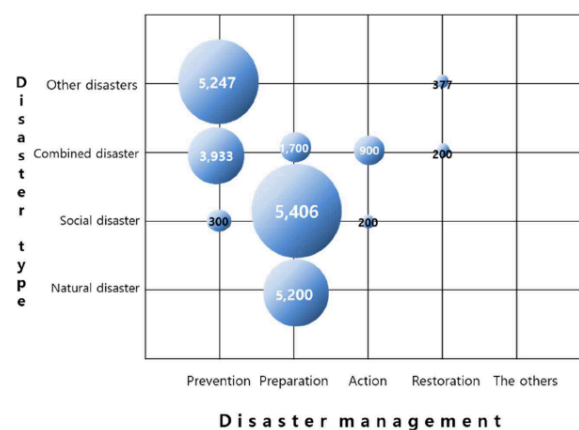


Figure 1 Example of portfolio matrix (Unit: million won)

The set-up of sharing goal of program group and portfolio matrix is the core work in the item of relevance & effectiveness and the systematic nature respectively. Effectiveness of program group can be drawn as summing up each program's effectiveness regarding comparing position in the portfolio matrix. In the case of efficiency, each program has their own

performance indicators and there is no sharing performance indicators of program group. That's why the perspective of efficiency was deleted in the new framework of program group evaluation.

The new framework was applied to the NRI research program group. This group was consisted of 10 programs belonging to the 10 national research institutes, which deal with agriculture and livestock, fishery, forest, environment, quarantine, arboretum, meteorological research.

Table 6 10 Research Programs

R&D Program	Organization	'18 budget (billion Won)
Agricultural Basic Foundation Research Program	National Institute of Agricultural Sciences	64.7
Horticultural & Herbal Test Research Program	National Institute of Horticultural & Herbal Science	59.8
Crop Test Research Program	National Institute of Crop Science	48.9
Animal Test Research Program	National Institute of Animal Science	45.3
Fisheries Test Research Program	National Institute of Fisheries Science	31.0
Forest Science Research Program	National Institute of Forest Science	41.8
Forest Species Research Program	Korea Forest Service (Arboretum)	14.8
Animal and Plant Quarantine Inspection Technology Development program	Animal and Plant Quarantine Agency	21.5
NIER Research Program	National Institute of Environmental Research	45.1
Meteorological Service Support Technology Development Research Program	National Institute of Meteorological Sciences	14.9

In this case, the sharing goal of program group was drawn as public good in 10 diverse areas, while the portfolio matrix was not able to be set up due to the lack of comprehensiveness of 10 research programs. That's why the direction of investment portfolio could not be suggested on the base of hierarchical structure of 10 research programs.

Program performances can be divided into academic performances such as paper, patent and commercialization and policy performances such as supply of public service and satisfaction of policy and so on. The level of academic performances have broad spectrum between 10 research programs and overall lower level compared with average of National R&D programs in the quantitative and qualitative way. The recommendation goes to the improvement of policy performances including raising the alignment of policy performance indicators with its program goal rather than the betterment of academic performances for the sharing goal as public good.

Conclusions:

In this research, the potential of transition to policy evaluation from program group evaluation was shown in the new program group evaluation framework, which overcomes the limitations of previous framework, and its application to NRI research program group. Policy level is normally higher or wider than that of program and program group, especially the goal's scope. Suggested evaluation framework is suitable to the program group evaluation, and its usage could be extended to the policy evaluation. The application of new framework to NRI program group shows that the limitation of comprehensiveness of program group. The difference between policy and program group would be the boundary of targeting objects such as

program group, institutions, strategies or plans and so on. To bridge between program group and policy evaluation, the more comprehensive analysis of plans / strategies regarding policy relevance is needed.

In the next step, the framework for policy evaluation will be suggested based on the review of all the R&D related plans / strategies regarding more detailed policy relevance. This research can be used for a guideline for program group evaluation and a cornerstone for policy evaluation.

B2 SCIENCE POLICY ADVICE

- Special Session –

Wednesday 05 June 2019 from 14:00 to 16:00

Abstract 67

SCIENCE POLICY, ADVICE AND INTERNATIONAL RELATIONS: BLURRY BOUNDARIES IN THE WAKE OF GRAND CHALLENGES

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Aim of the proposal:

In this panel, we intend to discuss science diplomacy as a *primus inter pares* of concepts in the STI policy field that, in Charles Weiss' terms, "affect International Affairs". First of all, we are interested in the question what studying science diplomacy from a science policy perspective can learn from other recently emerging STI concepts and their study? Second, which productive consequences of other recently emerging STI concepts for International Affairs can be discerned? Third, what role does "scientification" play in the stabilization and/or alteration of the practice of science diplomacy, even if this is limited to discursive stabilization? Finally, how is the science-policy interface of the STI community and the foreign policy community reconfigured due to recently emerging STI concepts?

Background:

Science, technology and innovation (STI) policies for sustainable development goals are crucially dependent on both advanced knowledge and international collaboration. Global interaction processes produce knowledge flows with different structures of intent, interest and ways of working, certainly in the context of efforts to address Grand Challenges, such as the Sustainable Development Goals (Colglazier 2018; Kriegler et al. 2018; Kuhlmann and Rip 2018; Schot and Steinmueller 2018). This may not only involve the transformation of business conduct (Giuliani 2018), but also putting innovation studies to work (Fagerberg 2018). These suggestions are joined by calls to reinforce the importance of social sciences in general vis-à-vis a natural-scientific dominance and the emergence of a critical perspective on challenges such as climate change (Brand 2016b; Stirling 2014). Other ideas invoking global ethics revolve around working towards a "normatively consistent global architecture for sustainable development" (Gupta 2015). In other words, addressing those Grand Challenges necessitate 'deep transitions' (Schot and Kanger 2016) or 'social-ecological transformation' (Brand 2016a).

Methodology and empirical base:

Session focus

In accordance with the question posed by Charles Weiss, this session proposes to further explore the relationships, overlaps and distinctions between the science community, the foreign policy community and other emerging STI concepts. Relevant questions are:

- What are the consequences of science diplomacy and other recently emerging STI concept for the domain of International Affairs?
- What similarities and differences can be identified between recently emerging STI concepts that impact on International Affairs? Do they represent outcomes of similar (or counteracting) processes on the science policy interface? Are they complementary and if so, how?
- As a boundary object, science diplomacy does not have a fixed definition. However, thinking in terms of meta-governance (Jessop 2016), what conditions, mechanisms or governance

modes underlie science diplomacy?

- What are specific contributions of science diplomacy to policy efforts addressing SDGs? Are there relevant experiences and examples? What can we learn from them?

- What is the role of Science Diplomacy as one of many emerging STI concepts? How does the advent of Science Diplomacy relate to developments, processes and activities surrounding other emerging STI concepts? What can Science Diplomacy scholars learn from those other emerging STI concepts?

In other words, this session intends to shed further light on the question what makes science diplomacy and what are its dimensions? Its inherent focus as well as the concept's novelty link the session to conference topics #1, #2 and #7, "R&I policies toward mission-oriented sustainable research", "New governance of STI policies: actors, networks and instruments" and "Globalization and the geography of knowledge and innovation" respectively.

Results:

In recent years, a range of conceptual ideas emerged to engage the interface between STI policy and international collaboration aimed at enabling structural changes in the fabric of our interactions not only with each other on a global scale, but also with our natural environment. Such conceptual ideas include transformative change, deep transitions, the quadruple helix, open science, or the call for increased involvement of citizens in science, decision making and foresight activities, but also 'science diplomacy'.

Science diplomacy is a boundary object on the science-policy interface. It links together actors from the STI community and foreign policy and it does so across country borders and continents. In this context it has turned into an intriguing concept for scientific research as well as for practitioners in diplomacy and science policy. Granted, the mechanisms, actors and institutions generally subsumed under the term have been around longer than the term itself. Nevertheless, the sheer coming into existence and proliferation of the term warrants a closer examination.

Conclusions:

Papers and presenters

- "Conceptual Drift: Ten Years of Science Diplomacy." (Tim Flink)
- "Science Diplomacy and the case of Zika in Colombia" (María Piedad Villaveces Niño)
- "De-Conceptualizing Science Diplomacy as an Interface Symbol" (Charlotte Rungius)
- "Meta-governance in the making: process and emerging substance of a Science Diplomacy governance framework" (Stefan Kuhlmann, Gonzalo Ordóñez-Matamoros, Ewert Aukes)

B3 SOCIAL INNOVATION 2

- Special Session –

Wednesday 05 June 2019 from 14:00 to 16:00

Abstract 27

CONCEPTS AND APPROACHES FOR THE ‘NORMATIVE TURN’ IN INNOVATION POLICY AND PRACTICE IN THE TIMES OF SDGS

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Aim of the proposal:

During the last Eu-SPRI Forum Exploratory Workshop (University of Twente, December 2018) one of the topics discussed was the ‘normative turn’ in innovation policy practice and theory (Lindner et al. 2016). ‘Directionality’ of political intervention and related concepts are requested to address ‘Grand Societal Challenges’ and ‘Sustainable Development Goals’ (SDGs), something that is perceived as challenge for theory and political practice (Kuhlmann & Rip 2018). A new ‘Transformative innovation policy’ asks for a radically new reasoning and designs. This turn can be considered as part of the ‘postcompetitive turn’ in science and innovation policy (Vasen, 2016), a new consciousness that tries to go beyond the previous focus in economic performance, and which tries to articulate alternative narratives and approaches about the final aims of innovation policy and in order to contribute to the achievement of the global Agenda 2030.

A handful of authors have explored innovation policy and practice dynamics from a certain normative standpoint beyond the focus on economic development. For example, they have highlighted how social innovations challenge dominant discourses and social structures (Smith et al., 2015); how equity issues are considered (Schot and Steinmuller, 2018); how values are mobilised (Martin and Upham, 2016); how the needs of the poorer are met (Linnenluecke et al., 2017) or how they transform power imbalances (Lawhon and Murphy, 2011).

However, as yet there has been no deep normative discussion addressing how and in which sense these processes build “better” societies. Why are the alternative practices or the mobilised values more desirable than those of dominant regimes? Why and how they are responsive to problem framings of diverse, less powerful actors? How do they deliver on societal grand challenges, SDGs and how do they create public value?

In this panel we would like to explore and to establish a dialogue between different approaches to analyse innovation policy and practice from a normative standpoint. The idea is to bring concepts and frameworks, as well as specific examples, which can provide elements for analysis and reflections on the sense and directionality of innovation policies and processes, if they want to contribute to address global challenges and the SDGs. The proposal directly connects with core elements of the conference, as it creates a space for debate on concepts for defining, addressing or evaluating transformative policies in the new context of localisation of the global agenda.

Normative issues about values, directionality, legitimacy or responsibility will be discussed from different perspectives by the different contributions: Paper 1 explores these questions by connecting socio-technical transitions literature with Sen’s capability approach; paper 2 discusses the potential and implications of responsible research and innovation ideas; paper

3 empirically explores the types, processes and impacts of social innovation and its implications for social transformation.

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Paper #1: Understanding justice in grassroots innovation practices.

Sergio Belda-Miquel, Victoria Pellicer-Sifres and Alejandra Boni (INGENIO, CSIC-Universitat Politècnica de València)

In order to normatively analyse grassroots innovations, we connect ideas on socio-technical transitions with ideas on justice coming from the vast literature on political philosophy. Different theories have embraced different foci to assess justice: i.e., the utilitarian focus on individual happiness or pleasure, by Bentham; the economic focus on the availability of income or resources; the focus on primary goods, by Rawls (1979); the focus on recognition proposed by post-structuralist thinkers (Fraser, 2008); the focus on justice in the processes of deliberation and communicative action (Habermas, 1987).

The latter is the case of Sen and the capability approach. Sen focuses on freedoms as the real opportunities people have to achieve the life they have reasons to value (Sen, 2001). In this way, Sen develops a comprehensive approach to justice which focuses on real ends (and not on means) and which assumes the plurality of life options and the complexity of processes for achieving what people have reason to value (Alkire, 2002). This approach can be very relevant for the analysis of socio-technical systems, as it recognises and considers the multiple dimensions of life and social practices (Alkire, 2002). It may open the way for considering socio-technical configurations as enablers or disablers of human freedoms, from a plural and comprehensive perspective of human flourishing.

This framework and connection thus lead to more specific normative questions to assess the contribution of grassroots innovation practices to justice: which capabilities are grassroots innovation initiatives creating and in whom? Which means are created in these niche practices that allow these capabilities to emerge? How do personal and contextual factors shape the conversion of means into capabilities? These questions will lead the analysis of two case studies in two key sectors in Spain: an energy cooperative, and food purchasing groups. These are initiatives with similar overall objectives of transformation, but they are very different in their strategies and forms, and operate in different socio-technical systems.

We use a purely qualitative research methodology. We draw on secondary information, on participant observation and individual interviews. For the qualitative analysis of information, we initially drew on predefined categories derived from our analytical framework, which were refined and complemented with additional categories, dimensions and issues of interest for the discussion.

The study suggests that grassroots innovations may not only be contributing to justice, but also enlarging the sense and the implications of justice when discussing sustainable transitions. In terms of justice, grassroots organisations are experimenting with new models that build, test and prefigure more just systems, but at the same time enlarge the meaning and the aspirations regarding justice. In broader terms, future research is still needed to deep into the dialogue between innovation and justice, but the study confirms that the study of grassroots innovations may be of key importance for this objective.

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Paper #2: The quest for public value from innovation: directionality, legitimacy and responsibility in innovation policy

Lisa Dale-Clough, Barbara Ribeiro, Elvira Uyarra (Manchester Institute of Innovation Research, Alliance Manchester Business School, University of Manchester)

Rooted in market and system failure concepts, innovation policy thinking has so far paid too little attention to the content of innovation and has been ineffective in addressing societal challenges such as poverty, ageing, climate change, and economic renewal (Weber and Rohrer, 2012). This has motivated recent advocates of a greater or improved challenge orientation in innovation policy (Schot and Steinmuller, 2016) and the use of targeted policies to articulate societal needs on the 'demand side' (Boon and Edler, 2018). Regional innovation policy scholars have also reacted and argued for greater focus in scholarly debates on the direction of innovation and change in order to address problems of economic restructuring and territorial disparities (Tödling and Trippel, 2018).

Intersecting these debates in innovation policy is the emergence of responsible research and

innovation (RRI) as a popular concept for exploring the relationship between science, technology, innovation and society (Ribeiro et al. 2017). Of particular concern to the RRI agenda is how to ensure innovation is aligned with societal needs and responds to pressing societal challenges. Although much of the work around RRI has been focused on publicly funded R&D, the concept is being increasingly recognised and alluded to by the innovation policy community as a basis for developing more spatially sensitive and responsive approaches to implementing innovation policy at a regional level.

These discourses on directionality, legitimacy and responsibility, although emerging from different bodies of literature, illustrate a 'normative turn' in innovation policy rhetoric. In this paper, we mobilise regional innovation policy, public procurement and RRI concepts in tandem to explore the meaning and relevance of such a turn for regional and local development. We focus on the case of public procurement of innovation in the context of the Social Value Act in the UK, where local governments work towards crafting their own social value policies, combining and embedding them into their development strategies. This activity is being replicated across Europe as the European Commission encourages procurement policies aimed at creating a more innovative, green and socially-inclusive economy. Procurement policies like these can be regarded as a response to a 'public-value failure' of innovation policy mechanisms, which can be defined as a result of the lack of capacity of the market and the public sector to provide "goods and services required to achieve core public values" (Bozeman 2002, p. 150).

Using RRI as 'critical' lens, we propose a series of elements that we believe position public procurement of innovation as a form of place-based innovation policy aimed at transformation. In doing so, we mobilise four RRI dimensions (Stilgoe et al., 2013) to different phases of the public procurement process (table 1):

Our paper makes two particular contributions. Firstly, we broaden the scope, but narrow the scale, of RRI by using it as an analytical lens in a specific area of demand-side innovation policy: public procurement. Secondly, we further refine understanding of the opportunities and challenges of using public procurement as a policy instrument to argue that a bolder normative framework for the analysis of innovation policy in the context of societal 'grand challenges' or 'mission-oriented innovation policy' must a) have a focus on creating public value; b) investigate how societal problems are framed; and c) assess the capabilities of different societal groups to engage in transformational change. We believe that by reflecting more comprehensively on the innovation aspect of public procurement of innovation using tools like RRI, we can both significantly improve our understanding of the contexts in which it is more and less likely to be useful (and eventually support practitioners) and re-situate the debates within debates about public administration, public value, and public policy which will enable more critical, theoretical and context-sensitive critiques of this innovation policy instrument in action.

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Paper #3: Building Blocks of a Typology of Social Innovation – Understanding the Intended Level of Change

Marthe Zirngiebl (TUDO)

Like technological innovations, social innovations have the potential to change society on the broader scale. While technological innovations are not necessarily driven by the aim to overcome societal challenges (Howaldt/ Schwarz 2016), it is one of the characteristics of social innovations, to establish new social practices that can better cope with a social need or societal challenge than the established practices (Howaldt/ Schwarz 2010). Building upon this understanding, (transformative) social change is regarded as a process that can be actively steered by actors (social innovators) as opposed to an understanding of social change as the outcome of an evolutionary process. As a lived practice, the number of social innovation initiatives tackling grand societal challenges like climate change, demographic change, or poverty is increasing all over the world (cf. Howaldt et al. 2016).

Yet, despite the growing public and academic interest in Social Innovation throughout the last decade, attempts to classify different social innovation initiatives have so far remained sporadic efforts. In their review of European social innovation projects, Jane Jenson and Denis Harrisson (2017) conclude: “Although social innovations pop up in many areas and policies and in many disguises, and social innovation is researched from a number of theoretical and methodological angles, the conditions under which social innovations develop, flourish and sustain and finally lead to societal change are not yet fully understood both in political and academic circles” (p. 7). Yet, investigating these conditions is vital for creating an environment in which social innovations, understood as a new figuration of social practices can thrive.

To answer this question, the paper builds on the rich data collected and analyzed within the European SI-DRIVE project (2014-2017; www.si-drive.eu). During the course of the project, a mapping of 1.005 social innovation initiatives was conducted of which 82 cases were selected for an in-depth case study. The results show that social innovations operate in a variety of policy fields (education, employment, environment and climate change, energy supply, transport and mobility, health and social care, as well as poverty reduction and sustainable development). All these policy fields find their replication in condensed formal systems characterising the range and possibilities of social innovations to develop, scale, diffuse and

institutionalise, and in the end foster processes of social change.

The paper sketches the first characteristics of a typology distinguishing between different types of social innovation along their relation to the formal system in which they are operating. This typology sees social change as interplay between the social innovation at hand and the formal condensed system with its institutions, formal actors and routinized practices. Thus, to grasp social change it is important to look at the system's reaction to and interaction with the social innovation. The paper argues that there are four ideal types describing this relationship:

1) Transforming – The social innovation changes the system radically: Transforming the system through social innovation is often a kind of hidden agenda in the initiatives but not seen as realistic or actively done. However, there are some examples like Uber or Airbnb but also micro-financing and car sharing which affect the existing system with significant market impact.

2) Modernising - The social innovation improves the system while leaving its chore untouched: Modernising the system is looking at the existing structures and is intending to improve the system. This type includes the improvement and supplement for instance of the health, education and employment system by digital solutions.

3) Repairing - The social innovation repairs parts (subunits) of the system: Repairing the system is the most represented type in the SI-DRIVE mapping, often done by grassroots initiatives and focusing on specific system gaps or failures and vulnerable groups.

4) Separating – The social innovation acts completely separated from the system: On the one hand, this can take the form of peaceful co-existence, i.e. the social innovation is tolerated or even accepted or (partly) integrated (becoming - mainly in a later stage - part of the system and forming a system hybrid). On the other hand, a social innovation can antagonize the system at hand, in result being combatted by it, prevented from the beginning or begrudged

The first three types engage with the system. Here, social innovations might emerge within or outside the system or form a hybrid. Their main difference lays in changing the system's structure more or less radically or leaving it untouched. The fourth type acts completely separated from the system as either a potential friend or foe. The potential shift from formerly separated social innovations to system hybrids shows that social innovations are by no means stable, but dynamic, in principle changing their character and type during the innovation process, based on the acceptance, activities and attitude of the relevant system players. In that sense, different actors of the system or in general actors taking part in the social innovation at hand might influence the relationship between a social innovation and the system.

The typology described is one example that will help to define the relationship of social innovations to the existing system and identify their strategies to success. So far, the relationship between social innovations and the formal system is one of the main success or failure factors for the development, diffusion and institutionalization of social innovation initiatives ultimately allowing or undermining processes of societal change.

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B4 RESEARCH INFRASTRUCTURES 1

Wednesday 05 June 2019 from 14:00 to 16:00

CARLOS MONTALVO CORRAL, Chair

Abstract 34

PILOT AND DEMONSTRATION PROJECTS FOR BIOREFINERIES: THE IMPACT OF GEOGRAPHICAL PROXIMITY ON INTERACTION QUALITY

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Chalmers University of Technology ~ Göteborg ~ Sweden

Research Infrastructure for STI studies: open data, big data, and new research avenues

The emergence of research infrastructures at European level, the use of open data, the availability of big data affects the modes of knowledge production and the role of research organisations. Are new avenues visible using these new resources? What are the changes produced in the modes of knowledge production? How policies at national and supra-national level promote and regulate the use of new tools?

Aim of the proposal:

In recent years, there has been increased interest in biorefining as its strategic importance in the transition to a sustainable bioeconomy has become apparent (for a recent review see Bauer et al. 2017). Biorefining is defined as “the sustainable processing of biomass into a spectrum of marketable products and energy” (IEA 2008) and includes a wide range of technologies and processes that can be integrated in a broad array of industrial contexts (from petrochemical to forest-based industries). Biorefining has thus the potential of transforming the current fossil based petrochemical-based industrial production systems to a biomass based systems and with potentially less environmental impact (Cherubini et al. 2009; Kamm and Kamm 2004). It has previously been argued that a distinctive set of PDPs can help develop, validate and scale-up biorefinery technologies and thus build and enhance the commercialisation and large-scale industrial implementation of biorefineries and development of socio-technical systems (Hellsmark et al. 2016a; Bossink 2015). Although the diffusion of biorefineries has encountered significant set-backs (Bacovsky and Sonnleitner 2017; Hellsmark et al. 2016b), biorefineries are still considered key for transition as well as technology and sector development (Fevolden et al. 2017; Frishammar et al. 2015). Thus, policy makers at regional, national and European levels have become increasingly aware of the importance of supporting PDPs and coordinating political efforts in trans-national contexts (Karlström and Sandén 2004). More specifically, policymakers attempt to pool efforts, since the member countries differ in their extent to which they can mobilise and provide financial resources to operate PDPs (Malerba 2002; Zhou et al. 2015).

Surprisingly, despite the importance of creating meaningful and distinctive European policy support programmes for PDPs (Hellsmark et al. 2016a), there is a relative paucity of empirical research to guide policymakers in managing the development of using PDPs as a common resource. This is particularly notable as policy support programmes must maintain consistent, desirable, and enduring alignment to ensure their long-term success (Flanagan et al. 2011; Rogge and Reichardt 2016).

The purpose of the current study is to close this gap and develop in-depth understanding how the emergence of pilot and demonstration projects for biorefinery development at European levels affects inter-organisational cooperations between actors across Europe. The study will hence contribute with a multidimensional analysis of what actual value this type of

infrastructure has for the industry in Europe and how this perceived value can be strengthened.

The impact of geographical distance on inter-organisational cooperation is commonly conceptualised as a multidimensional construct called “interaction quality” which captures the cooperating organisations’ perceived value of the “informational and technological exchange processes that occur during technology transfer projects” (Leischnig et al. 2014). By performing an empirical-based assessment of the extent to which the interaction quality is affected by geographical distance between cooperating organisations and PDPs, this study will support the design and coordination of technology and innovation policies at regional, national and European scales for improving the perceived value of the existing infrastructure.

Background: reference to the problem to be addressed, the research questions and the theoretical background of the proposal

Research on PDPs for sustainable technologies has largely relied on the technological innovation systems (TIS) framework (Frishammar et al. 2015). This framework proposes that technologies are created and diffused through the interplay of actors, networks and institutions in innovation systems (Hekkert et al. 2007; Bergek et al. 2008). Previous research conceptualises PDPs as supportive elements in the formation of TISs (Hellsmark et al. 2016a), that give rise to networks where a wide range of actors such as research centres, industry associations and policy makers is involved in the innovation activities through inter-organisational relations (Ceschin 2015; Mossberg et al. 2018). Inter-organisational relations refer to the collaboration between partners and are, thus, a core component in sustainability transitions, for instance in creating legitimacy or formulating joint visions (Hansen and Coenen 2015; Bergek et al. 2015). In general, innovation activities can take place at various geographical scales and cut through territorial boundaries (Truffer et al. 2015; Binz and Truffer 2011). In this context, previous studies on PDPs tended to rely on rather implicit conceptualisations of space or have focused on PDPs on the national scale (cf. Hellsmark et al. 2016b). None of these studies has explicitly sought to understand PDPs in a geographical context (Hellsmark et al. 2016a; Klitkou et al. 2013).

The literature, however, raises the idea that the respective distance of geographical co-location may affect the quality of inter-organisational relations (Binz et al. 2014). When collaborating through inter-organisational relations, recent developments towards collaborative innovation processes have led to a proliferation of studies in the management literature that focus on interaction quality as a measure of the profitability and efficiency of inter-organisational relations (Lohmann et al. 2014; Lohmann 2014). Interaction quality is defined as “summary judgment that refers to the informational and technological exchange processes” between collaboration partners” (Leischnig et al. 2014). In this context, while a substantial body of research has shown that inter-organisational relations are indeed affected by geographical distance, there is no empirical research into how the interaction quality in inter-organisational relations with PDPs is affected by geographical distance.

It is this gap in the literature that the present study seeks to address. More specifically, the following research question will be addressed: “How does geographical distance of organisations cooperating with a specific PDP context affect the perceived interaction quality?”

Our theoretical starting point is the technological innovation systems framework, which is used to explore the role of geography, and we draw on ideas from the management literature

to explain interaction quality. The proposed relations will be summarized in a theoretical model.

Methodology and empirical base: clearly state the methodology used in the paper and the source of data used

To examine the impact of geography on interaction quality with PDPs for biorefinery development, this study will utilize a structural equation modeling approach, enabling us to perform an empirical-based analysis of the influence of geography on interaction quality. In general, structural equation modeling enables quantitative testing of a priori developed hypothesis models and has become a widely used procedure for quantitative analysis in economic research (Diamantopoulos and Siguaw 2000; Kaplan 2001). This type has been used by several studies to examine interaction quality in different contexts (Leischnig et al. 2014; Lohmann et al. 2014).

Structural equation modeling covers two major steps, firstly the development of a theoretical model to explain the phenomena of interest on a conceptual level, termed structural model, and secondly the testing of the structural model with an empirical dataset. In the first step, this study will build on previous studies (Leischnig et al. 2014; Lohmann 2014) to build a structural model to explain the relation between geography and interaction quality at PDPs for biorefinery development. Leischnig et al. (2014) describe interaction quality as summary statement in terms of the following characteristics: “informational and technological exchange processes that occur during technology transfer projects, involving the assessment of the mutual or reciprocal actions between the technology transfer partners”. This proposal seeks to adapt this model to the context of PDPs for biorefinery development. In the second step, this study will test the theoretical model with an empirical dataset collected in an online-based survey.

The sample composition will depend upon cooperation partners with PDPs for biorefinery development. A systematic random sample will be created from a database on existing PDPs for the transition to a bioeconomy in Europe that has been built by a set of European research projects (ERIFORE, Pilots4U). The variables and relations are intended to be operationalised with existing instruments from previous research. This study will collect empirical data on interaction quality through an online-based survey instrument. According to structural equation modelling, a set of statistical analyses and tests will be used to examine the hypothesised relations between geography and interaction quality. This enables a comparison of the levels of interaction quality perceived by organisations according to geographical location in relation to the respective PDPs.

Results: achieved definitive or provisional results can be described, including their relevance with respect to the existing literature and contribution they provide to the field of STS studies

The results of the study will show the levels of interaction quality perceived by cooperation partners of PDPs, enabling a comparative analysis of the extents of interaction affected by geographical co-location between PDP and cooperatoin partners. The analysis will allow empirical-based insights in the role of geography in the emergence of PDPs at European scale. The intended contribution of this study is two-fold: First, in terms of theoretical development, the study links together two important research streams (technological innovation systems and management literature), thus providing insights into how the interaction quality with

PDPs is affected by geographical distance and how PDPs are embedded in geographical contexts. Second, we provide additional insights in the interaction with PDPs by examining interaction quality by a set of predicting variables.

Conclusions and policy implications of the findings:

The study will indicate the impact of PDPs for biorefinery development at European scales in the transition to a bioeconomy, measured by the perceived interaction quality in organisations cooperating with PDPs. Understanding the impact of geography on the extent of interaction quality, will help to guide the development of the emerging landscape of PDPs for biorefinery development in the transition to a bioeconomy.

Insights in the spatial range of PDPs can provide the basis for a more efficient implementation of biorefineries and contribute to policy design. Two major implications for policy might be drawn. First, by knowing how a PDP is embedded in the geographical context, policy makers may draw statements on the direction of their support policy programmes in terms of coordination efforts. Second, insights into the interaction with PDPs similarly can enhance the understanding of policy makers and managers in constructing and operating PDPs.

Key words: Pilot and demonstration projects, technological innovation system, geography, inter-organisational collaboration, interaction quality

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Abstract 82

THE BACKSTAGE PSEUDO-INFRASTRUCTURE OF OPEN DATA IN MOLECULAR BIOLOGY: REFLECTIONS FOR SCIENCE POLICY

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Aim of the proposal:

This paper provides an example of how Open Data have created a new mode of knowledge production in molecular biology (dry labs), and explores the often-ignored causes of Open Data in both policy and scholarly discourses when presenting molecular biologists as exemplars data sharing that might be replicated in other fields. It also cautions against an unforeseen negative potential impact of this new mode of knowledge production, known as computational biology or the dry lab, and reflects on infrastructures and policies for Open Data, and their potential consequences in other disciplines.

Background:

As part of a larger study on data reuse practices, we have found that, on the one hand, the Human Genome Project (HGP) and some disciplines, e.g., molecular biology, crystallography, etc., are usually presented as a paradigmatic project or disciplines, respectively, of Open Science in general, and of Open Data in particular. The main reason for pointing to these disciplines as being exemplary is that researchers share their data on online open repositories where other researchers can use them for any research purpose. However, research findings from disciplines concerned with studying the behavior of researchers, e.g., the sociology of science, history of science, science policy, information science, etc., indicate that researchers are frequently reluctant to share their data even privately. If researchers share their data, they can no longer barter with the data, losing their competitive advantage (Borgman, 2007). In fact, most of these studies, if not all, have shown that Merton norms are more a myth or ideal than a reality, e.g., Mitroff, 1974. In digging deeper into the literature about the data sharing practices of the HGP and molecular biology, Hilgartner's comments are worth reproducing because his description of scientists is at odds with their current open data practices:

"There is no reason to naturalize the culture and practices of molecular biology in the 1990s, assuming they were functionally necessary for efficient knowledge production. Nor is there any reason to reject out of hand the possibility of building knowledge-control regimes that constitute tightly integrated collectives, held together by shared goals, materials, and practices, that seek to optimize overall achievements through rapid circulation of data and materials. [...] [However,] this vision proved impossible to realize in a [...] population of autonomous, atomized individuals engaged in what some scientists, especially in human genetics, seemed to regard as nearly Hobbesian competition." (Hilgartner, 2017)

On the other hand, molecular biology always enjoyed an object-oriented epistemology, which allowed the creation of knowledge only from the experimental construction of data, at least until the end of the 20th century. Its knowledge production was based on the bench work or wet lab (Knorr-Cetina, 1999). However, nowadays, knowledge creation in molecular biology relies on both the web lab (experimental biology) and the dry lab (computational biology) (Penders, Horstman, & Vos, 2008). Both types of labs address the same biological issues, but they do so in different ways with varying methods. Computational biology, or the dry lab, is made up of three layers of computation depending on its closeness to the data produced by the experiments with biological objects: close-to-data generation informatics, large data sets informatics, and systems modelling informatics, also known as *in silico* (Kahlem & Birney, 2006).

Research goals:

Current open data sharing practices in molecular biology and the birth of computational biology raises some questions whose answers can contribute to designing policies and instruments for STI. The goal of this research is to understand why data sharing practices of molecular biologists are open, and whether any kind of causality exists between this open behavior and the new mode of knowledge production – computational biology. We aim to shed some light on the actors, policies or instruments, which enabled or caused this open data behavior.

Methodology and empirical base:

In order to answer our research questions, we principally draw upon both recent and not-so-recent studies dealing with the history and sociology of molecular biology and genetic biology (e.g., Contreras, 2011; García -Sancho, 2012; Hilgartner, 2017; Hilgartner & Brandt-Rauf, 1994; Kaye et al., 2009; Knorr-Cetina, 1999; Strasser, 2008, 2010; Strasser & De Chadarevian, 2011; Suárez-Díaz, 2016).

We also draw upon interviews with three researchers in ovarian and breast cancer in Canada and Spain as part of an ongoing larger study (forthcoming). Our study's main goal is to identify the causes and enabling factors that allow researchers reuse research data for purposes other than replication or reproducibility. Our study draws upon ten case studies.

Three of them belong to the field of molecular biology. Two of the case studies belong to the Varderhyden Lab¹ of the Ottawa Hospital Research Institute (Canada), and one case study belongs to the INCLIVA² Health Research Institute (Spain). The three case studies are small laboratories of molecular biology (web labs) and have served to answer the research questions of this research at hand. We have conducted eight 45-to-75 minute interviews with these three researchers between the beginning 2017 and mid-2018.

For our research, one ethics protocol was requested at both the Ottawa Health Science Network Research Ethics Board (#20160949) and the Office of Research Ethics and Integrity of the University of Ottawa (#A01-17-03), Canada.

¹ <http://www.ohri.ca/profile/vanderhydenlab>

² <https://www.incliva.es/>

Some follow-up emails with them are also part of our analysis. All interviews have been transcribed, and analyzed with an interpretive approach with the help of NVivo 11 Plus.

Findings:

Our findings are twofold. On one hand, the main actors and instruments, which are behind molecular biologists' open data behavior, are journal editorials' coercive requirements. On the second hand, the research open data infrastructure –if we can use this term– in computational biology consists of hundreds of independent online data repositories, which complicate the reuse of data.

Several intertwining causal factors led to the development of the dry lab. First, the linkage between experimental work and methods of natural history, namely data collection. This linkage was pioneered by Margaret O. Dayhoff, leading to the creation of databases of protein sequences, which were initially materialized with The Atlas of Protein Sequence and Structure in 1965. Second, both molecular biologists and computer scientists took part in a crucial decision: to create a national computerized database. Last, but not least, the U.S. National Institutes of Health (NIH) –with some delay, maybe due to doubts about the usefulness of collecting data as opposed to experimenting in labs as the only valid method for doing science–, provided funding for creating publicly available databases. Two competing project proposals applied for the NIH funding: Dayhoff's and Walter Goad's. The latter's proposal received the funding. His model, for collecting data, differed from Dayhoff's mainly with respect the questions of authorship and priority. Goad chose a method, which was aligned with the reward system of science: journal editors had to request from researchers "the submission of sequences to the database [as] a condition for the publication of an article" (Strasser, 2008, p. 538).

It was the dependence of researchers on journal requirements, which obligated molecular biologists to share their data openly. However, the untold story about openness is that researchers' publish-not perish dependency on journals is the real reason behind molecular biologists' data-generosity, and which ultimately consolidated a new mode of knowledge production in molecular biology known as the dry lab.

Also, we have found that, ultimately, the condition imposed by editors in molecular biological journals triggered the creation of hundreds³ online publicly available databases (e.g., GEO Profiles, TCGA, etc.), which, in turn, became the object of study of computer scientists trying to answer the same or similar research questions as biologists. However, the reuse of data available on these databases is sometimes questionable (Ioannidis et al., 2009). One of the reasons deterring a full exploitation of data in open databases is that researchers may employ different "releasing" strategies, e.g., withholding data variables or data, when depositing their data onto publicly available databases in order to maintain a competitive advantage for exploiting their own data (Hilgartner & Brandt-Rauf, 1994). There are other reasons, though, such as the overwhelming task of finding and reusing the right data among so many data (Zou, Ma, Yu, & Zhang, 2015).

³ According to a report of 2014 Molecular Biology Database Collection in the journal *Nucleic Acids Research* (NAR), there are 1552 publicly online databases (Zou et al., 2015). However, nowadays there could be available about 2000 publicly online databases (<http://www.oxfordjournals.org/nar/database/a/>)

Borrowing one of our interviewees' words:

Interestingly, in my field there has been a recent boom in the amount of available data [...], so there's now almost too much data to use!

(October 1, 2018)

An unexpected but interesting finding from our interviews is that small web labs may end up being dry labs because of their inability to compete with big wet labs in generating their own experimental data:

Interviewee A: *I should emphasize that [to produce these big amounts of data in our lab] is theoretically possible too, and there is nothing they did technically that it is out of our reach, umm, but the scale they did it at is a multimillion dollar project, so, and that, you know, requires I think their paper, you know, has 30 plus authors all working together for it, so we can generate some of that but to scale it to that proportion you need a lot of people, and lot of money.*

Interviewee B: *So, what happens? That what we do not have is the funding for this type of analysis, but it is not of my interest [having this funding] either because if we find funding to carry out this type of analysis, we could only have some samples when other people are using hundreds of samples. So, what is the point that I make the same experiment in 20, 25 samples when there are groups out there, that this is public data, which are using thousands of samples or hundreds of samples? It's wasting the money ... eh ... (this is a free translation of the original words⁴) (December 22, 2017)*

This competition would not only have consequences on the type of lab they chose to be – experimental or computational–, but on the journal publishing options. They would have to choose between journals for experimental biology or computational biology:

Interviewee A: *But the reason I said it was a perspective article rather than a traditional research article... There is a trend in journals that unless you are like writing a new algorithm, or methodology, or something, they typically don't accept submitted articles that are simply reanalysis of preexisting data. [...] There seems to be a trend that reanalysis even for something new and exciting is not enough. [Journals] want some sort of follow up. [...] In fact, the journal Nature, I believe -- one of them actually started trying to do a new type of article that was specifically for reanalysis papers because typically they would not be accepted for a normal article. So, they said, "Well, we understand that this is important and we need to find somewhere to put these papers because they're good," so they had something like computational analysis as a like type of paper, which is interesting, you know?*

⁴ "Entonces què passa? Que lo que no tinguem nosaltres és la financiació per a este tipo d'anàlisis, però tampoc en interessa perquè encà que trobarem financiació per a fer este tipo d'anàlisis, podrien fer-se servir unes quantes mostres quan altra gent està fent servir centenars de mostres. Entences, ¿quin sentit té que jo faja el mateix experiment en 20, 25 mostres quan hi ha grups per ahí, que això són les dades públiques, que estan fent servir milers de mostres o centenars de mostres? És tirar els diners... eh..."

Conclusions and discussion:

We suggest that design efforts in research infrastructures and national and supranational policies for research resources should be accompanied by changes in the reward system of science.

Our hypothesis is that it is the current reward system of science, which forces researchers to adopt different deliberate “releasing” strategies, e.g., withholding data variables or data, publishing all potential articles at the same time from a data set before releasing it, etc. Coercive instruments like the ones by journal editors may only work apparently: there are hundreds of open databases available for reuse, but imposing openness will surely lead to the development of “closure” strategies.

Furthermore, society in general and the scientific community in particular take for granted that new modes of knowledge production are positive. While we do not disagree, we suggest that new modes of knowledge production, together with other factors, may have unintended negative impacts as we foresee in the field of molecular biology:

First, there could be a re-distribution, and thus divide, of the two modes of knowledge creation (experimental biology and computational biology) and scientific contribution between big labs and small labs, and thus create or increase a competitive gap that is insurmountable between these two types of laboratories. Big labs could easily assume both experimental and computational modes of knowledge production, while small labs may choose, rather be forced to choose, only the computational mode of knowledge production.

Second, the fact that a new mode of knowledge production has been developed, does not imply that the knowledge created from this mode be epistemologically accepted by the scientific community in order to advance the field. It seems that findings from computational biologist are “minor” contributions, which after all need to be tested in the web lab to be accepted as “valid knowledge”⁵.

Even more, this divide of a first versus second division of knowledge may be the main cause of a re-organization of journals in molecular biology. The field has created journals to publish the “second division” knowledge generated by computational scientists, and devotes only some specific sections of existing first-division-knowledge journals for them. Nor to mention a potential divide between labs in the Global South and in the Global North.

Although this research has omitted some other factors and causes explaining the birth of computational biology or the dry lab, it is known that social causality is very complex. So, last, but not least, because of this complexity we cast doubt on the possibility of reproducing or replicating this phenomenon in other disciplines, even if proper policies, instruments and infrastructures are in place. The new mode of knowledge production in molecular biology has also been possible thanks to either computer scientists moving into biology, or biologists moving into computer science, and this is not something which can be easily replicated elsewhere.

Further research from other perspectives and methodologies on this topic and discipline could shed more light on factors and causes, which have contributed to the creation of computational biology, and on potential impacts of Open Data, policies, instruments, etc. In addition, more case studies in different both small and big web labs are recommended to understand this phenomenon better and to identify more policy implications.

⁵ “Knowledge is a conventional belief. It can be explained by the social groups that construct it and by the social interests driving them” (Vinck, 2011, p. 165)

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Abstract 152

SOCIETAL IMPACT OF RESEARCH INFRASTRUCTURES IN CONTEXT

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Aim of the proposal:

This paper is dedicated to societal impact of research infrastructures (RIs). In particular those that operate in a complex context that include multiple members/funders, members/partners and other stakeholders; academic as well as non-academic and at regional, national and supranational level, such as the European Research Infrastructure Consortia (ERICs). Every RI, and every ERIC in particular, operates in its own unique network. In Europe, supranational policy organizations call for harmonized operation and unified governance approaches of RIs and ERICs. This includes societal impact and its assessment. Existing practices regarding societal impact assessment of research organizations do not fit the perceptions and expectations of RIs, ERICs and their stakeholders. Even commonly used methods to assess the societal impact of a specific RI, does not cater to the needs of the RIs and ERICs to develop and apply a common or joint approach.

This paper is dedicated to the development of such a joint approach for the organisation and assessment of RIs, in the field of materials research. Based on an analysis of the specific characteristics of RIs and ERICs, and based on current trends in societal impact assessment, we have developed a common approach for use by a variety of different RIs and ERICs. The approach is currently tested by 5 RIs and ERICs. The test-phase will result into 5 societal impact reports in June 2019

Background:

RIs come in many different forms and sizes, and there are several definitions. They share the reference to facilities, resources and services for (that enable) top level or excellent research (ESFRI, 2006; ESFRI, 2018; EC 2010b, EC, 2018a). Moreover, something is usually understood in policy terms as an RI, when its use as well as its governance transcends a single research organisation.

RIs are an objective of policies in Europe since the last two decades. The memorandum 'Towards a European Research Area' (ERA) (EC, 2000) positions RIs as policy objective and argues that a European approach is necessary. Given the importance of RIs for the progress and application of knowledge in Europe, more coordination is necessary. This coordination includes the creation of new RIs and the operation of existing RIs. RIs are also included as one of the ERA priorities. The objective of priority 2b is that "high-quality, accessible Research Infrastructures are at the heart of the knowledge triangle and key to Europe's ambition to lead the global movement towards Open Science".

A policy organisation specially dedicated to RIs is established in 2002: the European Strategy Forum for Research Infrastructures (ESFRI). It will support a coherent and strategy-led approach to policy-making on research infrastructures in Europe. ESFRI provides national

authorities the opportunity to explore common and integrated activities for the development and use of RIs (ESFRI, 2010), which is necessary, given that national policies for RIs differ considerably and are fragmented. The notion of a European strategy for RIs, offers individual member states the prospect of reducing costs, by sharing the capital and operational investments accompanying the establishment of RIs (Papon, 2004).

The introduction of the European Research Infrastructure Consortium (ERIC) legal framework (EC, 2009) is another development in the creation of a unified European RI policy landscape. The framework provides consortia the possibility to act as a European legal entity. A consortium consists of – and is funded and governed by – states (EU member states, associated countries, third countries) and intergovernmental organisations. The framework provides a structure for an intergovernmental organisation for research infrastructures. It provides guidelines on such issues as what RIs are and what they do, their goals, their governance and the expected contributions. An ERIC needs to represent added-value in the development of the European Research Area (ERA), it needs to contribute to the mobility of knowledge and/or researchers within the ERA and to the dissemination and optimisation of results (EC, 2018b). The ERICs have introduced their own policy body, the ERIC forum. It represents the ERIC members and its goal is to improve the operation of its members, to contribute to high-level policy discussions, to identify common challenges for ERICs and respond collectively to these shared challenges (ERICforum, 2019).

So, there is no lack of RI policy in Europe. Definitions are very inclusive (ESFRI, 2006; EC, 2018a) and allow for a large variety. Differences between the RIs and ERICs are substantive, including regarding the phase. Some of them are not yet in operation, but in the building phase. Yet they are characterised as RI. Regarding the expectations, these reach far beyond enabling (excellent) research. ESFRI mentions the important role of RIs regarding outreach (in addition to research and education), aiming at reducing barriers between science and citizens; it positions RIs as impacting on the European society and economy, because they are innovation drivers in a competitive knowledge-based economy; providers of know-how, methods and standards to national and international stakeholders; and advisers on policies; and it presents RIs as drivers for regional development, affecting scientific production and culture, higher education, industry (including supplying industry, as well as innovative start-ups) (ESFRI, 2018). To name but a few.

Several policy organisations have articulated concerns regarding the sustainable development and operation of RIs and ERICs (for instance EC, 2017). One of the challenges is the societal impact of RIs, and its evaluation. Some RIs require substantive public investments. The expectations driving these investments have resulted into a situation that even RIs that do not require substantive investments, are now expected to contribute to the needs of contemporary society (Hallonsten, 2017). But clear articulation of expectations regarding societal impact, or regular monitoring, are not yet common practice, neither among funders, members and stakeholders, nor at RIs (ESFRI, 2017). Still, the need to develop a standard methodology for assessing the societal impact of RIs is widely shared (cf. European Commission (2017), OECD (2017), ESFRI (2017)).

Yet there is no lack of societal impact studies dedicated to RIs, often grey reports. Most focus on a specific RI (Simmonds, 2016; (Kolarz, 2017; Van Belle et al, 2018), There have been attempts to develop a more generic frameworks (Greniece et al, 2015; Roschow et al, 2014;

OECD, 2017; OECD, 2018; RI-PATHS). There are similarities, such as the use of a model or of elements of a log frame (inputs, activities, outputs, outcome). The studies differ in how they analytically “pull apart” impact and RIs. The questions “impact of what?” and “impact on what?” are addressed in different ways.

But neither of these studies provided a basic framework that was useful for the five RIs in the ACCELERATE project. The studies and methods do not respond to their needs. The differences between the RIs, including each network, and the perceptions of the actors in the network, require a flexible and responsive approach. There are uncertainties regarding societal impact, both on the side of the RI, as well as on the side of the members/funders. There are no standard evaluations or protocols in use, there are no practices yet. Some of the funders are not academic, and have a different evaluation tradition. Some of the societal impacts of RIs do not relate at all to academic activities, such as for the majority of impacts of the RIs that are in the building phase.

Methodology and empirical base:

The context of this paper is the ACCELERATE project, dedicated to the long term sustainability of RIs in the field of materials research. The RIs have articulated the need for a proactive governance of societal impact. The ACCELERATE consortium consists of five RIs: CERIC (Central European Research Infrastructure Consortium), ESS (the European Spallation Source ERIC), FRM II, HZG-GEMS (Helmholtz Gesellschaft) and ELI (Extreme Light Infrastructure). They are all dedicated to enabling materials research: the characterisation of matter, from subatomic to supramolecular scale. The research that the RIs enable is done with equipment called beamlines or instruments. These are connected to a powerful source, an accelerator, spallation source, or laser.

We have used desk research to study the evolving policy context of RIs. We focused on policy documents concerning RIs, including societal impact (assessment) of RIs. We studied literature on RI impact, including consultancy reports and case studies. Through our project, we had access to official as well as internal documents of the member RIs, including Statutes and Annual Reports, as well as monitoring documents.

We interviewed representatives of the RIs and organised joint workshops to identify questions, interests and needs regarding impact, to identify relevant stakeholders that are involved in the evaluation of societal impact, as well as to discuss expectations and practices. We observed a meeting of the management of one of the RIs with one of their members/funders.

The societal impact approach is based on a conceptual understanding of what an RI is, and on the real world needs of the five RIs. The societal impact approach is based on current developments in the academic as well as the grey literature. It is written down in a protocol, that currently is tested by the five members. The test-phase will result into 5 societal impact reports in June 2019.

The approach is based on Theories of Change (ToC) (see for instance Taplin, 2013; Van Drooge and Deuten, 2017). There are similarities with logic models and impact pathways, yet a ToC articulates and includes preconditions that are thought necessary and assumptions that are

thought to play a role. Developing an ToC can be understood as negotiating what impacts to expect, at what moment in time, by whom and under what preconditions (Vogel, 2012). It can be regarded as a horizontal form of governance. From the ToC, a number of evaluation or monitoring questions can be identified (Van Drooge and Spaapen, 2017).

The protocol does not describe impact categories. It states that what relevant impacts are, depends on and can be negotiated by, the RI and its stakeholders. So the first step is to identify or negotiate relevant impacts. Next is to understand how an impact will become manifest. In other words: develop a theory of change. Here the protocol draws also on literature that focuses on processes and contributions, instead of attributions (Spaapen & van Drooge, 2011). Another issue that the protocol addresses, is to what extent the RI is accountable, or can be held accountable, for a change or impact to become manifest. ToC uses the notion of “accountability ceiling”. This refers to the change for which an RI can be held accountable (Taplin et al., 2013); and the other way around, it limits the extent to which an RI can be held accountable.

During the testing phase, we are in regular contact with each of the five RIs (biweekly-monthly), through skype, email and one site visit per RI.

Results:

The members of ACCELERATE are all dedicated to enabling materials research, but that apart from that, they mainly differ, in size, scope, phase and governance. To mention two: (1) a building project estimated to cost 1.8 billion euro, leading to a state of the art facility that will not be operational until 2024, and (2) a coordinating and networking organisation with an annual budget of 3 million euro and members that contribute their up and running, and sometimes aging, facilities. It is evident that the impacts will differ given these characteristics, and that different impacts are expected given the different stakeholder communities. At the same time, supranational European initiatives call for coherent policies regarding (assessment of) societal impact of RIs. There is an inherent tension here, given the different characteristics and contexts.

The ACCELERATE members report that there is more to impact than is formally agreed in statutes and communicated in strategic objectives. Different stakeholder groups have different perspectives of what an RI is. And there are differences within stakeholder groups as well. For example, for one member/funder (a science ministry) of one of the ERICs, the membership provides them with a networking opportunity regarding EU policies. For the partner facility of that same member state, the membership contributes to developing improved and internationally recognized standards. This is seen as a positive and empowering signal for their junior researchers: the domestic facilities are competitive. Another example is the potential membership of one member state of another ERIC, where the same ERIC is an opportunity for high tech industry (ministry of economic affairs) as well as an opportunity for domestic researchers to use state of the art facilities abroad (ministry of science). And a third example is the RI that is funded by science ministries. The RI perceives its spill over effects as relevant, such as providing medical companies access so they can make radio-isotopes for cancer treatment. However, the RI is not perceived, nor evaluated, as an entity that enables cancer treatment.

Every stakeholder has a different perception of an RI. And each perception relates to a

different impact or contribution. On top of that, at least in the case of ERICs, come the requirements that relate to the EU, such as the contribution to the ERA. These perceptions of what an RI is, and what impact to expect, can be discussed and negotiated between the RI and its stakeholders, and among different stakeholders. An RI is in that sense a boundary object (Star and Griesemer, 1989). It is adaptable to viewpoints of a wide variety of stakeholders. This includes stakeholders that are not commonly involved in science and innovation, such as local communities and regional employers. What a Research Infrastructure is, is influenced by the perception and expectations of the stakeholder, the activities and strategy of the RI as well as the negotiations, or the lack thereof, between these actors.

In impact methods and societal impact reports of specific RIs, we identify two major shortcomings for our purposes. We have tried to overcome these with our method. The first is that it is often unclear why certain impacts or impact pathways are chosen. Economic impact, innovation, capacity building are some of the impacts that are often mentioned, yet every method and study presents a slightly different set. The rationale for the choices is often implicit. This leaves the question: why this collection of impacts? The other shortcoming is that although many projects and reports mention that there should be a relation between an impact, the RI and the indicator, this relationship is not articulated. This leaves the question: what does a specific indicator tell?

Conclusions:

Studying reports and methods, and relating that to the practice of a number of RIs, aids in understanding the challenge regarding societal impact. The diversity of RIs, the large variety of stakeholders of an RI and the different views they have about an RI, suggests that a standard set of impacts or indicators doesn't do justice. We have developed an approach that tries to take this into account. It starts from the observation that an RI operates in a complex context, and that it is perceived differently by different stakeholders. Both RIs as well as stakeholders search for points of reference. This searching provides the opportunity to develop a joint view on what the RI is, and what can be expected of it.

The case of RIs and ERICs provide an example of a complex actor network or constellation, in which academic and non-academic partners collaborate, negotiate and deliberate. The societal impact approach is aimed to enable this process and manage expectations. The first results of the testing phase suggest that all partners can use the open approach indeed. They each develop a societal impact report for their unique context, in response to, and sometimes in discussion with, their funders.

Abstract 123

UNDERSTANDING THE INFLUENCE OF NATIONAL RESEARCH POLICIES ON THE FORMATION OF RESEARCH INFRASTRUCTURES

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Aim of the proposal:

The purpose of this paper is to understand the influences between the formation processes of research infrastructures within different scientific fields and the political-administrative processes associated with national research infrastructure roadmaps. We aim specifically to answer the following research questions:

RQ 1: How do different research infrastructures fit within the national roadmap process?

RQ 2: How are specificities of different research infrastructures taken into account in the national roadmap process, if at all?

RQ 3: How does the labelling of research infrastructure as a result of the national roadmap process impact the design of different research infrastructures?

The paper will focus on observing these interactions and implications on both sides – and how the roadmap process (formally equal) accounts for differences between research infrastructures directly and indirectly.

Background:

Research infrastructures are facilities, resources, and services used by user communities to conduct research (Hallonsten 2018). There are many different types of research infrastructure focused on different domains of research (ibid.). A traditional perspective of research infrastructures includes consolidated single site facilities commonly used in particle physics or astronomy. Research infrastructures can also be distributed over several sites to achieve broad coverage for observation such as the Integrated Carbon Observation System Research Infrastructure (ICOS RI – commonly known as ICOS), which has more than 100 stations in twelve European countries. Some are even mobile, such as scientific vessels. The growing demand for ever more costly and complex research infrastructures is one reason why they becoming a topic of interest for policy-makers.

The research infrastructure ‘roadmapping’ process seeks to bring together research communities and policymakers to support decision-making on the prioritization and funding of research infrastructures in order to support the national decision-making process for prioritizing and funding of research infrastructures. (OECD 2008). Historically, most European states used only national policy to support the national decision-making processes for the prioritization and funding of large-scale research infrastructures, following the European Strategic Forum for Research Infrastructures (ESFRI) for ‘roadmapping’ their research infrastructures (REF). Since state policy for research does not reflect the subtleties of domain-specific research (Edgerton 2017), the different national processes to elaborate roadmaps for research infrastructures are no exception, referring to one single policy/process to address the whole context of research infrastructure. Nonetheless, the concept of roadmaps for research infrastructures proved to be a popular one and consequently these RI strategic

prioritization exercises became embedded in most European countries.

The increasing number and diversity of research infrastructures is a result of an evolving research environment. Research collaborations are growing in number and scale, and the volume of data is growing. Concurrently, policymakers are becoming interested in the economic aspects of research but are demanding greater accountability and returns on their investments. In this sense, research infrastructures are at the crossroads of two processes. A disciplinary process, bottom-up and distributed, driven by the needs and interest of the scientists. The second process is a political-administrative one. Here the underlying 'rationality' is the managerial one of central planning, avoiding duplications, streamlining efforts, etc. – related for example to New Public Management and public bureaucracy policy models.

Conceptually we understand research infrastructures as crystallizing agents of a distributed community around an infrastructure or service related to a shared understanding of a field and a common research program. Luukkonen and Nedeva (2010) developed a notion of integration to aid understanding it as part of a specific policy process. Their main argument was that it requires 'crystallizing agents' for integration to be successful respectively for integration to occur. They also claim that such integrated entities in research are mostly knowledge-related and embodied in artefacts (incl. infrastructure) and researcher competence sets. Both are needed to achieve integration of research teams, communities and/or organizations. Based on the claim of Luukkonen and Nedeva, we understand research infrastructures as bottom-up integrators of not only communities but also facilities, data, and practices. As such crystallizing agents of scientific communities, they relate to the specific characteristics of the fields and how they are organized. Therefore, the differences between research fields exist not only in their objects of research but also differ in their manifestation as crystallizing agents such as facilities, networks or standardized practices, which result from different dynamics.

As political-administrative processes research infrastructure policies obey to a notion of planning and management rationality, and are largely blind against field differences. Nonetheless, research infrastructures are required to fit into this framework to receive legitimacy and funding. This is why the national roadmap processes as such influences the further formation of research infrastructures, through their specific labelling of research infrastructures. Depending on the organization of the research funding system of a country the roadmap process has different implications on research infrastructure formation.

Deriving from the model of crystallizing agents we suggest that the research infrastructure formation processes takes place through negotiations between actors on both sides – users and funders – searching for compromises.

Methodology and empirical base:

The systemic conditions of Switzerland make it a particularly interesting case study for understanding the formation of national research infrastructures and the influence of national policies. The single case study focusses on the political-administrative characteristics of the country, which is part of the family of Germanic administrative tradition (Painter and Peters (2010)). Switzerland has a federal and decentralized state structure, with a consensual executive government and separated administrative capacities. The Swiss research system is also organized federally, with competences for research funding shared between the federal government and the cantons.

The nested cross-case analysis focusses on the entire process of formation, acquisition of

funding, and implementation of different RI in Switzerland. The selected cases here are FORS and SwissFEL. The two cases represent very different types of research infrastructures and research communities but both of them started to form before the roadmap process was introduced in Switzerland. Therefore, a long-term analysis will allow us to understand the characteristics of research infrastructure formation of different scientific fields. How – if at all – these differences are considered within the national research infrastructure policies. And, how the labelling of research infrastructure, resulting from the political administrative characteristics influence the formation process of the selected cases.

The qualitative data was collected through semi-structured expert interviews with relevant actors. The interviews were recorded and transcribed with omissions of irrelevant digressions, interruptions etc. in order to be as true to the conversation as possible, yet pragmatic. For the sake of achieving complete and robust qualitative data, these will be completed through a review of additional documents as well as expert interviews with all relevant actors for the selected cases. The inclusion of different sources of data as well as interviewing different actors on the same topic of investigation allows for triangulation of data. The synthesized case studies will be shared with the interviewees for validation of the collected data.

Results:

A characteristic of the Swiss case is the broad distribution of responsibilities for research infrastructure funding as well as the existence of a variety of funding instruments for different types of research infrastructures. This situation leads to several public funding streams for research infrastructure, resulting in a lack of transparency in the decision-making and overall allocation of public funds. At this point, the collected data indicates that the roadmapping process in Switzerland doesn't take the differences of research infrastructures from different scientific fields into account, resulting in a more advantaged position of negotiation for the more traditional types of research infrastructures. The completed analysis will allow to identify more specific implications.

Conclusions:

The Swiss context offers a good case to understand the influence of different research infrastructure labels and a political-administrative process, which is blind to differences of scientific fields, on the formation of research infrastructures. Moreover, it shows the difficulty of successfully implementing a centralized planning process into a research system, which is federalized and decentralized.

B5 GLOBALIZATION AND GEOGRAPHY

Wednesday 05 June 2019 from 14:00 to 16:00

ANTONIO ZINILLI, Chair

Abstract 37

INNOVATION RESEARCH ON AGRICULTURE AND CLIMATE CHANGE: A SYSTEMATIC REVIEW OF EVIDENCE

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Aim of the proposal:

This paper examines empirical innovation studies on agriculture and climate change that were published in the Web of Science from January 1992 to November 2018. It assumes that conceptual frameworks used in studying agricultural innovation dynamics in the field evolved in response to the limitations of linear diffusion model as well as to the recent developments in the theory and practice of agricultural innovation studies. The paper is concerned about whether adaptation to climate change is mainly conceptualized as a problem of complex innovation system that requires multi-actor processes and partnerships (Douthwaite and Hoffecker, 2017), instead of a 'pipeline' approach to innovation (Sumberg et al., 2003). For this purpose, the innovation studies were organized according to Klerkx et al.'s (2012) historical evolution of agricultural innovation perspectives.

Background:

As systems thinking continues to shape innovation studies, agricultural innovation has been reconceptualized as a process involving technical and social systems that are co-evolving over time (Fagerberg, 2018; Kilelu et al., 2013). The technology adoption paradigm was abandoned as technology is seen as only one of the many aspects of innovation, and that social and institutional dimensions are not merely external conditions that make technology works (Leeuwis, 2004). This most recent paradigm is called agricultural innovation systems (AIS). Despite these theoretical developments in agricultural innovations, it is unclear whether AIS is influencing agricultural policies and practice as institutions and communities respond and adapt to the impacts of climate change. In the academic literature, climate change presents challenges in the agricultural sector that require both short-term coping strategies to abrupt shocks from climate-related disasters as well as long-term, adaptive mechanisms to endure long-term shifts (Rickards and Howden, 2012).

Through a scientometric analysis and qualitative review of carefully selected 24 empirical academic papers from the Web of Science, we attempted to answer the following research questions: (i) What are the conceptual frameworks and key concepts used in studying innovations in the context of climate change and agriculture? (ii) Do recent agricultural innovation studies look at diverse ways (i.e. incremental, radical, and transformational innovations) of responding to complex sustainability challenges in the agricultural sector? and (iii) Do these innovation studies sustain the dominant innovation pathways and the narratives centered on technology adoption, modernization, and growth which are not inclusive enough?

Methodology and empirical base:

Three keyword search strategies were applied to delimit the scope of potential articles for review. Results from each keyword search strategy were then qualitatively reviewed based on the following selection criteria: relevance of the article to the purpose of research, articles must be empirical studies or meta-analysis of empirical research cases, and quality of journals. In the end, 24 articles passed the selection criteria, which were then subjected to a thorough qualitative thematic analysis. Scientometric analyses were conducted, particularly the co-occurrence analysis for key terms used and the co-citation analysis for key authors that were cited in the articles.

Results:

This systematic review of empirical innovation studies on rural agriculture and climate change reinforced a paradigmatic view of farming systems research approaches rather than a trajectory view that sees agricultural innovation research as a time sequence of progressive evolution of ideas and practices (cf. Possas et al., 1996). Evidence from empirical cases showed that linear diffusion studies are being conducted alongside explicitly agricultural innovation studies and other interdisciplinary ('hybrid') studies on agricultural innovations. Complex systems thinking and sustainability science have also opened up spaces for different paradigms to co-exist. Yet, in spite of evidences that climate change and other key drivers of global change are complicating the problems of agri-food systems in ways that could not be resolved by linear innovation models, simple systems approaches to agricultural innovations still persist (Renkow and Byerlee, 2010), and they are currently being justified in settings where government service delivery is weak, where democratic institutions are under insidious threat, while authoritarian populism is on the rise (Scoones et al., 2018).

The scientometric analysis also illustrated the significant influence of science-policy studies, the Dutch School of AIS, and more broadly, complex systems thinking on innovation research in agriculture and climate change. Klerkx et al.'s (2010) 'Adaptive management in AIS: the interactions between innovation networks and their environment' is the most cited reference, and it is also the most central actor within the social network, linking all the clusters together. Complex systems thinking began to influence innovation research in agriculture and climate change only in the last 10 years or so, and it is expected that this trend will continue in the years to come. But are these agricultural innovation research on track in producing the knowledge that is needed to solve the most pressing issues affecting smallholder farmers in the most vulnerable areas of the world? Only certain concepts from complex systems thinking are being applied in the articles that were reviewed. And even though complex systems thinking is gaining ground in innovation research in agriculture and climate change, 13 out of 24 are focused on incremental improvements at the farm-level. Nine articles went beyond local optimization and scrutinized how some features of the agricultural system are being reorganized to create new farming systems or address the systemic causes of farmers' vulnerabilities and marginalization, and only two articles are seriously concerned about deep systemic transitions in agro-ecological systems.

Moreover, the articles that were reviewed in this study are silent about power and politics dimensions of agricultural innovations. Majority did not question who wins and who loses when an innovation system privileges one pathway over another. In fact, not a single research

took an explicitly normative stance in interrogating how agricultural innovations can be mobilized to achieve human wellbeing and ecological integrity while enhancing social justice (cf. Leach et al., 2010).

Conclusions:

As the need for radical and transformative change in agriculture becomes increasingly urgent, innovation studies in agriculture and climate change have to explicitly ask what forms of innovations are equipped to address poverty and inequalities in vulnerable rural areas of the world. Future innovation research must also move from imposing concepts of complex systems theory over lived realities of people in agro-ecological systems to a more grounded attempt to understand how agricultural actors adapt to different types of change, and ways to promote and protect parallel innovation pathways that cater to the poorest and marginalized farming communities, alongside more established pathways. This kind of research may help enrich existing knowledge and conceptual frameworks on agricultural innovation systems research with greater value and utility, especially for the agricultural sector in the global south.

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Abstract 68

CORPORATE EXPLOITATION OF TERRITORIES OF KNOWLEDGE - A CASE STUDY ON PHARMACEUTICALS AND CHEMICAL SECTORS

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Production of S&T knowledge is of paramount importance for the firms who rely on technical innovation for sustaining the ever shortening cycles of global competition. In R&D intensive sectors, corporate technological innovation relies on the exploration and further exploitation of new knowledge.

By operating more and more R&D facilities in multiple geographic regions, MNEs utilize simultaneously several sources for knowledge production. Such a diversity of sourcing confers advantages to MNEs as they can optimise, adapt or complement knowledge production according to their needs (Cassiman, 2006). Adequate integrative capacities are necessary in the firm to absorb and further build up on the external knowledge. However, a widespread outsourcing can become quite challenging and risky because of the organisational complexity it can generate (Meyer et al., 2011). To overcome this risk, firms complement R&D outsourcing with collaborative R&D. Co-creation of knowledge is easier for the firm to absorb and to rely on for further internal developments. Moreover, firms engaged in R&D collaborations are more open to external knowledge (Laursen and Salter, 2006).

Large multinationals are embedded in ecosystems that support and sustain their activity (Gassler and Nones, 2008). These systems are connected but the activity is concentrated in certain locations. Cincera and Ravet (Cincera, 2011) give evidences that the geographic diversification of R&D centres in the EU large firms benefits their R&D productivity and show that the regions where the subsidiaries are located matter. They make the assumptions that this benefit results from the strategic locations of the subsidiaries whose aim is “to make use of the knowledge and technological resources in centres of scientific excellence located worldwide”. The importance of the foreign subsidiaries in the firm’s knowledge production has been described by Kuemmerle (‘Home Base Augmenting’) and Cantwell (‘Competence creating’) (Kuemmerle, 1997); (Cantwell and Mudambi, 2005). The foreign firm’s R&D facilities use local competences and tap into the knowledge and technological resources in centres of scientific excellence located worldwide to produce new knowledge and technologies that can then be shared in the different entities of the firms. Optimisation strategies to locate R&D activities depend on many factors. Besides, the evaluation of the technological strengths of the countries/regions/cities with respect to those of the company, local institutional factors (R&D public support, IPR rules, quality of technological infrastructures), the costs and the possibility to access qualified human resources also matter (Subramaniam and Hewett, 2004). Nowadays, most empirical works study the creation of new knowledge at the local levels (regions, clusters, cities) (Boschma, et al. , 2014 ; Rigby, 2015).

Our research deals with the management of knowledge production in the largest European firms in the sectors of Chemicals and Pharmaceuticals-biotechnology. Combining data from

different resources available in the RISIS project, it provides empirical evidences on the modes of the exploration (using scientific publications) and exploitation (using patents) of new knowledge in the large and R&D intensive European firms in the sectors of Chemicals and Pharmaceuticals-biotechnology.

It focuses on the respective contribution of internal and external collaborative production of knowledge and on the geographical locations of the corporate R&D production. Following our previous work showing how these large firms are internationalised regarding the R&D production, taping both in knowledge from Europe and from the US, benefiting both from their worldwide spread internal skills and from external local networks (Laurens et al, STI2017), this paper aims at a finer description of the mode and location of knowledge production, using both the geocoding of geographic information and the recognition of institutions in our database. In particular, it aims at studying at the scale of metropolitan areas in which zones is the exploration of knowledge concentrated and in which zones is the exploitation of knowledge produced.

Activities approaches and results:

To deal with the management of knowledge production, the paper uses the scientific publications produced by the firms as a marker of the exploration of their knowledge and relies on the patents applied for by the firms as a marker of the exploitation of their knowledge. It exploits a database that identifies the priority patent applications and the scientific publications produced by a set of 115 large European industrial firms from the industrial sectors of Chemicals (36 firms) and Pharmaceuticals-Biotechnology (Pharma-biotech in the following) (79 firms) located in five European countries: France, Germany, the United Kingdom, the Netherlands and Switzerland. The list of the firms was established using the 2009 edition of the IPTS "Industrial R&D Investment Scoreboard" that provides the names of the largest R&D corporate investors worldwide.

The database that includes both the patents (CIB database) and the scientific publications (Leiden publication database) produced by the firms (using a consolidated perimeter including subsidiaries in which the parent company had more than 50.01% of shares). Legal applicants and signing institutions are classified according to their institutional affiliations: entity belonging to a large firm, other firm, entity from the public research sector (university, PRO...). Moreover, patent applicants and inventors addresses as well a publication signing institutions were geocoded

The final database contains 87 965 scientific publications produced between 2001 and 2010 (18 733 publications of the firms from the Chemicals sector and 69 232 publications of the firms from the Pharma-biotech). The patent dataset includes 35 925 transnational priority patents filed between 2001 and 2008 (22 750 applied by firms from the Chemicals sector, 13 175 by firms from the Pharma-biotech sector).

- 1) Global picture of the knowledge production

Our results have given empirical evidences to picture the modes of knowledge exploration by the European large firms in the industrial sectors of Chemicals and Pharma-biotech. The two sectors have in common a number of characteristics:

- They perform research activities on a collaborative mode with universities but internalize technological developments;
- The research activities are more internationalized than the technological ones and the R&D performed outside the firm's home country always contributes significantly to the exploration of knowledge;
- R&D carried out in the United States matters as much as the R&D performed in foreign European countries and the US top universities are key research partners;
- For research, the firms gather skills worldwide and develop all types of collaborations: national internal and external collaborations either in the firm home country or in other countries where the firms has installed R&D facilities. They also develop collaboration with foreign external partners either from their R&D centres located in the home country or set abroad.
- When carried out internally, R&D is performed in the home country but also in foreign countries. Conversely, the exploration of new technologies is most likely carried out in the home country.

2) Geographical analysis of knowledge production

In order to further detail the location of knowledge production, we carry out a three-step geographical analysis.

In the first place we analyze comparatively the locations distributed all over the world (with a grain of analysis of metropolitan areas) of, on the one hand, the internal corporate research facilities and, on the other hand, the external S&T institutions mobilized in the production of corporate knowledge. The results indicate striking differences in the modes of production of corporate science (assessed through the authoring of academic publications) and of corporate technology (assessed through the application for patents of invention). Whereas the former reveal extended networks of academic collaborations spread across various continents, the latter show that the production of corporate technology is hardly collaborative and barely internationalised - the historical or domestic space of a firm, be it a multinational company, remains the bulk source of inventions.

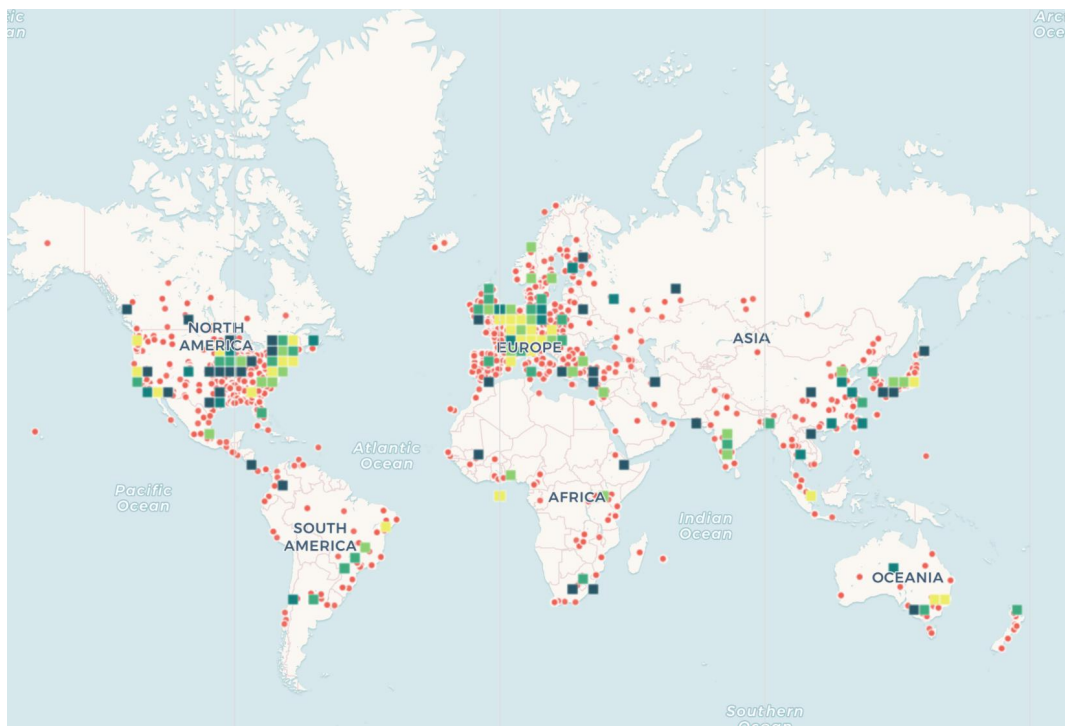
Secondly, maintaining the distinction above-introduced between production of scientific (i.e academic publications) and technological knowledge (patent of invention), we study the differential use the corporations make of knowledge-producing territories. Some areas (mostly with a metropolitan status) are exploited in a privileged way for co-producing either science or technology, some are used for producing both science and technology.

Finally, this paper characterize the attractiveness of the top knowledge producing metropolitan areas according to the local public research potential - assessed first through universities appearing in RISIS OrgReg – in terms of PhD “factories” and academic production. An example of patterns for the exploration and exploitation of knowledge production is shown below for a swiss pharmaceutical company (Novartis). It contrasts the widespread worldwide distribution of the exploration of knowledge (Figure 1) and the geographically concentrated exploitation of knowledge (Figures 2 and 3). Moreover, it shows that the exploration of knowledge is carried out in collaborations with external institutions located near worldwide Novartis R&D centers but also with external institutions located at distance. The picture is rather different for the exploitation of knowledge. When co-application of patent with an

external institution takes place, it involves an external institution most often located close to Novartis facility applicants. Concerning the production of inventions, the diversity of the locations of the inventors is much lower than what is observed for production of basic research.

It is the aim of this research to compare on a larger set of firms the distribution of such information on geography for science and technology production using a geographical delimitation using metropolitan area delineation.

Figure 1: Mapping of the addresses of signing institutions in Novartis scientific publications



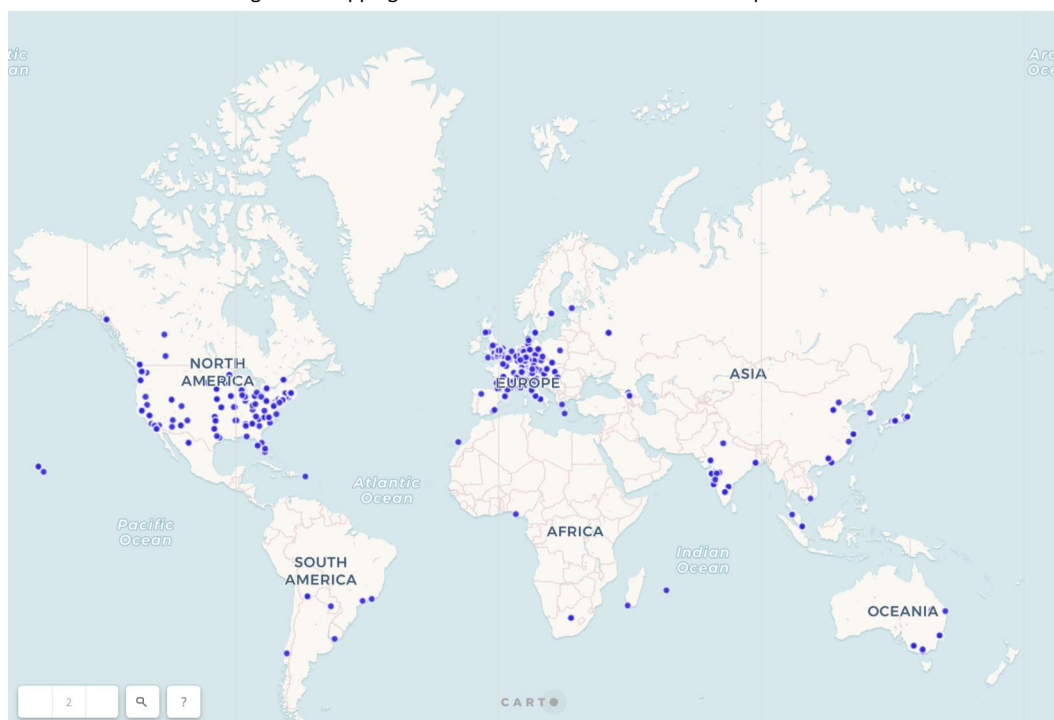
(red circles: external institutions, square: institutions belonging to the Novartis group; color from dark green to yellow: increasing number of applicants)

Figure 2: Mapping of the addresses of applicants in Novartis patents



(red circles: external institutions, square: institutions belonging to the Novartis group; color from dark green to yellow: increasing number of applicants)

Figure 3: Mapping of the location of inventors in Novartis patents



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Abstract 76

FROM BIOCLUSTERS TO THE BIOECONOMY: LESSONS FROM THE SUSTAINABILITY TRANSITION OF THE PULP AND PAPER CLUSTER IN THE BASQUE COUNTRY

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The bioeconomy:

Given current levels of ecosystem (over)exploitation and the impending threat of climate change disrupting the availability of essential resources, human society requires a paradigmatic shift in the way vital societal functions are fulfilled. Moving towards a bioeconomy is increasingly seen as a potential solution.

The ultimate objective of the bioeconomy is to replace incumbent non-biodegradable products and processes dependent on non-renewable resources with ones that are re-usable, biodegradable, and are fuelled by renewable biological resources (Martinez De Arano et al., 2018). Consequently, this new economic paradigm entails activities that translate the dormant value in renewable biological sources, processes and waste streams into eco-friendly value added products in sectors such as energy, paper and packaging, textiles, chemical and polymers etc. (Brunori, 2013; Imperial College London et al., 2015).

Achieving the bioeconomy calls not just for the conceptualization of future socio-techno-economic developments but also for conscious attempts to shape these developments, to provide them with the necessary momentum, and to institutionalize them (Hilgartner, 2007; Birch et al., 2010). This process will require changes up and down the value chain and thereby, the collaboration of multiple actors from society, government, science, agriculture and industry (Hermans et al., 2015). This means bioclusters will play a pivotal role in the quest to attain the bioeconomy.

From bioclusters to the bioeconomy:

Our project explores how bioclusters can pave pathways for the sustainability transition to the bioeconomy. Following Porter (1999), we define bioclusters as geographic agglomerations (of interconnected, mutually dependent firms and institutions) operating in one or multiple bioeconomy sectors. Bioclusters are crucial to the transition to the bioeconomy because:

1. Cluster initiatives have become an important tool to establish, promote and strengthen economic collaborations, learning, and innovation required to achieve regional sustainability goals. (Carvalho et al., 2012; McCauley and Stephens, 2012; Lindqvist et al. 2013). Towards this end, bioclusters localise actors along the entire value chain: producers of biological sources; actors that convert biological sources into value-added products; and actors that recycle waste and by-products into valuable commodities (Brunori, 2013).
2. Bioclusters link diverse actors such as firms, (regional, national, supranational) governments, universities, research centers etc. The clustering of different

sustainability-minded actors in a biocluster are supposed to result in positive externalities that increase the possibility of, and act as a support structure for, the creation of biobased innovations and industries crucial for the transition to the zero-carbon bioeconomy.

Research objective:

Since our study concerns an investigation of the role of bioclusters in the transition to the bioeconomy, it addresses theoretical shortcomings in two streams that have developed in isolation, but occasionally overlap: sustainability transition studies (STS) and evolutionary economic geography (EEG). STS studies socio-technical transitions in sectoral regimes: long-term processes that require a combination of technical, organizational, economic, institutional, socio-cultural and political changes (Van den Bergh et al., 2011). EEG is concerned with understanding the functioning of clusters and the reasons for their existence, by analyzing their evolution over time (Ter Wal & Boschma, 2011).

Both fields share the shortcomings of a lack of emphasis on the role of the regional context and that of actor agency. STS does not have a great tradition of investigating how the specificities of places, and the decisions and actions of individual actors influence transition processes. On the other hand, while EEG can explain how industrial structures shape a cluster's trajectory, it struggles to explain how regional structures and actor agency do.

Consequently, the objective of this study is to advance understanding of the role of regional structures, industrial structures, and actor agency in the evolution of bio-cluster trajectories. In moving towards this objective, we answer three research questions in this paper:

- 1) How did regional structures influence the sustainability transition of the pulp and paper cluster in the Basque country?
- 2) How did industrial structures influence the sustainability transition of the pulp and paper cluster in the Basque country?
- 3) What was the role of actor agency in the development the sustainability transition of the pulp and paper cluster in the Basque country?

A framework to study biocluster evolution:

To answer the research questions, we developed a novel framework to analyse cluster evolution, based on the conceptualisation of clusters as *complex adaptive systems* (Martin & Sunley, 2011). With its emphasis on the role of not just industrial structures but regional structures and actor agency as well, our framework overcomes the shortcomings of extant frameworks in STS and EEG.

Our framework is founded on the notion of cluster members being part of three different, but overlapping, complex adaptive systems: the cluster, the *regional innovation system* (RIS) (Asheim & Coenen, 2006) and the *sectoral system of innovation* (SSI) (Malerba, 2002) (see figure 1).

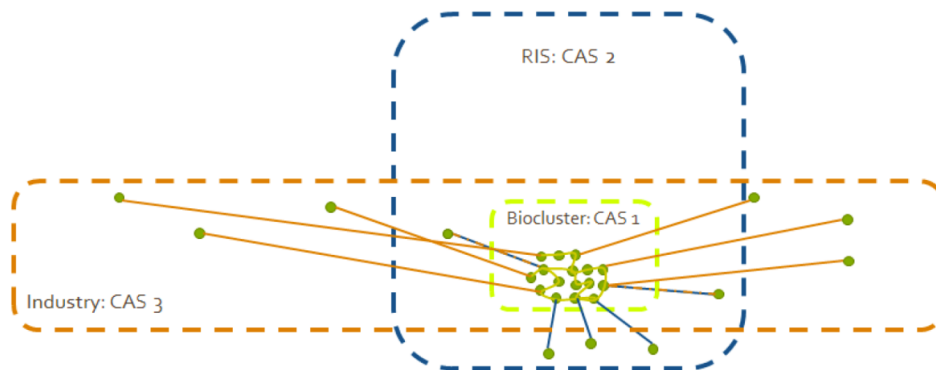


Figure 1: A cluster is embedded within two complex adaptive systems, the regional innovation system and the sectoral system of innovation. This means the cluster actors are members of three overlapping CAS: the cluster, the region and the industry.

In our perspective, the evolution of the biocluster trajectory is the variation in macro-level properties of the cluster CAS, such as network size, the industrial mix of the cluster etc. The framework explains this variation through three interacting processes (see figure 2)

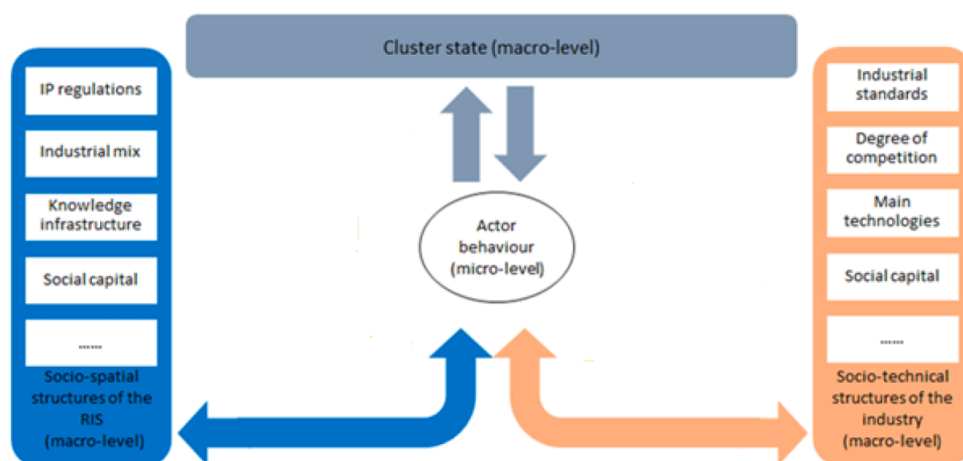


Figure 2: The macro-level properties of the cluster emerge from the dynamics of actor behaviour. These emergent properties of the cluster guide/restrict actor agency within the cluster. Actor behaviour within the cluster (and thus, the cluster trajectory) is shaped by the socio-spatial structures of the RIS and by the socio-technical structure of the SSI. On the other hand, actors can use agency to shape these structures.

1. The emergence of the (macro-level) properties of the cluster CAS from the dynamics of actor agency (at the micro-level). Concomitantly, these emergent properties guide/restrict actor agency within the cluster.
2. The interplay of actor agency (from the micro-level) with regional socio-spatial structures (at the macro-level). Actor behaviour in the cluster will have to (partly) adhere to the socio-spatial structures. On the other hand, as members of the RIS, cluster actors can modify the regional structures using their agency.

3. The interplay of actor agency (from the micro-level) with industrial socio-technical structures (at the macro-level). Actor behaviour in the cluster will have to (partly) adhere to the socio-technical structures. On the other hand, as members of the SSI, cluster actors can modify the regional structures using their agency.

External phenomena such as a spike in oil prices can cause the RIS or SSI structures to change. These macro-level changes will, then, lead to changes in actor behaviour at the micro-level. These changes in actor behaviour will cause a variation in the macro-properties of the cluster. While some actors in the cluster (and beyond) will try to prevent changes in the cluster state, others will try to precipitate it. What results is a game of power where opposing groups of actors employ combinations of the three types of agency required to shape cluster trajectories: technological entrepreneurship, institutional entrepreneurship and place leadership (Giuliani, 2011; Hermans et al., 2013; Grillitsch & Sotarauta, 2018). Depending on which group has the superior levels of agency, the cluster trajectory may remain the same, undergo minor changes, or change completely.

Research methodology:

For the analysis of the evolution of a particular biocluster, we use the methodology of event-history analysis (EVA). EVA is “based on the process approach, a world view that conceives of change processes as sequences of events” (Suurs, 2009: 29). These sequences are then combined to derive a meaningful narrative. Through a chronological organization of these events, the EVA will reveal how a biocluster’s trajectory developed through the interactions of several events and processes.

Case studies:

In our project, we will be analysing two cases: the paper province cluster in the Värmland region of Sweden and the *cluster del papel* of the Basque country in Spain. These cases were chosen because they share certain similarities: they operate in the same industry, the cluster organisations were established just one year apart, and they are located in regions that have consistently been classed into the same innovation performance group by the EU’s regional innovation scoreboard (Innovation followers between 2004 and 2014, and strong innovators in 2017) (Hollanders & Es-Sadki, 2014, 2017). However, the similarities end there as, interestingly, there is a stark difference between the trajectories of the clusters. While the paper province has gone from strength to strength, to the point where it received the gold label for excellence in cluster management from the EU (Paper province, 2017), the cluster del papel has, as we will describe in the next section, had a chequered history. We envision a comparison of the evolution of these clusters’ trajectories through the prism of our framework, to arrive at insights that will benefit the operation and management of bioclusters and of (unrelated) diversification vital to achieving the bioeconomy.

Between December 2018 and February 2019, we conducted 11 semi-structured interviews (involving present and past cluster management, cluster firms, governmental organisations, and a climate change consultancy) and collected voluminous amounts of secondary data on the cluster in Spain. Furthermore, we will conduct more interviews in May 2019. Therefore, at the Eu-SPRI 2019 conference, we will be presenting an event-history analysis of the

evolution of the trajectory of the *cluster del papel* between 1970 and 2018, using our framework.

First results: the evolution of the Basque pulp and paper cluster

The cluster del papel was formed in 1998 and as of 2018, is made up of 33 pulp, paper, and paper-machinery companies situated in Spanish Basque country (Pais Vasco).

Our research has revealed that in spite of Pais Vasco RIS being one of the first in the world to embrace Porter's idea of cluster-based renewal, with policy of the past twenty-seven years emphasizing support for cluster organisations and for the facilitation of collaboration between cluster members, development of quality technological infrastructure, promotion of internal and external R&D, and the formation of competent human capital (Valdaliso et al., 2016; Orkestra, 2017), the pulp and paper industry in the region has been in decline since 1970 (Elola et al., 2012; Valdaliso et al., 2016). In the restructuration of the past five decades, the number of pulp and paper firms has gone from 33 to 10 (see figure 3).

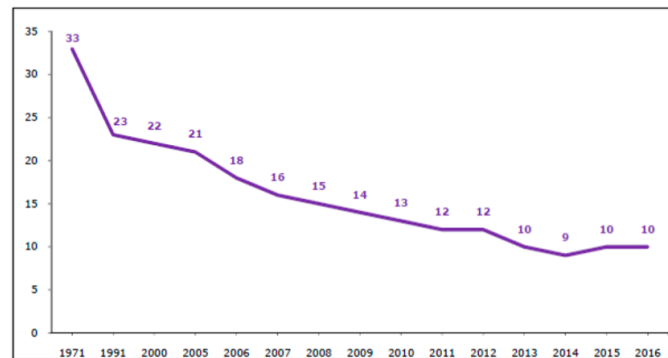


Figure 3: The paper and pulp industry in Pais Vasco has been in decline since the Nineteen seventies (Cluster del papel, 2017a:15).

Regarding the macro-level properties of the cluster, we found that in spite of the difficulties it has faced with cluster strength, the priority for sustainability has increased over time and most relevantly for this conference, the cluster has been transitioning from an unsustainable “basin of attraction” to one that represents higher energy efficiency, lower pollutant emissions, better recycling/reuse of waste streams, and lower water and electricity usage, since the turn of the century. In the period between 2005 and 2008, the cluster reduced its carbon emissions per product by 14% (Vasco Press, 2010).

Between 2010 and 2017, the cluster has moved even further towards sustainable operation (see figure 4).

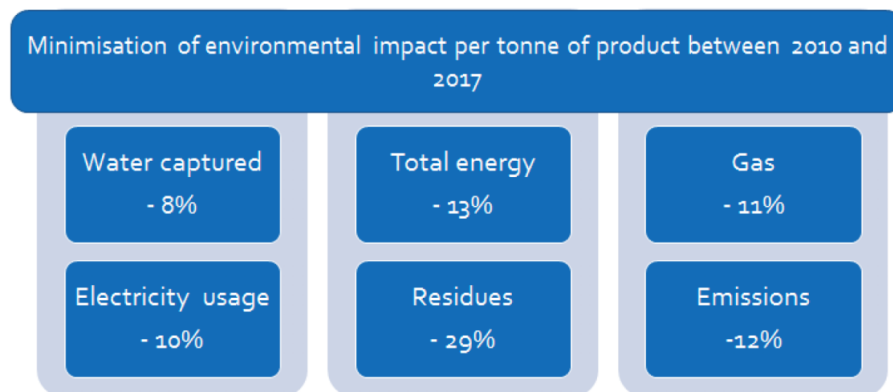


Figure 4: Cluster-level data between 2010 and 2017 shows how the cluster del papel reduced water, gas and electricity usage, greenhouse gas emissions, and reduced the amount of residues released into rivers. Figure adapted from (Cluster del papel, 2017b:19).

Crucially, this sustainability transition has involved semi-successful attempts from the biocluster to diversify into unrelated bioeconomy sectors such as the production of bio-coal and bio-based industrial absorbents, as well as an instance of technological entrepreneurship that caused first-in-the-world biobased products.

Our contribution to the conference will demonstrate how external phenomena (eg. the recession of 2008), changes in the regional structures (eg. revocation of subsidies for cogeneration plants in 2013), industrial structures (eg. the commoditisation of paper from the 1980s), and actor agency (eg. the firm of Coinpasa acting as a place leader to form the cluster after the government had failed twice) interacted over time to engender the trajectory of this biocluster. We will especially emphasize the interactions that caused (or impeded/prevented) the sustainability transition and biobased diversification of the cluster del papel.

First conclusions:

The case of the Basque paper cluster is one that makes evident the opportunities and restrictions (with more of the latter in this case) afforded by the nested nature of complex adaptive systems or in policy science terms, of existing in a system of multilevel governance. While the cluster CAS is nested within the regional CAS of Pais Vasco, Pais Vasco is nested with the CAS of Spain, and Spain in the CAS of the European Union.

While there is sufficient evidence on how changes in the structures at the EU or Spanish level (especially changes in environmental policy), and external phenomena at these levels (eg. the liberalisation of the Spanish economy), trickled down to the regional level, affecting the behaviour of cluster firms and thereby, the fortunes of the cluster del papel, we found very little evidence of cluster firms being able to shape or influence structures at any of the levels beyond that of the cluster. This is owing to the low levels of agency possessed by the cluster firms.

The lack of sufficient actor agency, especially of institutional entrepreneurship and place leadership, has prevented the cluster from being able to dictate its fortunes and made it subservient to the vagaries of regional and industrial structures, which, unfortunately, have mostly had a negative effect on the cluster.

The paucity in agency can be traced to the dynamics of regional competition policy (and the resultant behaviour of the paper and pulp firms):

- 1) Until the sixties the Spanish market, and therefore, the Basque market was a closed one. Protectionist policies at the macro-level resulted in an attitude of complacency, and low priority for innovation, entrepreneurship and competition at the micro-level. Protected by tariffs on imports, firms became used to producing low and medium quality press, print, and writing paper. Firms competed on the basis of cost, the availability of labour, depleting technological assets, and the agglomeration economies around the regions of Tolosa and Biscay.

However, exclusive production for internal markets meant that on average, Basque firms were smaller than those in other regions. As the market opened up in the seventies, the firms found that they could not compete on the basis of cost, with their narrow range of low to medium quality products, and obsolete machines, in an industry that was increasingly becoming more and more consolidated and internationalised.

- 2) Another legacy of protectionist policies may be the low-levels of mergers and collaboration for innovation. Basque paper and pulp firms in the 20th century and early 21st century were mostly family owned. Possibly owing to hopes of a stable internal demand, and problems between families, these firms refused to collaborate and share knowledge and resources. Even after liberalisation, these firms carried on with this attitude. Consequently, the government and other stakeholders had to go through two abortive attempts at forming a cluster, before it was finally formed in 1998 (and even then, some firms stayed away). Attempts at causing firms to merge, in order to achieve economies, were abortive, as the merged firms closed down soon.

The result of these events and processes were several firm closures well into the second decade of the 21st century. The firms that survived were ones that specialised in niche markets, invested in new machinery, and became more international. Some were bought out by multinationals.

The survivors of today are industry followers caught between a rock and a hard place, where they are too small-scale to have an impact on the industrial structures and are too large to qualify for regional innovation and R&D support. This has had two denouements as far as the biocluster's trajectory is concerned:

- 1) The small size of the firms has meant they have very little lobbying power to influence (environmental) policies at the regional, Spanish and European levels. For instance, the Basque cluster firms lobbied unsuccessfully against Law 1/2012 and Law 9/2013 of the Spanish government. These laws abolished the premiums that were being paid to the Basque firms for green electricity generated through gas or biomass powered cogeneration and stopped financial support for new plants. The loss of premiums negatively affected the competitiveness of the firms, stalled investments, and in one case, caused revenue losses of up to 25%. Another example is that of the *Ley de agua* of 2006 of the Basque government (that was derived from directive 2000/60/EC of the EU). This law was put further financial

pressure on the cluster firms, some of which would close down within the next five years.

- 2) The sustainability transition of the cluster has been mostly through incremental changes in process, and end-of-pipe technologies. Because of their relatively limited financial assets, low-levels of financial support from the regional government and EU (to the extent of between 3 to 10 percent of the project cost), and because they belong to a conservative industry with significant sunk-costs, Basque firms have very rarely opted for the more expensive clean-production technologies route to sustainability.

On the other hand, while cluster firms have engaged in sustainable technological entrepreneurship in multiple instances, these efforts have often received little or no institutional support (financial or regulatory). Success has been limited by firms facing difficulties in effecting changes in necessary regulations and product classifications. For instance, in 2014, a combination of a paper and a paper-machinery firm were successful in diversifying into a related bioeconomy sector. They introduced to the market, a completely biobased, completely dissolvable hygienic wipe product. However, since in Pais Vasco, Spain and the EU, there is no clear definitions and classifications for this product type, the firm is mostly exporting the product.

Our main conclusion at this point, from the case of the cluster del papel, is that actors at the regional level are best suited to develop transition policies because they have a more robust grasp of the place-specific factors, and they are better capable of fine-tuning policy instruments. Policies that are derived from the paradigms of the national and supra-national level, while benefiting certain regions, harm other regions. Especially in regions where the actors do not have sufficient agency to influence the paradigms at the higher levels. For instance, when the 2000/60/EC was translated into *Ley de agua* of 2006, it was criticized for not acknowledging that not all recommended best available techniques (BATs) were applicable to all factories in Pais Vasco and that not all factories in the region could afford the BATs.

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Abstract 134

FROM KNOWLEDGE BASED CATCHING-UP TO LEADING THE DEVELOPMENT OF NEW SOCIO-TECHNICAL SYSTEMS: CHINA'S CHANGING POSITIONS IN THE GLOBAL SOLAR PV INDUSTRY

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Aim of the proposal:

Recent research in catching-up and leapfrogging literature has been at pains to explain how latecomer countries, besides a few exceptional cases, could move out of the middle-income trap. We aim to propose a conceptual approach - which builds on recent insights from economic geography and socio-technical transition studies - to emphasize the need for a broader view on industry formation beyond knowledge development. This includes market formation and the development of new institutional context conditions, which enables the emergence of entirely new socio-technical systems.

Background:

Studies concerning industrial catching-up in developing countries have very much emphasized the role of knowledge base or technological capabilities as the key for latecomer countries to leapfrog global incumbents in knowledge intensive industries as a means to generate higher income jobs. In particular, the semiconductor industry was a central focus given the industrial widespread effect and the few exceptional success stories of South Korea, Taiwan, and to a lesser extent, Singapore. The underlying factor of these success stories has been closely associated with the interplay between supportive national institutions and firm-level strategies for driving the accumulation of knowledge or technological capabilities in the latecomers (Lall, 1992; Kim, 1997; Lee and Lim, 2001; Mathews and Cho, 2007; Figueiredo, 2008). A number of other developing countries such as China and Malaysia have subsequently envisaged to follow the successful footsteps of these few so-called Asian tigers in the last two decades. However, since the success of the Asian tigers in the early 2000s, realities have shown that the success stories are not easily replicated and that not every latecomer will be able to leapfrog global incumbents in high-tech industries. Latecomers like China and Malaysia were not able to lead in the global semiconductor industry despite years of investments and so remained trapped in middle-income economy status.

In a similar vein, economic geography studies focusing on success conditions of regions to diversify into new technologies and industries suggest that knowledge relatedness is a primary precondition for success (Boschma, 2016). It is argued in this literature that being a leader in related knowledge fields predicts with a high accuracy whether a region will be able to lead industry development in a new technological field. Studies concerning catching-up often adopt this view and focus on how latecomers can leverage lacking indigenous knowledge (or technological capabilities) through linkages that they establish with foreign multinational corporations (MNCs). This translates into finding a stable position in the respective global value chains (GVCs) and over time trying to move up to higher added value positions. National governments can support these endeavors by creating conducive

conditions that drive agglomeration and spillover effects through locally established industries (Vind 2008; Pietrobelli and Rabelotti, 2009; Fu et al., 2011). Creating related knowledge stocks is therefore considered as being the key concern in the learning and upgrading processes of latecomers. However, the persistence of the middle-income trap indicates that this knowledge-focused strategy may not be sufficient for all countries to gain stronger positions in GVCs, which allow for higher wealth generation.

In order to identify a broader set of potential strategies, we have to investigate longer-term trends in the global industrial order that could provide new windows of opportunity. The emergence of a new techno-economic paradigm (TEP) that combines Information Communication Technology (ICT) with green energy technologies (Perez, 2013; Mathews, 2013) confronts latecomers today with an unprecedented challenge: simultaneously aiming at technological or industrial catching-up while embarking on sustainability transitions of core sectors. Whether middle-income countries would be able to identify new alternatives in the emerging green industrial era and be able to lead GVCs is a topic that is increasingly gaining scholarly research and policy attention. One of the most pressing issues concerning middle-income countries is whether these latecomers would be able to endogenize path creation or diversification processes in the newly emerging cleantech sectors by building on their pre-existing technological capabilities accumulated from previous industrializations (Yap and Truffer, under review). Existing catch-up studies are therefore in need of finding alternative mechanisms to be proactive in creating or diversifying industrial paths under the conditions of a new green TEP.

Very recent developments in economic geography have started to explore factors beyond the related knowledge base and which explain cases of unrelated diversifications. One salient approach has been proposed by (Boschma et al., 2017), which argue that unrelated diversifications happens when countries or regions shift their industrial policy focus away from developing new technologies for global markets towards embarking on the establishment of entirely new socio-technical systems (Markard et al. 2012). This requires moving the emphasis beyond knowledge or technologies and considering processes like market formation, legitimation, resource mobilization, guidance of search, which complement technological innovation and ultimately lead to socio-technical transitions in the sectors considered (Binz et al. 2016).

We want to contribute to this debate by analyzing an emblematic industrial development that is strongly associated with a potential shift towards a green TEP, the emergence of a global solar photovoltaic (PV) industry. In particular, we inquire whether and how far related variety of the semiconductor industry predicts success in the global cleantech sector of solar PV, as both industries share key elements in their knowledge base. Amid the increasing prominence of the global sustainability debate, all the widely cited success countries have recently diversified into the solar PV industry: firstly, South Korea and Taiwan and later China and Malaysia. Based on existing concepts of knowledge relatedness, one would expect that South Korea and Taiwan would also sustain leaderships in the global solar PV industry. Paradoxically, the reality says otherwise as the production output of China in the PV industry grew exponentially in the last decade and the country had become the largest producer of solar PV in the world. China leads not just in terms world production but also world deployment of PV technologies. More interestingly, China has become increasingly innovative in the realm of embedding the technology into the systems. This paper therefore aims to examine this

paradox by revisiting the role of related and unrelated diversification in latecomer industrial catching-up. We first analyze how relatedness between semiconductor and solar PV helped kick-starting the industrial development process. More importantly, in the subsequent steps, we show that the success of Chinese new path creation in the solar PV industry depended on the ability to manage a broader set of deployment and institutional embedding processes which are decisive to establish a global leadership role. This particularly involves a shift towards unrelated diversification strategies through the development of entire socio-technical systems.

Methodology and empirical base:

The analysis of this paper draws on 19 semi-structured interviews with key informants of different stakeholder groups in China solar PV industry, including academia who are also active policy experts; intermediaries (associations, alliances, consultancies and expert committee members); domestic PV manufacturers, domestic and foreign technological companies; and key part suppliers. The interviews were conducted in April 2018 in the cities of Beijing, Shanghai, Anhui, Zhejiang, Jiangsu and Xian. The interviewees for this study were selected on the basis that they are leaders of the PV production value chain that they are particularly active in, the ones that are highly innovative in the system integration realm (installations and maintenance, ICTs, energy efficiency and storage, servicing, etc.), representative industry association and consultants which carry a rather neutral stand, and a typical failed PV company which was formerly one of the indigenous pioneers in the 1990s. Priority is given to companies that proactively seek new business models and entrepreneurial experimentations. All the interviews in this study were thoroughly transcribed and checked. We will analyse the transcriptions qualitatively using the MaxQDA software. The relevant data were extracted and processed based on categories derived from the coded concepts (Gläser and Laudel, 2013). During the process, the theories were revised in order to match with the data (Yin, 1994; 2011; 2014). The findings were further triangulated through content analysis of government and company reports, as well as secondary data sources.

The paper also corroborates the interview findings with a patent analysis. We use all patent applications filed between 1986 and 2014 from European Patent Office Worldwide Patent Statistics Database PATSTAT (EPO, 2017 spring version). In order to remedy the issue of multiple equivalent patents for one invention in multiple offices, we use the DOCDB patent family definition (Martinez, 2011). The year of the DOCDB patent family is the application year of the first patent in the family. We use backward citations of patents to measure the knowledge origins. We use information on inventor location and technology class to place a cited patent in different categories along geographical and technological dimensions. First, we label a cited patent of inventors in the same country as inventors of the citing patent as domestic knowledge, otherwise foreign knowledge. Second, we label a cited patent as solar knowledge when the cited patent is tagged by Y02E10/5 class. We treat a cited patent as semiconductor knowledge when the cited patent is tagged by IPC 4-digit class H01L and not labelled as solar knowledge.

Results:

The paper distinguishes the historical development of the Chinese PV industry into three trajectories based on three time periods. During the period of Formation, boom and crisis (late 1990s – late 2000s), Chinese PV industry strategized to insert themselves in existing

GVCs. Subsequently, during the period of Exponential growth (late 2000s – around 2013), Chinese PV companies successfully caught up and found strong positioning in GVCs. These two development phases of Chinese PV industry were built on China's related capabilities in manufacturing in general and in the semiconductor industry in particular. China PV manufacturers upgraded their activities from assembling modules and caught up in the GVC by vertically integrating to upper stream activities. However, a typical question remains whether a catch-up model relied on these knowledge relatedness is sufficient for China to move to the frontier and eventually achieve industrial and environmental leapfrogging. We therefore in the following show how China in the next phase (after early 2010s) began embarking on strategies broader than knowledge to build new socio-technical systems for PV technologies.

Since the mid-2010s, the Chinese PV industry entered into a new restructuration phase, of which the industry faced increasing consolidation, the GVC positioning of Chinese PV companies shifted, and new business models emerged. These developments overall led to a proposed third trajectory, of which China PV industry embarked on the Development of new socio-technical systems of production and consumption. The paper identified four major emerging trends in China PV industry and showed in how far the country has embarked on unrelated diversification strategies and towards building new socio-technical systems in the field of solar PV. Through qualitative content analysis of the interview data, the paper outlined the following trends: (1) rapid and widespread domestic market deployment; (2) dynamics of business restructuration: vertical integrations and strong GVC positioning; (3) moving to the frontier of innovations; and (4) innovations beyond mainstream and production-based value chain.

The Chinese PV industry began transforming its electricity structure through effective market deployment strategies of PV and proactive entrepreneurship in anchoring international resources (via foreign acquisitions of technologies), technological experimentations, and combining other knowledge fields (e.g. ICT) for PV system integrations. The industry also increasingly observed high dynamics in business models and vertical restructuration, as well as rapid and progressive technological experimentations at the frontier of PV system integrations. One of the generative contexts were for instance PV systems that are installed in rural areas to help mitigate poverty, across infrastructures such as in buildings, transport systems, roads, and on different physical conditions (e.g. surface water, deserts, mobile usages). These initiatives require many experiments and extensive innovations in realms that are conventionally not addressed in the PV manufacturing industry but broader knowledge fields in order to ensure successful system integration of PV technologies. New technological trajectories against conventional mainstreams are also being introduced in this period of time in the Chinese PV markets to compete for higher efficiencies. Entrepreneurs furthermore introduced new solutions in system integrations for electricity generation based on PV, with Chinese companies leading in the field of high-end installation and application services (i.e. power generation, power, energy storage and efficiency, and infrastructures). China PV industry has therefore moved beyond the focus on the production-based GVC to embark on developing new socio-technical systems, with the ambition to generate radically new trajectories for both industrial and environmental leapfrogging.

To corroborate these interview findings, the paper subsequently reconstructed the development trends through patent indicators. We analyzed in how far the solar PV industry

has profited from related variety in the knowledge base. While solar PV needs to draw on a wide variety of related knowledge fields, semiconductors show strong similarities in terms of the basic technological components like silicon materials, wafer slicing, etc. The global patent analysis also shows that China has definitely caught up in terms of innovation activities by tracing the share of backward linkages to indigenous versus foreign patents among the leading countries. Finally, we see some strong indication that China's innovation activity has strongly moved downstream in the value chain, indicating a stronger orientation towards establishing entire electricity system solutions instead of only producing PV technology components. We see that China has three classes on downstream activities that lead the ranking of its backward linkages to sectors other than semiconductors or photovoltaics. Whereas other countries have a much more upstream oriented profile.

Conclusions:

The Chinese solar PV industry has undergone a few structural changes since the early formation phase in the late 1990s. Existing studies have shown how Chinese entrepreneurship formed the early phase of the industry by turning China into a popular manufacturing base of PV modules for the US and EU markets (Zhang and White, 2016; Binz and Anadon, 2018). The industry grew substantially but came to a major halt following the 2008 financial crisis and anti-dumping policies of the western countries. The Chinese government subsequently introduced the domestic FIT policy in order to salvage the local tumbling industry. Leveraging on the growing domestic market, Chinese manufacturers were catching up quickly by vertically integrating into upper stream activities including activities in the wafer and solar cell processing. In so doing China PV industry found much stronger positions in the GVCs, by having the entire manufacturing VC being carried out in China, driving down the prices and increasing exports of PV modules to other countries in the world. At the same time, Chinese firms invested increasingly in innovation pushing up the national patent stock in solar PV substantially. Chinese government only started to promote indigenous market deployment after the crisis and mainly as a means to buffer the overcapacity, which emerged due to the anti-dumping regulations of the EU and the US. It remained therefore unclear up to that point in industrial history whether China PV industry would be yet another example of the country's strategy to invest into low cost and high-volume manufacturing or whether actually a successful catch-up trajectory would be reachable.

While conventionally national governments favored policies to building up the knowledge base and accumulating technological capabilities, the experience of China PV industry shows that strategies beyond knowledge relatedness is crucial to move to higher potentials of industrial leapfrogging (hence higher economy development) and generating radically new solutions for environmental challenges. The Chinese PV industry has only very recently begun moving towards this direction since the mid 2010s.

The emergence of the green TEP provides ample windows of opportunity for latecomers as the required innovations need new infrastructures, business models and consumption patterns. This broader set of opportunities has to be informed by a broader understanding of what it takes to successfully develop new socio-technical systems. It is therefore crucial to inform existing catching-up studies on how latecomer may endogenize the emerging windows of opportunity. Drawing from the experience of China's PV industry, this paper argues that latecomers should quickly move beyond the conventional strategy of "moving up the GVC" or

upgrading within the structure of production-based value chains. Market deployment strategies are crucial to help latecomers venturing into new and unrelated industry paths. Meanwhile, developing countries that are still reliant on MNCs in channeling technologies into the home countries through FDI policies should consider how they can build up stronger capability bases for achieving both industrial catch-up and sustainability transitions. These two goals might not always represent hard tradeoffs, but might provide a number of synergies for rapidly growing economies (Yap et al. in preparation).

Solar PV however represents a specific type of footloose technology, which enables to shift geographical centres of the industry rather quickly (Binz and Truffer 2017). We still maintain that the processes identified in this paper will only be stronger in the case of other industries, which are more sticky in either its knowledge development characteristics or in the needs for customizing market penetration. A second limitation of the paper is that China represents a very particular context with its huge and rapidly growing market in all sorts of basic infrastructures, its capacity to provide a plethora of experimental contexts, a huge resource base and the high problem pressures. We maintain however that our results are also relevant for other smaller, middle-income trapped countries. We would expect that only betting on improving the indigenous knowledge base might prove to be a risky development strategy. Especially under conditions of a new green TEP, socio-technical systems are likely to undergo fundamental transformations. Being strongly rooted in old GVCs might therefore represent a high liability for the longer-term development. Sustainability transitions has also proven that small countries have been able to outcompete large countries in the development of new industries (as in the famous comparison between Denmark and the US in the early formation of the wind industry (see Garud and Karnoe, 2003)). This paper therefore encourages future studies that analyze industries with different characteristics, which might require different unrelated diversification strategies undertaken by latecomers in addressing the challenges of the emerging green TEP.

C1 PUBLIC FINANCING POLICY

Wednesday 05 June 2019 from 16:30 to 18:00

LIV LANGFELDT, Chair

Abstract 80

PUBLIC FINANCING FOR R&D AND COLLECTIVE SYMBOLIC CLAIMS: DO THEY WORK AND FOR WHOM?

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Aim of the proposal:

Drawing on unique longitudinal data of collaborative R&D project proposals, we study how collective symbolic claims may lead to the acquisition of public funding, what is the combination of claims that work, and who makes such claims.

Background:

Public funding for innovation has long been considered as an accelerator of the innovation process due to its contribution to the resolution of resource limitations faced by businesses. Lack of financial resources is one of the main barriers to innovation (Hewitt-Dundas, 2006) and in the face of an increasing demand for innovations, the acquisition of such resources becomes an imperative for resource seekers and a challenge for resource holders.

Public support to private R&D often comes in the form of direct subsidies traditionally aimed at resolving market and system failures thought to decrease private incentives to invest in innovation (Clarysse et al., 2009). More recently, capability and adoption failures have been converted into rationales for policy intervention (Metcalf and Georgiou 1998, Dodgson et al 2010) and have been incorporated into policy instruments that aim at enabling long term behavioral changes of private organizations with respect to innovation (Gok and Edler, 2012). Despite such efforts, the doubt of whether public financing has an additional substantive effect on the behavior of firms with regards to innovation remains.

While research on innovation policy evaluation has progressed in identifying evidence and types of behavioral additionality during and after the implementation of an innovative project (Buisseret et al., 1995; Falk, 2007; Metcalfe and Georgiou, 1998), it has been less attentive to the extent to which claims or actions of fund receivers are substantive or symbolic. This is an important issue to consider as it raises concerns with regards to the effectiveness of public policy and amplifies the possibility of distorted results. The tension here is that while public policies to stimulate innovation actively seek to alter firms' behavior, the changes produced may be primarily driven by legitimization practices employed to attract financial resources. Legitimation strategies can entail both, substantive and symbolic claims and the effectiveness of the latter with respect to resource acquisition remains an interesting field of inquiry.

Prior work confirms that legitimacy is particularly important for new venture success (Starr & Mac- Millan, 1990: 83; Aldrich and Fiol, 1994) and that symbolic claims affect resource holders' judgement when evaluating ventures and projects (Zott and Huy, 2007; Navis and Glynn 2011). So far, the effect of symbolic claims and other legitimization practices for resource acquisition has been studied in the context of private financing of individual firms. In this work, we expand existing theorizing by exploring such dynamics at the collective level and study the implications of such business practices in the context of public financing for innovation.

Institutional and resource dependence theorists have long argued that institutional pressures related to efficiency and economic fitness lead to conformity and isomorphism in individual business practices (Salanick and Pfeffer, 1978; DiMaggio and Powel, 1983), and public policies and programs belong to the wide spectrum of institutional processes that trigger strategic organizational responses (Oliver, 1991). We suggest that such “pressures” become explicit in the case of public competitive schemes that require proposals to fulfil predetermined criteria in order to receive financing and that conformity and isomorphism can be observed at a collective level (i.e. firm consortia). In the meantime, the need to balance conformity and distinctiveness in proposals seeking funding (Navis and Glynn, 2011) is intensified under conditions of high uncertainty and information asymmetry, as the ones prescribing the innovation process, a tension that makes, both, the preparation and the evaluation of proposals more challenging.

In a public policy setting the probability of mimetic conformity and isomorphism (DiMaggio and Powel, 1983; Galaskiewicz and Wasserman, 1989) is expected to be more pronounced as information on public fund allocation is more observable and private agents can gain knowledge regarding the strategies that others have followed and have found to work. Meanwhile, prior work has argued that under a high level of scrutiny and monitoring, such as in funding proposal evaluation, symbolic claims will be less efficient (Marquis, Toffel and Zhou, 2016; Marquis and Toffel, 2013), a contradiction that raises our first question that asks whether collective symbolic claims work during the process of public resource acquisition.

Extant research on symbolic management has identified a wide range of symbolic actions (Zott and Huy, 2007) and has moved beyond the dichotomy of symbolic versus substantive strategies, suggesting that, in reality, the two practices can be combined (Berrone et al., 2009; Kim and Lyon, 2012). Results show a greater impact on legitimacy when a variety of symbolic displays is used (Zott and Huy, 2007) and when they are combined with substantive actions (Berrone et al., 2009). However, deeper knowledge on the distinct combinations of symbolic actions is missing from extant work, a gap that leads to our second research question that explores the degree of symbolism that may increase the possibility of receiving public funds. Finally, research has also established that, even in a homogeneous and strong institutional field, not all organizations respond equally to isomorphic pressures from their environment (Oliver 1991; Murrillo-Luna, Garcés-Ayerbe, and Rivera-Torres, 2008; Berrone et al., 2010). Berrone and Gomez-Mejia (2009) find that some firms are more eager to comply in a substantive way than others and suggest that this variation in responses is likely to be a function firm specific characteristics. Extending the exploration of the factors that may underlie the heterogeneity of responses to institutional changes, our third research question seeks to uncover who reacts in a more symbolic manner in changes of evaluation criteria for financing.

To answer these questions, we examine the claims made in proposals submitted to the IFP program, a funding scheme launched by the French government to subsidize collaborative R&D projects. Data is drawn from 152 R&D project proposals submitted during the period of 2005 to 2014 to several competitive clusters in France and 56 semi-structured interviews with applicants and proposal evaluators.

By answering the research questions above, this paper contributes to extend knowledge in several ways. First, it extends the literature on legitimation and symbolic management and the effect of the latter on resource acquisition. Extant studies have mainly analyzed such effects in the funding patterns of entrepreneurs by venture capital funds; we expand this line of work by focusing on public funding. Second, while prior work analyzes the use of symbolic claims and its impact at firm level, our study explores the implications of symbolism at

collective level. Third, prior research has mainly emphasized on environmental policies that stimulate symbolic claims without direct financial implications for the firms. In addition to expanding the type of policies studied, the innovation policy setting allows for the analysis of a more direct link between symbolic management and monetary gains in a context where conformity and distinctiveness need to coexist. Fourth, this work deepens the analysis on the different types of symbolic claims and their combinations and tries to identify the type of agents or agent agglomerations that react more symbolically to institutional requirements. Finally, this work informs the innovation policy literature on the possibly of “negative behavioral additionality” by exploring different degrees of symbolism and emphasizes the fact that not all types of behavioral changes are desirable and that the nature of selection criteria has an important role to play.

In the following sections we: (i) discuss the theoretical pillars that support this work, (ii) describe the empirical approach, methods and data used, (iii) present and discuss our findings and (iv) draw our conclusions as well as the managerial and policy implications.

Methodology and empirical base:

This study is contextualized in the French innovation system and more specifically the IFP, a national funding scheme to finance collaborative projects via calls for proposals twice a year. Data is drawn from 152 R&D project proposals submitted during the period of 2005 to 2014 to several competitive clusters in France and 56 semi-structured interviews with applicants and proposal evaluators.

Results:

Our data show that the number of general policy objectives of the program increases in every policy round to include the support of more innovation related activities while the time frame allowed for explicit results is reduced. For instance, the general objectives of fostering R&D, innovation and collaboration at national level are now accompanied with requisites of specific location of R&D and co-funding. At the same time, in its third stage the policy requires that new products and services are developed within three, instead of five years required in the previous stages. While the evolution of policy objectives is reasonable and relevant, their implementation through the establishment of new selection criteria needs further consideration.

However, our interview data revealed that at the time of the evaluation and project selection, the actual weights applied to selection criteria do not always match the published ones. The patterns of acceptance and rejection based on firms’ characteristics do not vary significantly across the three stages of the program, a fact that allows us to discard the possibility that selection is driven primarily by these factors.

Placing the focus on symbolic claims as these are captured by the misalignment of innovation goals as presented in the proposal and the actual ones we observe that the overall use of symbolic claims has been increasing. More specifically, in the first stage of the program 32% of the proposals contained symbolic claims, a percentage that rose to 45% during the second stage and 71% in the third stage. Looking at the type of symbolic claims used, we see that while symbolic claims with regards to the innovation goals of the projects were not present in the first stage of the program, their use increased during the second and the third call for applications. Symbolic claims with respect to the project’s potential to create jobs decreased in use in the second and third phase of the program while the frequently exaggerated predictions with respect to expected revenues remains relatively constant.

Looking at the effect of such claims on the probability of receiving public funding, we observe that in the first phase of the program projects containing symbolic claims were more likely to be rejected, a trend that changes in the second and third call. More specifically, in the second stage, we find that projects containing symbolic claims with respect to the innovation goals and the expressed market impact have more probabilities of being accepted than rejected while the exaggeration of job creation indicators does not work toward the same direction. With respect to the degree or different combinations of claims that affect the possibility of receiving public funds, our data showed that applicants in the first stage of the program included up to two types of symbolic claims in their proposals and such proposals had a higher rate of acceptance. In the second stage, the higher degrees of symbolism included in the proposal the less difference it makes on being funded or not, supporting the argument that too many symbolic claims do not improve the chances of receiving resources. However, more moderate use of symbolic claims seems to benefit proposals seeking funding. Interestingly, the majority of proposals containing symbolic claims that were submitted in the third call use all three types of claims to increase credibility and such strategy does not seem to be penalized at the time of evaluation.

Looking at “Who makes symbolic claims” our data shows that consortia led by young firms (less than 10 years of age) make the smallest proportion of total symbolic claims and are more penalized by resource holders when doing so, while the same does not hold in the case of symbolic claims that are included in projects led by older firms. In the same line, about half of the projects including symbolic claims are led by market leaders and the majority of those projects gets financing.

We then turn to look at how the patterns of past success in fund acquisition relates to the use of symbolic claims. We find that consortia led by firms that have poor historical performance at attracting public funds are those more prone to include more unconcise information in their proposals and also are the least likely to receive funding. A similar pattern is observed when looking at the network centrality of the leader. Consortia led by more outsider firms using more symbolic claims tend to be less successful in resource acquisition. Further, consortia dominated by large firms are found to use more symbolic claims than the ones dominated by smaller firms and interestingly, the former have a higher rate of success in the call than the latter. Finally, turning to the role of environmental scrutiny, our data show that while consortia operating in high scrutiny environments use more symbolic claims, such practice does not work as the majority of such proposals gets rejected.

Conclusions:

We motivated this study by asking whether symbolic claims made at a collective level lead to resource acquisition and if so what are the combinations that work, and who makes such claims. Our findings confirm and expand existing theorizing and empirical results on symbolic management in several ways.

First, as in the case of private source of financing, we find symbolic claims are at work and are not sanctioned by resource holders. Second, we confirm the idea proposed by Berrone et al. (2009) and Zott and Huy (2011) that the use of a variety of claims seems to increase the possible benefits related to symbolic management, and extend such research line by looking at distinct degrees of symbolism as well as different combinations. Third, building on the sparse research discussing the drivers of symbolic management (Marquis and Toffel, 2013; Marquis et al, 2016; Kim and Lyon, 2015, Markóczy et al. 2013), we directly address the question of “who makes symbolic claims” and hence advance our understanding of how firm

and group characteristics are related to symbolic practices.

Finally, this study confirms that the added pressure for efficient resource allocation, accountability and the risk of policy failure often drives selection towards less risky projects (Victório et al., 2016; Feldman and Kelley, 2006; David et al., 2000), or in our case, those that inflate ROIs

This work carries implications for both managers and policy makers. Its value for managers lies in the fact that it clearly shows how isomorphism can become institutionalized and result in the reduction of a critical mass of variety of innovative ideas and projects. In addition, the study shows that partner selection is relevant to the effectiveness of symbolic claims with respect to resource acquisition and that when claims are made at collective level the characteristics and past experience of the leading partner matter.

As for policy makers, especially those working in the innovation policy field one important result of this study is that one of the primary objectives of such policies, i.e. altering firm behavior, might be distorted. In addition, the institutionalization of symbolic management that seems to be taking place and the increasingly high weight placed on market knowledge rather than scientific endeavour may lead to an imbalance of R&D efforts that downplay the importance of basic research. A second implication regards the changes caused in the formulation of consortia competing for R&D funding and the symbolic addition of partners that may not contribute to the ultimate objective of the policy. Finally, the acceptance and resource allocation to projects that symbolically claim to target radical innovation may result in disproportionate funding of incremental innovation and consequently decrease the ability of policy makers to foresee disruptive innovations and perform adequate technological forecasting and foresight.

Abstract 141

SMART SPECIALISATION STRATEGIES IN CENTRAL EUROPEAN COUNTRIES: POLICY STANCES, PRACTICE AND LIKELY IMPACTS

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This paper is aimed at considering the likely impacts of smart specialisation strategies (S3) processes in the Czech Republic, Hungary, Poland, and Slovakia (CE4 countries) by analysing the broad context, in which the S3 documents had to be devised; the overall approach followed, methods and processes applied during the strategy-setting stage; as well as the main objectives and implementation tools identified. This proposal, however, is based on a work-in-progress paper, and thus not all these aspects can be covered in the presentation.

The principal challenge for the CE4 countries is to achieve cohesion with the advanced member states of the EU, and hence to possess the economic means to improve quality of life. To this end, international competitiveness should be enhanced significantly and then maintained for long-term. It is not a trivial task as they are squeezed in a 'nutcracker' formed by advanced countries, on the one hand, and dynamic industrialising countries, on the other. The former ones are capable of controlling international production and innovation networks and markets via new technologies, financial muscles and superior business models, while the latter ones are characterised by extremely low wages and highly disciplined work forces. It is crucial for the CE4 countries to escape from this trap, and thus using the subsidies they receive from the European Structural and Investment Funds in an effective and efficient way should be perceived as a major opportunity. Hence, devising well-targeted smart specialisation strategies (S3), followed by a successful implementation, is a major task for politicians, policy-makers and businesses. Moreover, the 2014–2020 programming period could be the last one, in which the CE4 – and other recipient – countries can obtain massive subsidies from the EU, sufficient for achieving fundamental structural changes required for significantly reducing the gap with the advanced economies. A major shift, therefore, is needed in the overall approach from 'absorbing' as much EU funds as possible – in essence, just spend the money in time, adhering to the administrative and accounting rules – to utilise those funds wisely and strategically to attain the desired outcomes and impacts.

The paper relies on evolutionary economics of innovation as its overall theoretical framework, and more specifically it takes the concept of entrepreneurial discovery (ED) process as its starting point. The main methods are document and statistical analyses, covering the CE4 countries.

Decisions on setting priorities for smart specialisation are clearly influenced by numerous factors; actually, by so many that it is simply not possible to consider all of them in a single paper. The major ones include (i) size, the level of socio-economic and regional development; (ii) the economic weight and strategies of foreign affiliates and that of indigenous SMEs; (iii) decision-making structures and practices; (iv) the national innovation system (its composition, patterns of business-academia collaboration, main types of innovations pursued); (v) the outcomes of previous strategic decisions, that is, the prevailing specialisation patterns (composition of outputs and exports); (vi) the skills and experiences accumulated while conducting those activities, in which a country or region has been specialised; (vii) the available production equipment (technological level, degree of flexibility, etc.); (viii) trade and other connections shaped by previous specialisation patterns and location; as well as (ix) the

available physical infrastructure (at least to some extent). This presentation discusses the first four of these factors, highlighting both similar and dissimilar features of the CE4 countries, covering the years up to 2012, as decisions on smart specialisation strategies had to be made in 2012–2013. This abstract, in turn, highlights some major features of the national innovation systems of the CE4 countries.

Policy-makers, business people and researchers working for publicly financed higher education and R&D organisations are all supposed to be major contributors to S3 processes. It is important, therefore, to characterise the STI policy governance and research sub-systems in the CE4 countries, depict the patterns of innovation co-operations and highlight the main types of innovation activities.

The STI policy governance sub-system: centralised decision-making, ad hoc use of modern policy-preparation tools

Insufficient, ad hoc orchestration of STI policies in the CE4 countries has prevented these policy tools from being more effective, and thus using public money in a more efficient way. Moreover, the STI policy governance sub-system has been repeatedly reorganised in the CE4 countries, at least once in a parliamentary cycle. These frequent changes in governance structures prevent organisational learning by policy design and implementation bodies, and this lack of stability also hinders their efficient functioning. Further, constant re-organisations put a significant administrative burden on RTDI actors, and thus hamper innovation performance.

An essential property of smart specialisation is that it should be place-based. The centralised decision-making structures and practices in the Czech Republic, Hungary, and Slovakia, where not even the NUTS2 (statistical-administrative) regions have had decision-making competences and funds to devise and implement STI policies, is in a stark contrast with the place-based character of a genuine smart specialisation.

The Marshall Offices of the 16 Polish regions devised and implemented their own regional Operational Programmes in 2007–2013, including the RTDI components. The RTDI elements of these regional OP, however, were not place-based: the Polish “regions selected similar specialisations, related to the most popular, broadly defined technology areas, without major intra-regional differentiation”. (Klincewicz, 2014: 22)

Monitoring and evaluation of policy programmes and the overall policy mix to inform policy-makers and other actors when devising new policy tools and overall strategies are applied intermittently, at best, in the CE4 countries; and rather formally in the case of policy measures co-financed by the EU, just to satisfy the bureaucratic requirements set in various EC rules. With the exception of Poland, technology foresight has not become a regularly used, essential element of the policy-preparation toolbox, either, although the first national foresight programme in the region was conducted as early as 1998–2000 in Hungary. (Szpor et al., 2014) While there are major differences between foresight and entrepreneurial discovery processes – e.g. in terms of their scope, objectives and time horizon –, this fact forcefully indicates that policy-makers do not perceive participatory decision-preparatory methods as useful – let alone indispensable – ones. Hence, the chances of relying on these methods wholeheartedly are rather slim.

The research sub-systems: diversity in terms of inputs, performance, composition and recent structural changes

The research sub-systems of the CE4 countries share broadly similar legacies: up to the late 1980s they had been characterised by a highly centralised, politically controlled public R&D sector – including industrial R&D institutes run by line ministries responsible for industrial sectors –, and a rigid division of labour between universities, focusing mainly on teaching, on

the one hand, and institutes of the Academies of Sciences, almost exclusively performing research, on the other. Given these common structural features, as well as the dominant role of FDI played during the transition to market economy, one could assume that while the research sub-systems have changed radically since the 1990s, country differences would not be significant in the 2010s, either. Yet, both input and output R&D indicators suggest important dissimilarities. Although the Czech GERD/GDP ratio was only 63% of the EU28 data in 2000, it was nearly at the same level by 2012 (90%). At the other extreme are the Polish and Slovak figures: roughly one third of the EU28 figure in 2000 and at around 40% in 2012. In other words, although Slovakia started from a significantly lower level than the Czech Republic, her progress was significantly slower. Hungary was in between with her increase from 44% of the EU28 level in 2000 to 63% in 2012.

Business R&D efforts are particularly important from the point of entrepreneurial discovery. Two indicators can be used to characterise these efforts: BERD/GDP and the share of GERD financed by industry. Business R&D expenditures relative to GDP were also the highest in the Czech Republic in 2000 (58% of the EU28 figure), reaching 76% of the EU28 figure by 2012. The corresponding Hungarian, Polish, and Slovak figures were significantly lower in 2000. While the Hungarian BERD/GDP ratio increased from 0.35% in 2000 to 0.84% by 2012, the Polish one from 0.23% to 0.33%, the Slovak figure even decreased from 0.42% to 0.34%, respectively.

The share of GERD financed by industry was the highest in Slovakia in 2000 and rather close to the EU28 figure (97%), but it dropped to 69% of the EU28 figure by 2012. The Czech figure was also close to the EU28 one in 2000 (91%) but shrank to 66% by 2012. The Hungarian ratio increased from 67% of the EU28 figure to that of 85%. The Polish ratio was the lowest in 2000 and remained at that position in 2012, too, with a modest increase, which meant a small improvement relative to the EU28 figures, too: up from 53% in 2000 to 59% in 2012.

The composition of the CE4 countries' research sub-systems, measured by the share of the three main research performing sectors either in employing researchers or performing GERD, was also rather diverse in 2012. For instance, the business sector in Hungary and the Czech Republic employed a higher share of researchers than the EU27 total, while this ratio was less than half of the EU27 ratio in Poland. The business sector performed a higher share of GERD in Hungary than the EU27 total. This ratio was significantly below the EU27 total in Slovakia and Poland.

The weight of business sector in performing GERD has increased by over 20 percentage points in Hungary, while decreased by almost 25 in Slovakia. The higher education sector gained nearly 3 percentage points in Poland and around 25 points in Slovakia. As changes have occurred in both directions in all the three major research performing sectors in the Czech Republic, Hungary, and Slovakia, neither a similar structural composition of their research sub-system can be observed, nor a move towards a similar structure.

Foreign controlled firms play a dominant role in terms of performing BERD: they account for nearly 80% of intra-mural business enterprise R&D expenditures in Slovakia and over 60% in the Czech Republic and Hungary. Their weight is smaller in Poland, but still significant.

The OECD, in co-operation with the SCImago Research Group developed an indicator to assess scientific excellence: the share of top 10% most cited documents (in the respective field of science) in all documents, published in 2003–2012, aggregated at a national level, and taking into account the nationality of the lead author of the cited document. Using this indicator – the share of top 10% most cited documents, led by a domestic author – the Czech Republic and Hungary fare practically with an identical performance, ahead of the other two CE countries. Yet, all the CE4 countries are at the bottom of a league table of the 40 countries

considered in that exercise in the following order: the Czech Republic (4.2%), Hungary (4.1%), Chile (4.0%), Mexico (3.4%), Poland (3.1%), Slovakia (2.4%), Indonesia (1.7%), and Russia (1.4%).

Business-academia co-operation:

One of the major lessons of evolutionary economics of innovation has been that different types of knowledge, skills and experience are required for successful innovation processes, and these elements are rarely possessed by single entities; rather, these are distributed among various actors. Hence, their co-operation is vital to integrate these elements to exploit them for improving economic performance. Hence, business-academia collaboration is a vital element of entrepreneurial discovery processes. It is important, therefore, to review the types and intensity of these collaborations in the CE4 countries from various angles: firms can contribute to funding R&D activities conducted at HEIs and PROs, can rely on knowledge generated by them, and engage in innovation co-operation with them.

As for the share of HERD financed by industry, the CE4 countries show rather diverse patterns again, and the direction of change is different, too.

Czech businesses financed a significantly larger share of GOVERD than that of HERD in 2000 (9.6%) but then this figure dropped to 4% by 2012. Similarly, the Polish figure fell from 9.5% to 5% in the same period. The share of business funding in GOVERD started at a high level of 11–13% in 2000–2001 in Hungary, halved in 2002–2004, exceeded 10% again in 2005, was in the range of 12.3–14.3% in 2006–2010 and 9.8–11.5% in 2011–2012. The Slovak figure was the highest among the CE4 countries, staying significantly above the EU28 figure in all years.

The quality of co-operation among the NIS players can also be characterised by firms' assessments as to the importance of sources of information for their innovation activities. In all countries participating in the Community Innovation Survey (CIS) a much larger share of firms regards businesses a highly important source of information for innovation than 'scientific' sources. Data are presented here only for two 'scientific' sources of information for innovation of the five ones identified in the CIS questionnaire, namely HEIs and PROs. Universities were ranked No. 2 among the five 'scientific' sources of information for innovation only in Hungary, third in Slovakia and the Czech Republic and fourth in Poland. As for the other 'scientific' source of information for innovation, PROs were ranked third in Poland, fourth in the Czech Republic and fifth in Hungary and Slovakia.

Most firms in the EU member states indicated innovation co-operation with their business partners in the relevant rounds of the CIS, that is, HEIs and PROs are usually the least frequently mentioned innovation co-operation partners. Higher education institutes are ranked No. 4 in three of the CE4 countries, too, in terms of the frequency of innovation co-operation with them. In Poland, however, HEIs are the third most frequently mentioned innovation co-operation partners. PROs are ranked No. 7 (out of seven) in three CE4 countries and No. 6 in Poland.

Qualitative analyses point to several reasons for weak business-academia (B-A) collaborations in the CE4 countries. In brief, companies and publicly financed R&D units are driven by fundamentally different incentives and goals to be involved in R&D and innovation activities. Hence, there are inherent hindrances to B-A collaboration. Companies are interested in R&D activities that are likely to lead to business results at some points. Projects are regularly monitored and assessed, and when necessary, a given project could be substantially reshaped

or even stopped. Thus, tight project management and keeping commercially sensible information secret are of vital importance. In contrast, researchers working for universities and PROs are not simply interested, but strongly encouraged to disclose their results as quickly and as widely as possible. Further, they are usually less accustomed to tight project management, but noticeable changes have occurred in recent years, due to tighter control exercised by both the domestic and foreign funding agencies.

From the point of entrepreneurial discovery processes it is worth looking at the share of enterprises engaged in product innovation activities: it is less likely that firms only active in process, organisational or marketing innovations would be active participants in exploring and creating opportunities for smart specialisation. From this angle, the differences are rather stark between the Czech Republic – _being ahead of the EU28 figures – _and the other three CE countries with a low share of innovative SMEs. Hence, the likelihood of having SMEs as active participants in entrepreneurial discovery processes in the latter three countries is rather low.

Tentative conclusions:

The major characteristics of the CE4 STI policy-making structures and practices, that is, competition among the most important decision-making bodies; insufficient, at best ad hoc, orchestration of STI policies; centralised decision-making practices; sparse, irregular use of modern policy-preparatory tools (PPTs), especially participatory ones, make the task of devising and implementing smart specialisation strategies a particularly demanding one. It is an important question in which way these obstacles have been perceived and interpreted: (a) turned into major tasks, that is, the removal of these obstacles is among the main policy priorities; or (b) accepted as essential features that are ingrained into the policy governance sub-system, and thus any attempt to change them can only be a wasted effort. This perception is likely to have a decisive impact both on the process to devise S3 documents and their implementation.

Specialisation patterns in terms of production and exports have been crystallised to a large extent by foreign direct investment in the CE4 countries by 2012–2013 when preparation started to devise the S3 documents. Foreign affiliates play a decisive role in R&D, production, and export activities. Their activities are driven by business and “search” strategies set by their headquarters. In contrast, the vast majority of indigenous SMEs possess weak strategy setting and technological capabilities. Business-academia co-operation is patchy. Given these structural features it is unlikely to have capable and committed business people as ‘champions’ of ED processes.

The relevance of the EDP concept in the CE4, as well as in the less developed regions in the more advanced, seems to be questionable for two reasons. First, this concept stresses the need for new ways of thinking, methods and processes, in particular (a) strategic vs. short-term thinking, (b) excellence vs. cost-based competitiveness, (c) systemic use of PPTs, including participatory methods, (d) place-based, that is, decentralised strategy-setting in countries, which were heavily centralised for long periods. The final version of the paper will consider if this pressure induced learning and change processes, or it was too early to insist on it as ex-ante preconditionality for the 2013–2020 period.

Second, the concept of ED processes mainly considers R&D-based innovations, while non-R&D-based ones are equally important even in the advanced economies.

The comparison of the major factors influencing the S3 processes indicates major differences among the CE4 countries, in spite of their rather similar historical legacies. This diversity in their context for applying S3 methods – in other words, using ED processes – implies that noteworthy differences can be expected in terms of the impacts of smart specialisation strategies.

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Keywords: Smart specialisation strategies (S3); Entrepreneurial discovery (ED) processes; Preconditions for ED processes; Diversity among Central European (CE) countries; The relevance of the ED concept in CE countries.

C2 EMERGENCE OF NEW MARKETS

Wednesday 05 June 2019 from 16:30 to 18:00

GASTON HEIMERIKS, Chair

Abstract 39

THE EMERGING BIOECONOMY FROM AN INNOVATION SYSTEM PERSPECTIVE: PROSPECTS OF ENTREPRENEURS

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Aim of the contribution:

The vision of a bioeconomy calls for a radical shift in current approaches to production, consumption, processing, storage, recycling and disposal of biological resources (OECD 2009; Leadbeater 2013; Schot & Kanger 2016). The concept envisages fossil carbon consumption to become increasingly replaced by renewable alternatives. A cascaded usage of biological matter is required in view of planetary boundaries. Therefore, European STI policy for the bioeconomy stimulates intensified actors' collaboration across sectors and divers branches of industry in view of strengthened sustainability. However, outcomes appear to be rather limited. Against this background, we aim to characterise the perception of bioeconomy actors. We will highlight the bottlenecks that are identified by entrepreneurs from within a German biocluster to impact their innovation capability and opportunities. This analysis allows for new insight into IS dynamics as perceptions can be expected to guide actors' behaviour. Results aim to support STI policy for the emergent bioeconomy and SDG attainment.

Background and Rational:

Basing itself on Schumpeterian and evolutionary perspectives, innovation systems (IS) theory (Freeman 1988, Lundvall 1992; Nelson & Rosenberg 1993) focused upon organisations, institutions and socio-economic structures as components of the systems. Organisations were characterised as the players or actors, while institutions were conceived as the rules of the game (Edquist 2011). In another strand of the scientific IS discussion, it was argued that an IS should be defined in terms of what it does – namely: its functions (McKelvey 1997; Rickne 2000; Bergek & Jacobsson 2003; Edquist 2004). This latter approach was found helpful for the justification of policy interventions in view of transitions (Markard, Hekkert & Jacobsson 2015). However, both IS models have been criticised for scant attention paid to the IS micro level and human agency. A lack of guidance for STI policy was diagnosed in consequence (e.g. Kuhlmann, Shapira & Smits 2010).

First bioeconomy-focussed research efforts have investigated the presence of actors and effectiveness of STI policies (e.g. Ehrenfeld & Kropfhäuser 2017; Hüsing et al. 2017) or applied IS theory to detect systemic weaknesses (Purkus et al. 2017). Instead of ending in a responsibility void of 'system failure', recent IS research underlined that theory has to incorporate how actors themselves experience and contribute to the enactment of complex processes like innovation, create new trajectories and transform systems (Ison 2010; Borrás & Edler 2014; Sotarauta 2017; Upham et al. 2018). IS theory was found particularly suited for the study of this 'transition in the making' (Farla et al. 2012, Hermans 2018).

Theoretical Framing:

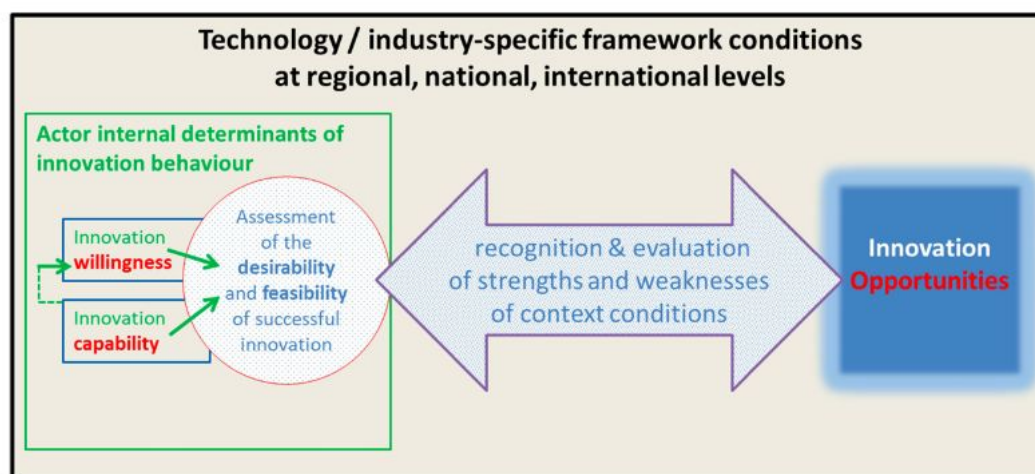
IS can be studied at a regional, sectoral and national levels. The structural elements of an IS are actors, networks and institutions. The actors driving innovation are organisations or

organizational units active in new knowledge creation through interactive learning, and/or knowledge use and application. Actors are linked to each other through market and non-market relations – they build networks. Kuhlmann, Shapira & Smits (2010) underlined that leading IS are characterised by productive network relationships among R&D organisations and industry (IS micro level) and the political system (IS meso & macro levels). The third component, institutions, are understood to simultaneously arise from and constrain social action (Giddens 1979, 1981). As social structures are understood to be constantly renewed by actors, change promoters operate in parallel to preservers of the status quo (Lawrence & Suddaby 2006). Thus, some outcomes of IS-internal dynamics might be unintended by any actor.

Established institutions, actor constellations and power relations in specific networks constitute innovation incentives, hurdles or opportunities to individual actors (Edquist 1997; Weber & Glynn 2006). The differentiation of innovation 'willingness', 'capacity' and 'opportunities' (see Figure 1) allows for a more fine-grained analysis of agency interacting with specific IS properties. Innovation willingness is caused by a multitude of factors from actor-internal to socio-cultural determinants.

Actors' innovation willingness in bioeconomy clusters, however, can be taken for granted as it is documented by their involvement in R&D projects. Actor-internal capabilities consist of competencies and resources. They nevertheless include externally co-determined rights and obligations that are tight to the roles and the social positions of actors (Abdelnour, Hasselbladh & Kallinikos 2017). An actors' evaluation of own innovation capabilities is not independent from the shape and extend of innovation opportunities (called 'opportunity spaces' by Grillitsch & Sotarauta 2018). The evaluation of the desirability and feasibility of successful innovation by motivated actors is assumed to be the crucial determinant of their (individual or collective) innovation behaviour, agency and resulting IS bottom-up dynamics.

Figure 1 Determinants of entrepreneurs' innovation behaviour from an IS perspective



As pointed out by Malerba (2005), the types and structures of relationships and networks differ from one sectoral innovation system (SIS) to the next - mainly due to specific characteristics of the relevant knowledge base, technologies and demand. Rigidities of socio-technological structures and related institutions have quite different origins, shapes and

qualities for different industries (Martin & Sunley 2006, Grillitsch & Rekers 2016). IS research concluded that the insufficiency or rigidity of a critical component may block or slow down the performance of the entire dynamic system (Boekholt 2010). A multitude of intertwined institutions and associated organisational structures are expected to have a bearing on the actors' perception of opportunities. There is also an impact on the actors' capabilities as context conditions shape pathways to gain legitimacy for new undertakings and secure the necessary resources (Suchman 1995; Hannibal 2016; Geels et al. 2017). They affect an actors' actual or perceived room for manoeuvre and shape her 'lived experience'.

In view of accelerated transition we ask: Which IS components do bioeconomy actors from different industries regard as prominent barriers or potential drivers of their innovation capacity and opportunities?

Methodological approach:

Qualitative data have been collected through in-depth, semi-structured interviews in a German bioeconomy cluster. Interviewees were asked about strengths and weaknesses of context conditions at local, regional, national and international levels. The reasoning behind the notion of 'relevance' of perceived context conditions was explored regarding own innovation capability and opportunities.

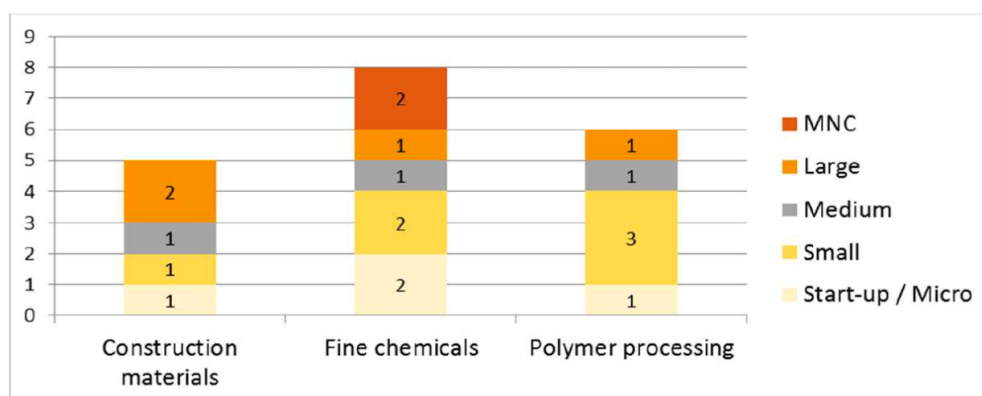
Recorded interviews were transcribed and coded for a differentiation IS levels as well as the impact categories.

The commercial actors' innovation capacity as well as their perception of SIS strengths and weaknesses was expected to be strongly influenced by their size and age. These characteristics are commonly taken to guide research into the impact of the socio-economic positions or the 'power' of actors. Therefore, it was decided to also segregate actor statements accordingly.

Sample data:

On the basis of registered membership and R&D projects, 35 interviewees were recruited in the period 11/2017 to 06/2018 from the "Spitzencluster Bioeconomy" in such a way that the chemical, plastics and construction material industries are covered. The interviews covered 27 of 30 joint R&D projects financially supported by public cluster promotion¹. Out of the 35 interviewees, 19 actors were managers or heads of R&D departments in industry. Only results from this group of actors are reported here. With respect to the size distribution of respondents, one or two micro enterprises or start-ups (less than 10 years in business) were included in all three branches of industry (see Figure 2). SMEs constitute 37-50% of the sample per industry while (subsidiaries of) large or multinational companies (MNCs) make up the remainder.

¹ 40 Mio. € were contributed to cluster activities by the BMBF in the period 2012-2018.

Figure 2 Size distribution of respondents from industry (N=19)**Selected results:**

The analysis of findings is still ongoing. Main results from the industrial actors in the chemical and construction material SISs are highlighted here.

Companies in the chemical SIS (mostly) were established on the basis of fossil fuels. They produce and sell standardised bulk and speciality products that normally are subject to global price competition. Innovation efforts typically start with laboratory research, proceed to upscaling (pilot plant / demo plant) and only thereafter eventually lead to full plant construction and industrial-scale production.

As already pointed out by Nelson & Rosenberg (1993), chemical engineering has to invent entirely different processes throughout scaling-up. A secure and year-round flow of large amounts of uniform feedstocks (traditionally through pipelines) is part of the standard operational modus.

Fine chemicals are often produced in close vicinity to refineries. This pattern resulted in industrial complexes with complementary facilities and outputs. The industry sample for the analysis of the chemical SIS includes incumbents as well as new entrants without prior operations in the fossil-based industry. The latter employ new technology or/and have special knowledge on underexplored renewable feedstocks. Two of the respondents (one large and one micro enterprise) are using genetically modified enzymes in their processes.

Table 1 provides an overview of the factors that respondents of the chemical industry SIS identified to potentially have the greatest positive impact on their innovation capacity and opportunities. The innovation capacity was not found to be restricted by access to competent engineers, other experts or skilled workforce by any size category of companies in this SIS. Rather access to finance was perceived as the decisive factor. While LMCs rely on classical banks for external financing, SMEs and young companies depend on government support in order to access the capital needed to eventually boost their innovation capacity.

Those factors that were perceived to potentially have the strongest positive impact on the innovation opportunities of respondents, reside at multiple IS levels. SMEs in the chemical industry point to the volume and price of CO₂ emission certificates and LMCs to the oil price as presently green chemicals are far more expensive than oil-based products. Start-ups and micro enterprises underlined access to biomass which is determined by international framework conditions as well as macro-level sector policies that shape decisive characteristics

of primary production and environment protection. Respondents were aware of the possibilities to set directions for research in plant breeding (maximising biomass) and establish feedstock flow coordination support. Direct public demand in the framework of public procurement activities would also widen bioeconomy innovation opportunities from the point of view of this group of actors.

Table 2 Drivers of innovation capacity and opportunities from the perspective of actors in the construction material industry SIS

	Start-up & Micro enterprises	SMEs	(Subsidiaries of) Large & Multinational enterprises
Capacity	<ul style="list-style-type: none"> • Access to (risk) capital (meso/macro) • Revised governance of the agricultural sector (macro) 	<ul style="list-style-type: none"> • Access to R&D promotional funds with less bureaucracy (meso) • Consistent & meaningful & persistent promotional strategy (meso) 	<ul style="list-style-type: none"> • Strengthened educational and scientific capacities in professional education and universities (meso) • Simplified and harmonised regulation (macro)
Opportunity	<ul style="list-style-type: none"> • Decisive regulation (macro) • Coordination of efforts after systematic knowledge integration with a product/market perspective (meso) • Public demand (meso) 	<ul style="list-style-type: none"> • Decisive regulation (macro) • Holistic system perspective with a long-term vision (meso) • (Consumer) Education and awareness building (macro) 	<ul style="list-style-type: none"> • Oil price increase (international) • Awareness raising (macro) • Modernised regulation of standards and testing (meso) • Public demand (meso) • Market demand (macro)

SMEs constituted the group of respondents that clearly perceived a consistent and visible bioeconomy promotional strategy as decisive for a widened opportunity space. Official government communication and promotional schemes could ease their market development efforts. Both, SMEs and LMCs underlined that effective market demand for bio-based products would be most needed for broadened innovation opportunities. They would create the capacities or speed up efforts if only a sizeable number of customers would call for it. LMCs pointed out that the identification of new properties of green chemicals through strengthened experimentation could also open up new opportunities.

German construction companies are predominantly micro, small and medium, typically operate in regional markets, rely on qualified workers, nearby input supply and established building traditions. With the rise of concrete and steel construction in Europe over the past 150 years, the construction materials industry, however, has experienced increasing globalization. European norms and guides meanwhile co-determine national quality standards while insurances and liability laws aim at risk minimization for owners and communities. In consequence, the rate of innovation has normally been slow in the past. Waves of feedstock supply and the need for storage capacities have traditionally been a standard in wood-based companies. The sample for the analysis of the construction material SIS includes four companies that have always relied on wood or natural fibers for their business. The fifth enterprise has a wider focus providing joints to all types of construction projects.

Table 1 Drivers of innovation capacity and opportunities from the perspective of actors in the chemical industry SIS

	Start-up & Micro enterprises	SMEs	(Subsidiaries of) Large & Multinational enterprises
Capacity	<ul style="list-style-type: none"> Financial R&D promotion (meso) Access to (start-up & risk) capital (meso) International vision and experience of regional STI agencies (meso) 	<ul style="list-style-type: none"> Access to risk / growth / equity capital (meso) 	<ul style="list-style-type: none"> Friendly banks (macro)
Opportunity	<ul style="list-style-type: none"> Innovation readiness of public companies and government units (meso) Access to sizeable biomass volumes (meso / macro / international) 	<ul style="list-style-type: none"> CO₂ / emission price increase (EU – international) Consistent and visible promotional policy (meso) Strengthened support to market development & marketing of bio-solutions (meso) Market demand (macro) 	<ul style="list-style-type: none"> Oil price increase (international) Market demand (macro) Ongoing support to experimentation for the discovery of new properties of bio-based products (meso)

From the point of view of young or small actors in the construction material industry, their innovation capacity is also limited by restricted access to (risk) capital (Table 2). In addition, it was pointed out that successful collaboration with farmers would require a revised governance structure of the agricultural sector. Industrial actors cannot provide the requested purchasing guarantees in advance during years of experimentation with new plant varieties, processing technologies and market development. Just like in the chemical industry SIS, SMEs in the construction material industry underline their dependence on financial R&D support along with the difficulties created by the associated bureaucratic burden. Their call for a consistent, meaningful and persistent promotional strategy at the IS meso level is equally strong. Unlike their counterparts in the other sector, LMCs active in construction materials perceive a shortage of qualified manpower and specialised expertise in the downstream construction business where their inventions need to be applied. Another bottleneck is perceived in research and university education. Not only are new materials exposed to quality testing procedures translated from other industries due to lack of scientific evidence on bio-based materials and construction technologies. The shrinking availability of experienced partners in German universities and research institutes is also perceived as a serious threat to their future innovation capability. Extended capabilities are a reported prerequisite to surmount fragmented and complex regulatory hurdles to the certification of new materials. As young or small companies not even envisage to impact regulation, they list a ban on toxic or unsustainable materials among the factors that could open up new opportunities for innovation. In addition, non-financial STI promotion could facilitate the identification of new opportunities based on available knowledge. Sizeable public demand would significantly ease market entry from their perspective. SME's again expressed a medium to long-term perspective calling for a strong vision of STI policy and broad awareness raising efforts alongside regulatory change. The aspect of consumer awareness was also found decisive from an LMC point of view as it precedes market demand. These respondents also joint the young companies in their call for public demand stimulating bio-based material innovation opportunities. A significant oil price increase could substitute for the ban of specific toxic or unsustainable construction materials from their perspective.

First conclusions:

Bioeconomy promotion is an example of mission-oriented STI policy centered on R&D and crossindustry interaction that could enable a replacement of fossil resources. According to the European Commission's guide for this type of policy, "Ambitious objectives will ensure that researchers and innovators are challenged to deliver what would otherwise not be attempted ("additionality" in research). Yet, the objective should be framed to be on the one hand high-risk but also realistically feasible, at least in theory, within the given time period" (EC 2018: 14). Against this background, first results of this study point to considerable over-optimism of STI policy shapers for the bioeconomy.

Important rigidities appear to prevent policy harmonization across sectors and levels of governance.

Unsuitable STI policy governance and structures are diagnosed to hardly support the innovation capacity of SMEs, micro enterprises and start-ups. The latter are the white hope of radical change promoters (Paap & Katz 2004; Gibson & Birkinshaw 2004). If they do not evolve and/or their innovation capacity cannot unfold due to lack of access to capital, IS performance is seriously hampered.

Innovation opportunities are perceived to evolve in dynamic interaction of various structural factors across regional, national and international SIS levels. Most respondents voiced doubts on the feasibility of successful bioeconomy innovation under current framework conditions. The directionality of the SISs and main system design features are perceived to obstruct a dynamic bioeconomy evolution – pointing to 'transformation failure' (Schlaile et al. 2017). Efforts to maximize "the transformative impact of policy to shape and create new markets" (Mazzucato 2016:283) would best be translated into broad awareness creation campaigns, strengthened private and courageous public demand for bio-based construction materials, green chemistry and plastic products. Results support the call for "concerted actions" on sociotechnical configurations (Kuhlmann & Rip 2018:4).

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HOW CAN SOCIAL VALUE CREATION FROM RESEARCH BE CREATED MOST EFFECTIVELY BE STRENGTHENED FROM RESEARCH: BY DEVELOPING THE SCIENCE OR BY DEVELOPING REVENUE STREAMS?

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Aim of the proposal:

This study is an attempt to contribute to the call for more research into understanding how the potential conflict, or mission drift, between socially motivated activities and commercial success can be balanced by studying how “hybrid organizations” are organized. The four cases used for this study are all foundations with a focus on research and incorporate both non-profit and for profit activities to achieve their social mission: to deliver treatment to patients and give money back to science. The financial mission is obtained by commercializing medical innovations that might or might not build on the research supported by the foundation. Theory development to explain and predict the conditions under which hybrid organizations dual mission can be achieved would enhance knowledge of how, why and where hybrid organizations are most effective. There is, therefore, a need for greater understanding of how organizations account for both social and financial value.

Background:

Traditionally, industry, public organizations and private charities have been considered different forms of organizations but in the last decades the boundaries between the private, public, and non-profit spheres have become increasingly blurred. Instead “hybrid organizations” that combine aspects from different sectors have started to form. For example are nonprofit organizations often constrained by a lack of capital while for-profits are rather constrained by legal and not social outcomes. Hybrid organizations therefore address both of these constraints by allowing mission-driven nonprofits to access capital more readily and by allowing for-profits to commit themselves to achieving goals (Gottesman 2007). This is especially true when it comes to social enterprises where the objective is to provide benefit to society by using the market as a vehicle to ensure a sustainable revenue instead of relying on donations (Mair and Marti 2006). The bridging of different institutional logics and the blend of different competences and expertise may offer opportunities for innovation. This is supported by recent studies that have shown that these “hybrid organizations” create particular value when it comes to organizational innovation and institutional change (Padgett and Powell 2012; Hockerts 2015).

However, organizational theory studies have raised concerns that hybrid organizations may experience both external and internal tensions because of the positioning between different institutional spheres and the presence of multiple logics (Greenwood et al. 2011; Kraatz and Block 2008). These challenges have been further substantiated with the concern that hybrid organizations might be at risk of undermining the weaker logic a notion that has been termed mission drift (Fowler 2000; Jones 2007; Weisbrod 2004). Mission drift for social enterprises has been summarized as losing sight of their social purpose in order to survive, or become

more efficient or profitable (Ebrahim et al. 2014).

The potential conflict between logics presents a particular challenge in relation to how hybrid organizations are governed. Furthermore, these organizations are often accountable to multiple groups of stakeholders, likely with a multitude of varied objectives (Ebrahim et al., 2014), which increases the complexity of appropriate governance structures and accountability processes.

In this study we focus on hybrids where science is the mean to give back to society. Hybrid organizations founded on a model where excellent science will provide the foundation for future products and services have severe challenges in developing hybrid practices. In the excellent science model the degree of mutual dependency is furthermore low, which is a poor precondition for hybridity (Ménard 2004). The firms have no immediate use for the scientific undertakings, and the academics do not need the activities of the firms (Guldbrandsen et al. 2015). Also, different types of funding may stretch hybrid organizations that neither have strong roots in a company's operations nor the academic community in different and seemingly incommensurable directions. R&D funding of a certain type carries with it specific demands and influences (Rainey and Bozeman 2000). This "strategic demarcation between political and scientific tasks" (Guston 2001) is typical of the hybrid organizations found at the interface between science and other parts of society.

Earlier studies have discussed a number of factors that are characteristic for the organizational structure of hybrids. Battilana and Dorado (2010) suggest that sustainable hybrid organizations need to create a common organizational identity that strikes a balance between the logics the organization combines. Perry and Rainey (1988) emphasize ownership, funding, and mode of social control when discussing organizational forms that challenge a simple dichotomy between public and private. Structure affects the experience of tension between logics through its influence on the frequency and nature of tradeoffs between different objectives, as well as the location within the organization where decisions about such tradeoffs are made (Battilana and Lee 2014). Researchers have identified two solutions to the problem of managing hybridity: blended hybrids where the whole organization is characterized by elements of multiple logics; and structural hybrids where different parts of the organization adhere to different logics, resulting in their compartmentalization into structurally distinct organizational spaces (Greenwood et al. 2011; Kraatz and Block 2008). Such compartmentalization produces new requirements of coordinating between the structurally differentiated units (Lawrence and Lorsch, 1967) which may bring considerable integration challenges, and even the risk of organizational fragmentation (Greenwood et al. 2011). In a recent study, though, the assumption that structural hybrids are always composed of single-logic compartments has been questioned. Perkmann and McKelvey (2018) found that organizations adopting structural solutions to hybridity are more likely to be mosaics of small hybrid spaces, where each space is characterized by different combinations of hybridity rather than representing a simple model of structural hybrids. Blended hybrids on the other hand may use formalization in order to separate core practices associated with each logic from more incidental practices which subsequently enables productive collaboration between representatives of different logics (Ramus et al. 2017). Pache and Santos (2013) find that blended hybrids use selective coupling, i.e. they combine various intact elements from different logics, in order to project legitimacy onto external stakeholders.

Methodology and empirical base:

To answer our research question we conducted an inductive study of four industry foundations within the field of life sciences. Our cases included two large foundations that have existed for many years and two foundations, all located in Scandinavia, that have been started only a few years ago by researchers but where the two industrial foundations have been the inspiration.

So called industrial foundations are an ideal setting to study how the potential tension of different institutional logics can be balanced since they carry out both charitable and business activities, generally using dividends from business activities for charitable purpose (Thomsen, 2012). Hence they have both a social as well as a financial mission. Legally, a foundation is a non-profit entity that can only redistribute any profit when it is intended for charitable purpose (Thomsen, 2012).

The cases were selected to ensure the study had both variety and matching data but it is important to acknowledge that with an apparently limited population size convenience sampling was employed (Eisenhardt, 1989). Each foundation was treated as a separate case. Interviews with founders, researchers and individuals involved in both the commercialization and societal part of the organizations were interviewed. In addition annual reports, books and website data was used as supplementary data.

The interviews were recorded after permission was granted by the participant. The in-depth semi-structured qualitative interviews were designed to explore foundation formation, motivations, governance, stakeholders and operation. Other than position within the company, any personal details of the participant were irrelevant and of no additional value. The questions were open-ended but concise and used as conversation starters. The researchers was interested in having a discussion with each participant and obtaining information that was not already available.

The first step of analysis involved transcription of the interviews. ExpressScribe, a transcription software, was used to improve efficiency. Each foundation was first analyzed individually. This allowed the researchers to become familiar with each case in its' own right before comparison was made to other cases. This process was iterative and continuous. The data was reviewed for key themes that had been introduced by the researcher preceding data collection. The researcher also observed for additional themes that were relevant to the research question. The researcher was perceptive to all data having potential significance or value. The information was presented in a tabular display and included supporting quotes along with links to relevant literature. Using this technique the data could be presented in manageable manner while maintaining context, allowing for theory to be built (Eisenhardt, 1989).

Following this initial analysis, the four cases were compared to one another. Similarities and differences between cases could be identified by using the previously tabulated information for each case.

Results:

The cases consisted of four different foundations. Foundation A is an old foundation that have existed for several decades. It is the majority shareholder of the multinational pharmaceutical company, Company A1, and also owns Company A2, a smaller biotechnology company and a holding company, Company A3. The dividends from all of these companies are returned to the foundation, who in turn make grants to non-profit institutions, research in Nordic countries, universities and university hospitals. The founders, a researcher, were motivated to do “something good for the society” when he received the rights to produce and sell a drug for free under the subject to two stipulations. First, the product would be sold to the public as cheaply as possible and access not restricted to small number of individuals. Secondly, any surplus profits were to be fed back into research. Foundation B has a 60-year history and originated from a pre-existing pharmaceutical company, Company B1. It is the majority shareholder of the multinational pharmaceutical companies, Company B1, Company B2 and another company, Company B3. Foundation B was initiated by the widow of the pre-existing company’s founder “with the purpose of ensuring and expanding Company B1’s business, as well as providing financial support for primarily scientific objectives and the fight against diseases”. Foundation C was only recently established in 2012. In its short history, foundation C has had a close collaboration with Laboratory C. It has also established Company C, a company responsible for commercialisation aspects of academic innovations. The motivating factors of the founder, a researcher, included a disagreement with how the pharmaceutical industry conducted the development of new treatments and a dissatisfaction with the common commercialisation pathway for academic research. The benefit of setting up a foundation was that the success of research would result not in significant personal wealth but rather that the surplus profits would go back into further research to benefit society as a whole. Foundation D was established only in 2015. The greatest motivating factor for the founder, a senior professor, was his disappointment in the current commercialisation and knowledge transfer pathways for university research and innovations. The main objective of foundation D is to provide funding to further research. Regardless of the revenue stream (licensing agreement, dividends from a spin of company) foundation D will be will be responsible for redistributing any excess profit to the research community.

The most universal theme amongst the four foundations was that the foundations are motivated by societal benefit. These findings align with previous studies that at the core of social entrepreneurship is societal benefit, as opposed to personal and shareholder wealth (Austin et al., 2006; Zadek & Thake, 1997). That is not to say that commercial activities are not of interest to these four foundations but rather secondary to societal objectives. As is the case with social enterprises it appears as the commercial activities are a means to social ends (Ebrahim et al., 2014). The lesson to be taken by the foundations is that the objective of societal benefit is not achievable without commercial success. For Foundation C, the motivation for establishing a foundation was to achieve an objective of bringing life-changing therapies to the public for less cost than current pharmaceutical development. Revenue is needed to fund research and sustain the foundation but the scientific community and society are the largest beneficiaries.

A key theme among the foundations in this study was a disinterest in short term objectives. The vision and objectives of the four foundations studied remain largely the same today as when they were founded. Quality research that is not dictated by quickly obtained

economically promising results can be carried out and the commercial companies owned by these foundations have the freedom to be innovative and plan for the future without having to generate rapid, high revenues. The findings of this study suggest that the long term approach of the foundation model has the potential to be the means by which academic researchers source long term funding without being concerned about the demands of a corporate investor. These foundations have the freedom to act in this manner as they are not required to answer to shareholders.

The commercial companies owned by the foundations are managed and driven based on share price and financial performance. These companies pay surplus profit in the form of dividends to the foundation, which then redistributes the money to research via grants, research centres and other charitable activities. The commercial companies do not receive first right to commercialise or any other direct benefit. They receive the same benefit that the entire industry and research community does – increased funding. This is the opposite to the drive of the owning foundations, which are driven by societal benefit. There is little to no conflict of interest between foundation and the companies they own and they complement each other. For this reason, there is little risk of mission drift. The commercial companies are concerned with commercial activities whilst the foundation is concerned with social activities. Together they interact to form a sustainable perpetuating entity. It is this feedback loop that is important in distinguishing this potentially new model from social enterprises or other foundations.

The governance structures of these foundations is crucial to their survival. Hybrid organization literature has suggested that one of the greatest conundrums for the foundations is ensuring they give equal focus to both their societal and commercial activities (Ebrahim et al., 2014). These foundations involve a perpetuating entity with efficient governance at its' core. Whilst Foundation A and B are strictly self-governing, on a governmental level, law prevents them from favouring profit over achieving their societal mission. However, it is not the law that has rendered these foundations so prosperous but rather that the motives and vision of the founders are reflected in the governance structures. An example is Foundation A, which when founded had a main objective of solving societal problems. Additionally, the foundation was to ensure that any companies that it owned survived as long as the foundation did. Along with other conditions, these two were written into the statutes of the foundation

The concept of trust was alluded to throughout this study. It appears as though trust is crucial to the governance and long-term success of research-funding foundations. Commercial companies gain an element of trust from any investors or partners by being a majority foundation owned entity. The foundation appears to be trusted by the public, improving its potential to achieve its objective of benefiting society. A subtler aspect is the element of trust between all actors within this model. The realization of these foundations relies on the fact that researchers, companies, the industry, the foundation and investors all have trust in the other components of the system. One of the greatest challenges for hybrids is the division of their activities and the development of governance structures that will not jeopardise their social mission (Battiliana et al., 2012; Ebrahim et al., 2014). The findings of this study show that the segregation of activities, following a structural hybrid logic, in these research-funding foundations can be attributed to their success, however it is also important to emphasise that the foundations do so in a way in which all actors and entities of the model still remain interconnected.

While the governance of the foundations appears to be very efficient, it looks to be exclusive to this structure of foundations. However, it appears that it is the dual objectives and dual entities that makes this arrangement so effective. Without the commercial companies the foundation has lost a source of revenue and without a foundation ownership structure the companies are required to revert back to short term business strategy to satisfy shareholders.

Conclusions:

Our study presents a governance structure where both financial and social values go hand in hand and a business model that overcomes mission drift. The findings indicate that the success of the foundations can be partially attributed to their efficient governance. Practically, these foundations are governed by a self-renewable board of directors that act in accordance with law and the statutes written at the point of establishment. The foundation-owned companies that commercialize medical innovations and the foundation itself have a mutually beneficial relationship. The foundation receives dividends from the companies to redistribute for its social cause and the companies receive reliable ownership and an image of trust. The key to this relationship is that the foundation is driven by societal objectives and the companies are driven by business objectives – there is no cross over.

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DYNAMICS OF MARKET FORMATION: A NEW APPROACH FOR ANALYZING INNOVATION-INITIATED EMERGENCE OF NEW MARKETS

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Aim of the proposal:

Radical innovations and emerging technologies have the potential to contribute to tackling the major challenges facing society. There are, for example, high expectations for gene editing technologies and tissue engineered organoids in the treatment of diseases with unmet medical needs. Likewise, there are high hopes for renewable technologies that can lead to a more circular economy and a more sustainable society (Ghisellini et al, 2016).

In studying emerging technologies for transitions and addressing societal challenges, different aspects of innovation systems and innovation processes have been analyzed. For example, innovation and transition studies have paid much attention to the R&D phase, as well as experimentation with innovations (Hekkert et al, 2007; Geels and Schot, 2008). In many functional areas, such as energy provision, it has been recognized that there are numerous technological solutions already existing that could, if put into broader use, help to reduce carbon emission substantially. Therefore, the last few years have seen a shift in focus towards the question of how innovations can scale up and diffuse (Hyysalo 2018; Köhler et al, 2019). The demand side of innovation processes and the associated challenge of forming new markets is becoming increasingly central again (Boon & Edler, 2018). This raises the theoretical question, so far underdeveloped in transition studies (Köhler et al), of how we should understand and support market formation for radical innovations.

Background:

Therefore, this paper first critically reviews what has been learnt about markets and market creation in different bodies of literature ranging from STS, institutional theory to marketing studies. From these bodies of literature we then formulate 'functions' that need to be fulfilled in order to create and enlarge markets that are able to accommodate the radical technology. For a definition of radical innovations we start from the one provided by Chandy and Tellis (1998) who regard radical innovations as new products or services that "incorporates a substantially different core technology and provides substantially higher customer benefits relative to previous products in the industry". The definition emphasizes shifts in technological aspects just as well as the extent to which user preferences are changed through the introduction of the innovation (Tripsas, 2008). We utilize the mainstream economics definition of markets as structures that allow for exchange of goods or services between sellers and buyers. As we are interested in markets for innovations, we deal with markets on the level of aggregation of product or service markets.

For potentially radical innovations, there are usually no markets yet, which means that new markets must be constructed or that existing markets must be thoroughly changed. Questions that need to be answered are who the potential consumers are, what their preferences, needs

and abilities are, and which functionalities of the innovation should be emphasized to address these needs (Rosenberg, 1972). Many dimensions of the market are subject to uncertainty (Bergek et al, 2008). To deal with this uncertainty and to ensure societal embedding of their products, entrepreneurs must not only develop radically new technologies but must also engage in collective action with others to create markets (Van de Ven & Hargrave, 2004). Market creation is partly a cognitive process in which consumers are ‘taught’ or convinced how and why to use a product. Next to that, market creation is also regarded as institutional work as new institutions, such as standards or ways of exchange, need to be formed and accepted (Hughes, 1983; Moors et al, 2018). So, markets are not necessarily the result of possibilities opened up by emerging technologies, they can also be created in an active way involving a wide array of actors.

Increasing our understanding of market formation for radical innovations is necessary from the perspective of both users of innovations, producers and policymakers. These three groups of actors have cognitive, normative, material and institutional stakes involved. Users may want to be able to proactively bend the characteristics of the market in such a way that it fits their particular needs and wishes. Moreover, they might want the market to be organized in such a way that it is not running counter to their operations, values or perception of control. Producers are interested in optimizing their influence on the process of market creation through e.g. marketing activities and institutional entrepreneurship, i.e. actively aiming for the implementation of divergent changes (Battilana et al, 2009). From a policy perspective, there is increasing attention to tackling grand societal challenges. These challenges can only partially be met through supply-side measures. For ‘missions’ and transitions we need to emphasize the demand side. Weber and Rohracher (2012) drew attention to the difficulty of “anticipating and learning about user needs”, which they marked as the ‘demand articulation failure’. Governments have an interest in advancing the demand side and even co-create markets, e.g. because they are consumers of innovations as well (Edler & Georghiou, 2007) or because they follow a public interests in fixing certain markets (Robinson & Mazzucato, 2019). The functions that we want to discern are points of departure for policy to intervene.

Methodology and empirical base:

To understand market formation for radical innovations we first mobilize three bodies of literature (sociology of markets, marketing and business studies, and transition studies) from which we have drawn elements that are significant in the formation of markets and were included in a conceptual framework. We then apply the market formation framework to three cases: digital health technologies, carsharing, and 3D printing of biomaterials.

Results:

The results and conclusions sections will develop a functional approach for understanding and supporting market creation for radical innovation. It is currently work in progress but will be finalized before the Eu-SPRI conference in June, where it will be presented to the community for the first time.

Conclusions:

The results and conclusions sections will develop a functional approach for understanding and supporting market creation for radical innovation. It is currently work in progress but will be finalized before the Eu-SPRI conference in June, where it will be presented to the community for the first time.

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C3 SOCIAL INNOVATION 3

Wednesday 05 June 2019 from 16:30 to 18:00

MATTHIAS WEBER, Chair

Abstract 150

INNOVATION CAPABILITIES OR SOCIAL NEEDS: WHAT DEFINES THE SPATIAL DISTRIBUTION OF SOCIAL INNOVATIONS?

Kadyrova A.*

Alliance Manchester Business School ~ MANCHESTER ~ United Kingdom

This paper analyses the spatial location of social innovation compared with business innovations (so-called 'market' innovations). The research investigates the effects of variables identified in the geography of innovation studies (such as university or industry R&D expenditures, social and human capital indicators) and the variables related to the non-profit sector and social needs (such as growth of unemployment, poverty, decline in the GDP per capita or gaps in the public services) on social innovations and business innovations.

Numerous studies have demonstrated the effects of the R&D, human and social capital on inventive activity and innovative outputs. However, there is less understanding of what influences social innovation to emerge in certain places. The paper studies the differences in the location of social innovation and business innovation. For 65 European (NUTS 2) regions, I introduce four regression modes to examine associations with two dependent variables for contrasting types of innovations – the number of PCT patent applications and the number of social innovation projects.

The findings indicate that both patent activity and social innovation activity tend to concentrate in more economically developed and heterogeneous regions. Business innovations depend more on skilled human capital, while social innovation is driven by active civil society. However, both benefit from the overall innovation and entrepreneurial infrastructure in a region. The research has not found any evidence of association between the level of social deprivation and social innovation activity, contrary to the expectations.

Abstract 10

CROWDSOURCING AS SOCIAL INNOVATION FOR URBAN SUSTAINABILITY GOVERNANCE IN EUROPE¹

Certomà C.*[1], Corsini F.[2]

^[1] Ghent University ~ Ghent ~ Belgium, ^[2] Sant'Anna School ~ Pisa ~ Italy

Introduction:

Does the wide appreciation for crowdsourcing as short way toward greater democratization and participation in European academic research and research-oriented projects, actually correspond to a genuine interest in practice-oriented initiatives at local level?

To answer this question, we describe EU strategies for digital social innovation and participatory governance; and explore the meaning, the aims, the tools and the models adopted in crowdsourcing processes for public governance. This introduces the explorative section providing quali-quantitative analysis of how crowdsourcing for public governance is described in scientific and grey literature, research-oriented projects supported by EC and non research-oriented projects. On the base of our results, we considered whether, and under what conditions, crowdsourcing can foster sustainability governance via participation and social innovation practices.

1. Changing governance processes for a changing Europe

1.1 Digital social innovation for Europe

Building upon Lisbon's principles of opportunity, access and solidarity for the integration of social and environmental priorities into the new *Europe2020* strategy toward a smart, sustainable and inclusive growth, the *Bureau of European Policy Advisers* called for a new "enabling welfare state" relying on social innovation. Europe 2020 Flagship initiative and "*European Digital Agenda*" further pointed out that digital infrastructures are to be considered as fundamental enabling factors for addressing societal and environmental challenges via digital social innovation processes.

1.2 Using crowdsourcing for public governance

While some governments are familiar with crowdsourcing's benefits in traditional policy-making and the European Commission itself engaged in digitalising democracy, the possibility for crowdsourcing to transform governance has been only marginally investigated. In this regard, researchers demonstrate that crowdsourcing fuels the emergence of a new governance model characterised by distributed technological agency in demand-driven participatory processes.

2. Exploring crowdsourcing research and projects in Europe

2.1 Crowdsourcing in scholarly research and research-oriented projects

We used a bibliometric methodology to explore an overall set of 723 scientific articles.

¹This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 740191.

Results showed that crowdsourcing progressively entered the public domain in the last 5 years; and that from being considered a mere tool, it is now appreciated as a process, i.e. an coherent operative approach suggesting alternative pathways for achieving desired goal. Moreover the urban context emerged as the privileged locus for tackling with sustainability issues via crowdsourcing processes.

We compared these results with a review of the European projects databases (including Horizon 2020 and Seventh Framework Programme projects). Retrieved data confirm the evidences we got in 2.1: projects dealing with sustainability issues (food production, biodiversity and urban ecology, air pollution and decarbonisation, mobility, participatory landscape and planning, green economy) represent the vast majority of crowdsourcing-related projects, accounting for almost 25% of the total projects, and the 56% of sustainability related projects are carried out in urban contexts.

2.2 Non research-oriented crowdsourcing projects

Building on 2.1, we explored (via data-mining) non research-oriented crowdsourcing projects, supported and funded by networks of cities, local institutions, private associations or CSOs. In consideration of the CROWDWEEK Europe2018 these are described here with greater details. In re-thinking traditional participatory processes, non research-oriented crowdsourcing projects are often aimed at providing citizens with participatory tools for reporting social, infrastructural or organizational problems. Citizens become “eyes and ears” of the administration, detecting and documenting problems that need to be solved. This is basically an information-harvesting process deploying the potentiality of IoT that allow personal IC devices to interact with a central platform via dedicated software applications. FixMyStreet portal, for instance, is produced by mySociety, a non-profit social enterprise based in the UK, and provides citizens with dedicated online tools for mapping and reporting the data they want to build claims on. While this kind of projects requires citizens’ judgment about what actions are advisable to be taken by the administration, a passive collaboration in crowdsourcing platforms occurs when citizens are simply required to act as living sensors’ for recording, with dedicated tools, data about air quality, traffic and mobility, consumption behaviours and similar, or by taking part in closed-question surveys. The matter of concern data are collected about is not, in these cases, suggested by citizens, by rather pre-given by the promoter of the crowdsourcing platform, as exemplified by MK: Smart project by Milton Keynes city. Again, private companies, most often urban planning companies, also issue data collection initiatives, as exemplified by Citying platform. More commonly crowdsourcing processes are adopted in the public governance sphere for raising innovative ideas toward greater social cohesion and sustainability via digital suggestions box, as exemplified by CitizenLab or PublicLab toolkit. This last is aimed at citizens’ consultation and has been adopted by a number of cities in Denmark, Belgium, Germany and France. Again, the platform Otwarta Warszawa managed by Million You company collects people’s idea on urban development, in collaboration with the City Council who is called on deciding about emerging proposal. With the significant results of more than 60% of the population using the platform, Better Reykjavik represents an outstanding initiative connecting Reykjavik City Council with citizens whose main concerns can be acknowledged and prioritized via dedicated development projects. It is equally common to find public administrations or CSOs organizing contests for community-based projects proposed by lay citizens with the goal of planning or managing specific areas or services in the city, or, in reward of the funds to operationalize the

project itself. Suggested projects are always required to meet the goal of increasing sustainability and providing wide social benefits. Significant examples are the Prize2theFuture contest implemented by the Community Foundation of Greater Birmingham.

Crowdsourced contests are often included in participatory budget framework, as it was the case of the BurgerBudget call in Ghent for citizens-driven projects aimed at greening and making more socially inclusive, cohesive and sustainable neighbourhoods. Similarly in Paris the Madame la Maire J'ai une Idée platform has been provided by the city council to harvest ideas for participatory budget. Slightly different are crowdsourcing platforms used as consultation sites, as in the Imaginons Paris Demain case, where citizens have the opportunity to express their opinions on already existing (and sometimes contested) urban development projects.

Crowdsourcing platforms are also used for collecting funds; these initiatives go under the name of crowdfunding and they are increasingly adopted by local administration to attract project ideas and co-found those gathering more private donations (e.g. Speehive or Crowdfunding.gent by Gent City Council). As part of e-government initiatives crowdsourcing platform are also used for citizens to directly take part in the policy-decision process, parties electoral programs (e.g. Better Reykjavik) or legislative initiative (e.g. Citizens' Initiative Act in Helsinki). Finally, spontaneous initiatives from the ground-up focusing on urban regeneration, sharing economy (Peerby, Reusit, Freecycle), commons (Commons), collaborative planning (Impossible living) for urban sustainability are increasingly adopting crowdsourcing tools and proposing crowdsourcing-kind processes for supporting citizens engagement and empowerment in social innovation processes.

3. Crowdsourcing for public governance innovation

Non research-oriented projects are in general punctual and context-based as promoters themselves are willing to invest resources in cogent issues that attract a wide interest at local level. Moreover, while EU-funded research-oriented projects often rely on the collaboration of researchers, non research-oriented project often adopt a limited set of tools and, in consideration of the need to involve a broad range of differently technology-educated citizens, opt for userfriendly software. When considering crowdsourced topics, there are no significant differences in terms of general area of interest (e.g. mobility regulation, spatial planning, biodiversity and green areas management, energy efficiency...). However, while EU-funded projects tend to provide indeep explorations of a single issue, non research-oriented projects rather provide general platforms that can be used for tackling with a broad range of issues. Data-collection initiatives are often promoted by administrations that acknowledge the integration, interpretation and use bigdata for policy production as a priority; nevertheless citizens are likely to participate on the base of their socio-political commitment and the collaboration with CSOs and NGOs is often sought to this end. In all these cases, crowdsourcing is understood and adopted as a tool for complementing and expanding the possibility of face-to-face participation, rather than for advancing a brand new one.

In fact, participation, especially when understood as a form of engagement, requires the integration of online and offline processes. As a consequence, spatial proximity of the crowd, visibility of the issue and affectability (i.e. actual capacity to impact on the issue) can be regarded as necessary conditions for successful non research-oriented crowdsourcing initiatives.

We started our paper with reference to the EC's support for the social participation and innovation processes in public governance as an important complement of the Europe2020

strategy. Being a social innovation process, crowdsourcing promotes social cohesion and inclusiveness because “bringing people together from diverse backgrounds would help overcome negative stereotypes or prejudiced assumptions and encourage understanding, tolerance and trust” (Davies and Simon 2012). And we know that trust is the “most valuable currency” in engagement, sharing, and co-creation experience, especially in our age of diffidence and hostility (Nekaj 2018).

Abstract 23

SOCIAL INNOVATION – CHANCE AND CHALLENGE FOR UNIVERSITIES AND SSH

Howaldt J.*, Domanski D.

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Aim of the proposal:

Like technological innovations, successful social innovations are based on numerous presuppositions and require appropriate infrastructures and resources. It will be a major challenge for the development of social innovation to ensure a much higher involvement of research and education facilities. In these processes social sciences will be challenged to redefine their functions with regard to innovation. In the past, innovation research in the context of social sciences has contributed to explain the social dimensions, the complexity and paradoxes of innovation processes. Henceforth, much will depend on realigning the range of competencies of social science by contributing actively to the development of social innovation. Against this background participatory approaches that promote involvement and empowerment of civil-society actors are indispensable.

Methodology and empirical base:

As the global mapping of the SI-DRIVE project has shown, lack of knowledge is one of the biggest barriers for successful development of social innovations. This is also because usually knowledge exchange among academic and non-academic actors is not systematically supported in a regional ecosystem. The approach of the SIKE project (“Social Innovation through Knowledge Exchange”) demonstrates in international case studies the potential of universities to use their knowledge by developing new paradigms and tools for targeted exchange among actors from all societal sectors. At the same time, it shows how universities can learn from other organisations, which have more experience in supporting social innovation.

While SIKE’s approach of universities learning from practitioners is quite unique, currently, there is an emerging generation of Erasmus + projects (e.g., Strategy for Change, LASIN, SEASIN), which are seeking to transform the role of HEIs to become social innovators.

Theoretical Background:

The results of the global mapping of the SI-DRIVE project demonstrated that social innovation processes and the underlying resources, capabilities and constraints are related to the actors of the different sectors of the social innovation ecosystem. This includes a new role of public policy and government for creating_ suitable framework and support structures, the integration of resources of the economy and civil society as well as supporting measures by science and universities (e.g. education for social innovation performance, know-how transfer).

This also raises the question about the role of universities in general and of social sciences in particular in social innovation processes. The marginal engagement of research and education facilities shown in the mapping is in strong contrast to their essential role as knowledge providers in classical innovation processes and as one actor of the triple helix model. That

means that at this time we find an uncompleted eco- system of social innovation (quadruple helix) with one important pillar missing. It will be a major challenge for the development of social innovation to ensure a much higher involvement of research and education facilities.

The shift in focus towards social innovation means more than just taking new or other phenomena into account. To the extent that something new occurs at the level of social practices and not in the medium of technical artifact, a fundamental conceptual realignment in innovation research is necessary. It relates "to living together in communities and society" and concretely means "new forms of participation and social integration, of reconciling interest and social justice as well as individuality and solidarity" (Rammert 2010, p. 43).

Against that background, the role that Higher Education Institutions (HEIs) are playing in social innovation has evolved in recent years. Besides researching transformation processes, more approaches in which science itself is considered as an active participant in processes of social innovation are increasingly coming to the fore. Concepts such as Design Thinking or Transformative Research with focus on active participation of stakeholders are becoming more important for the work of HEIs with their environments (Schneidewind/Singer-Brodowski 2013). Through transformative research, science seeks to solve societal problems by activating processes of societal change. Against this background, the creation of appropriate structures (Living Labs and other spaces for exploration and learning) that help to develop knowledge based on experience in order to establish new social practices has received growing attention and needs to be further promoted. Only by sensitising people about societal problems and possible solutions, HEIs can advance the development of social innovation with community members. Through concepts, such as Service Learning or Explorative Learning, knowledge and experience of students are taken on and links between academia and society are developed, with the latter becoming an important partner in addition to economy. This also includes the question of new modes of knowledge production and scientific co-creation of knowledge aiming at an integration of practitioners and social innovators in the innovation processes (Nowotny et al. 2001).

The approach of the SIKE project ("Social Innovation through Knowledge Exchange") demonstrates the potential of universities to use their knowledge by developing new paradigms and tools for targeted exchange among actors from all societal sectors. SIKE is forging alliances between the stakeholders of the social innovation ecosystem, from business, local government, civil society organisations and community groups. For this purpose, the project has developed the concept of SIKE Units (Social Innovation through Knowledge Exchange Units) . SIKE's claim is to demonstrate that to successfully support social innovation a university needs a unit that would specifically develop and adapt knowledge exchange tools and processes to the needs of social innovators. Hence, the SIKE approach argues that universities should support social innovation in a systematic way beyond single (sometimes quite random) initiatives and activism. A SIKE Unit is the next step towards institutionalisation of social innovation through universities. Moreover, the explicit notion of knowledge exchange clearly places universities as conscious actors within the social innovation ecosystem: they proactively assume the task of facilitating the exchange, flow and co-creation of knowledge.

There are many ways how SIKE Units can contribute to knowledge exchange within the social innovation ecosystem. They can boost innovation within the participating institutions and the broader socioeconomic environment by jointly developing and implementing new multidisciplinary, problem-based continuing educational programmes as well as jointly developing solutions for challenging issues and developing social innovation practice. They can help to develop socially entrepreneurial mind-set and skills, creating schemes of

transversal skills learning and application in cooperation with social enterprises aiming at strengthening employability, creativity and new professional paths. In addition, SIKE Units open up new learning opportunities through the practical application of socially entrepreneurial skills, which can lead to the commercialisation of new services, products and prototypes, to the creation of start-ups and spin-offs.

However, SIKE's approach not only sees HEIs in their role as facilitators, moderators or brokers within the ecosystem, but also as social innovators. An important function of the SIKE Units is to develop (or to participate in the development of) social innovations. Against this background, SIKE directly involves – along with HEIs – non-academic actors as project partners in each one of the regions where it is operating. Usually, universities are not the most experienced social innovators. There are many organisations in other societal sectors with a longer tradition of developing social innovations. SIKE is aiming at creating opportunities for universities to learn from practitioners, such as SMEs, NGOs or social enterprises. Hence, while the idea of the entrepreneurial university is not new, the concept of HEIs as social innovators is still largely unexplored.

While SIKE's approach of universities learning from practitioners is quite unique, currently, there is an emerging generation of Erasmus + projects (e.g., Strategy for Change, LASIN, SEASIN), which are seeking to transform the role of HEIs to become social innovators. Some projects mainly focus on the role of transfer offices and outreach units, while others try to explore the potential of students and teaching staff. "Students for Change: Social Entrepreneurship in Academia" is developing a pedagogical method for universities to teach and train university entrepreneurs and innovators with the necessary skills and knowledge to be active players implementing social innovations. This approach seeks to position HEIs as actors who – as social innovators – play an active role in regional development. This project also aims at the institutionalisation of social innovation: one concrete goal is to convince university leaders and decision-makers to integrate social innovation in curricula of formal academic programmes.

Results:

Nevertheless, there are several challenges that HEIs need to meet in order to advance in the area of social innovation. First, they need to better understand what social innovation is: while more and more HEIs recognise the importance of social innovation for societal development and the need to engage in this area, they do not necessarily understand what social innovation is exactly about (e.g., it is often confused with the area of University Social Responsibility, which does not necessarily refer to (social) innovations). Hence, as long as those who work in this area and aim at introducing change have no clear concept and understanding of social innovation, it will be difficult to succeed.

This leads us to the next challenge. The topic of social innovation should be integrated along the three missions. On the one hand, social innovation is appearing on a growing number of universities' agendas, sometimes even becoming an important part of their development strategies. Some universities offer classes and degrees, such as Master or Bachelor. Others focus on research in social innovation. Probably the most common way for universities to engage in this topic that we can observe is related to manifold activities within what is usually referred to as the third mission (here mainly understood as social responsibility, outreach and engagement). On the other hand, we can rarely see a university where social innovation is major part of the strategy and integrated in all three missions (McKelvey/Zaring 2017). Therefore, the challenge is not only to develop activities in teaching, research and the third

mission. It is the issue of integrating social innovation along the three missions in a comprehensive way: the work in every 'mission' needs to be connected to the work in other missions, so that it can benefit from the others.

Third, there are two interrelated, fundamental characteristics of university support for social innovation that need to change: i) social innovation support activities tend to be ad hoc and largely altruistic, ii) as a result, while technological, commercially oriented innovation is recognised and institutionally supported by well-established knowledge transfer offices, there is no professional support function within universities for supporting social innovation. Until now, neither the infrastructure nor the funding has existed to make this possible, largely because governments and even university executives have been resistant to the notion of social innovation as an effective socioeconomic instrument. The adoption of social innovation at a policy level by governments throughout the world is creating an environment in which institutional support for this area becomes increasingly prevalent with funders willing to invest in projects.

Fourth, there is a challenge of integrating both the top-down and the bottom-up perspective. Usually, when universities assume their role as socially responsible institutions regarding their environment, they start developing initiatives, which are supposed to favour different target groups (e.g. communities). However, such initiatives tend to be designed and implemented from the university's perspective, missing to involve the target group right from the start. It is not surprising then that projects developed by HEIs do not necessarily respond to the needs, the ideas and the visions of communities and other target groups. HEIs have to learn how to work with target groups on equal footing and how to integrate their own perspective with the latter's perspective (Anderson et al. 2018, pp. 51 et seq.).

Conclusion:

In the increasing discussion on social innovation new participatory concepts for social science research have been developed. While there are a lot of differences with regard to the field of action, their objectives and the addressed problems these approaches are based on the idea of developing research and innovation process with and for society.

In these approaches, social sciences are challenged to redefine their functions with regard to innovation and societal transformation. This goes far beyond a better understanding of science or new concepts of transfer, but deeply affects the traditional academic ways of knowledge production. New modes of the production of social science and the social production of science will become necessary. "Mode 2" has been the label tagged to this newly emerging type of knowledge production by Nowotny et al. (2001) mostly referring to natural or engineering sciences.

There is a large gap between the traditional understanding of social research and science and the new mode of generating socially robust knowledge under the framework conditions as we have outlined them. The new mode of knowledge production will definitely require a thorough review of the classical quality criteria of what is scientific along with the development of new concepts, methods, procedures and organisational structures. The discussion about such an innovative approach to the production of social science as a process of social production could be very valuable for understanding the specific contribution of the social sciences to processes of innovation and societal transformation¹.

In the past, innovation research in the context of social sciences has contributed to explain the social dimensions, the complexity and paradoxes of innovation processes. Henceforth,

much will depend on realigning the range of competencies of social science as well as social scientists by contributing actively to the development and integration of innovations as well as by developing social innovation. The great challenge for contemporary innovation research lies in analysing its potential in the search for new social practices that enable us to secure the future and allow people to live 'a richer and more fulfilled human life' (Rorty 2008, p. 191). In these processes, social sciences will be challenged to redefine their functions with regard to innovation.

In the past, innovation research in the context of social sciences has contributed to explain the social dimensions, the complexity and paradoxes of innovation processes.

Henceforth, much will depend on realigning the range of competencies of social science as well as social scientists by contributing actively to the development and integration of innovations as well as by developing social innovation. Against that background, participatory approaches that promote participation and empowerment of civil-society actors are indispensable (Howaldt/Schwarz 2010). The requisite know-how is found not only in the sociology of technology, economic sociology, and organisational sociology (cf. Blättel-Mink 2006) but also in the debate about the importance of stakeholder involvement to increase the impact of the social sciences and humanities (Spaapen/van Drooge 2011). This also includes the question of new modes of knowledge production and scientific co-creation of knowledge (Nowotny et al. 2001) aiming at an integration of practitioners and social innovators in the innovation processes (Soler Gallart 2017).

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¹Against this background social innovation research can be seen as important part in the debate on Responsible Research and Innovation in Europe (European Commission 2012; von Schomberg 2013)

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C6 MISSION ORIENTED REASERCH 1

Wednesday 05 June 2019 from 16:30 to 18:00

CATALINA MARTINEZ, Chair

Abstract 16

A STUDY ON THE PERFORMANCE INCENTIVE OF MISSION-ORIENTED RESEARCHERS - A CASE FROM THE CHINESE ACADEMY OF SCIENCES

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Chinese Academy of Sciences ~ Beijing ~ China

This study is based on the practice of Chinese Academy of Sciences (CAS) since 1985. First, the study aims to summarise the high-performance incentive mechanism established by the fast-developing and mission-oriented research institute, i.e. CAS. Second, the study will analyse the background, effects and issues of the model in question. And last, this paper aims to bring up suggestions aiming at the performance incentive of mission-oriented researchers in the context of sustainable development.

As one of the largest and most advanced state research institutes in China, CAS has been served the state's needs since 1949. Serving as a typical state mission-oriented research institute, CAS has been exploring the policy mechanism that fit its position within decades, and has realised that researcher is the key element in S&T innovation and development. Thus, how to stimulate researcher's motivation is one of the major issues that has been taken into serious account. Observing from the macro environment, China experienced a stage of low level of S&T development and shortage of research talents since the reform and opening-up. And due to the fact that China was following the central planned economy system, a proper performance incentive mechanism was disregarded in the sense that China could not refer to the models and policies of developed states for both historical and technical reasons. And this triggered the idea of creating an innovative, self-catered performance incentive mechanism.

Methodology:

This study first adopts the historical policy analyses and case study methods to summarise the performance incentive mechanism of CAS as of institute foundation. Second, the study employs case studies, interviews and questionnaires to collect the feedbacks on the outcomes and effects of the policy implementation. And last, the study combines quantitative and qualitative analysis methods to suggest the historical background, effects and issues remained and bring up policy implications in the context of long-term sustainable development.

I. The establishment of CAS high performance incentive mechanism CAS was the first to suggest the concept of 'labour remuneration' in China. Served as a public institution, its salary system strictly followed the relevant state management policy. And in 1985, Chinese government established a structural salary system based on staff position level, in which the salary basement was highly regulated by central state. According to the salary level then, the position salary of a first-level researcher per month was 315 RMB, the basic salary was 40 RMB, the seniority allowance was 20 RMB, and the fixed income salary was 375 RMB, which hardly retained researchers motivated. In order to tackle this issue, CAS and Ministry of Finance (MOF) co-published a file of "Interim measures on the income and revenue distribution management of CAS and affiliated institutes" in 1992, stating that 40%-60% of the project funding surplus can be awarded as labour remuneration to the relevant staff; further, a 20%-30% of S&T service income, i.e. revenues from technology transfers, consulting, trainings, exhibitions and communications, can also be allotted to the relevant

staff. This interim standard played a crucial role in encouraging researchers to devote themselves in participating various types of state projects.

Besides the aforementioned methods, CAS also introduced a tripartite-structure salary system that incorporated basic salary with position allowance and performance payment. Basic salary and position allowance are remunerated by state fiscal allocation, whilst the last, which derives from project funding, revenues of technology transfer and S&T service and donations, is normally financed by research institutes or teams. The performance payment is closely associated with quantitative indicators, i.e. publications, project numbers and funding amount. With the fast increase in both comparative and social projects, the performance payments in most institutes exceed 60% of the total salary, or even reach 90% in certain institutes. The performance payment has become one of the major determinants of researcher's salary level.

In addition, CAS has been pushing the state policy reform in the related field. Since the establishment of the tripartite-structure salary system, other universities and research institutes have followed the similar step to propel the salary reform of reimbursing performance payment by using project funding. For example, Chinese government instituted the concept of indirect costs in project funding for the first time in 2009, in order to reimburse the performance payment of the relevant researchers. The ratio of indirect costs raised up to 30% in 2018, and in certain fields, i.e. basic research and pure theoretical research, the ratio may exceed 30%.

II. The background, effects and issues of CAS performance incentive policy making

CAS has established a series of high performance incentive mechanisms in the context of low level of S&T development and policy vacuums. In the late 80s and early 90s, the salary level showed no obvious difference between researchers and other civil servant, in the sense that both remained a rather low level. This can be attributed to the lack of modern management mechanism due to the macro policy environment of planned economy system. Yet later in 1985, Chinese government began to increase investment in S&T development and introduce market and comparative mechanism to initiate S&T management reform for better resource allocation, in which 'projects' started to play an important role in financing scientific research. Under this macro environment, CAS suggested the concept of labour remuneration in order to promote researchers' salary level. And in the later Knowledge Innovation Project, CAS institutionalised the concept and introduced tri-partite salary mechanism. This series of practices highly promoted the salary level of the existing researchers and also attracted numerous excellent researchers on the nationwide level, which impelled the fast development of CAS and urged CAS to better serve the state for its needs.

As mentioned before, this set of high performance incentive provided a policy base in the fast developing stage, yet it hardly caters to aim of long-term sustainable development. High performance incentive mechanism played a crucial role in the preliminary period of policy implementation; later however, it aroused a series of systematic problems: First, researchers tend to apply multiple projects and participate in social activities simultaneously; second, the instability of salary level frequently afflicts the researchers; third, much devotion in social or state projects deviates researcher's concentration from high-risk and long-term research activities; and fourth, researchers tend to dedicate in project managements and evaluation that decreases state S&T investment efficiency.

Findings:

CAS, a typical state mission-oriented research institute, established a series of high performance incentive mechanisms in the social context of low level of S&T development and policy vacuums. This series of policy models and practices highly motivated researchers, with which China's research level and talents training have witnessed a huge growth in the last 30 years, i.e. the SCI publications have exceeded USA and ranked no.1 on the worldwide level ; the high-level publications have witnessed a rapid increase over the years; and further, a growing number of high-level research teams emerged due to the fast-developing research level, which laid a solid foundation of research talents for the scientific community.

As mentioned before, the high performance incentive mechanism at that historical period achieved the very goals of motivating the researchers, talents selection and fast advancement in S&T research. However, China has shifted its S&T development goal from fast growth to original innovation and major breakthroughs. Therefore, this series of management mechanisms, including resource allocation, evaluation, performance incentives, may not be able to cater to its need and thus call for further consideration and reform.

Key words: CAS, mission-oriented institute, performance incentive

Abstract 55

MISSION ORIENTED INNOVATION SYSTEMS

Hekkert M.*. Negro S.

Utrecht University ~ Utrecht ~ Netherlands

Aim of the proposal:

This paper presents a new framework to analyse progress made in realising mission oriented R&I policies: mission oriented innovation systems.

The paper will argue that existing frameworks from our community like national innovation systems, sectoral innovation systems and Technological Innovation Systems are not suitable for measuring progress towards societal missions.

Societal missions provide very clear guidance to an innovation system to reach a specific societal goal within a specific time frame. This clear guidance and urgency is missing in the sectoral and national innovation systems frameworks. In the technological innovation system this type of guidance may be present but also this framework is not suitable to map progress made regarding societal missions since societal missions are hardly ever reached through a single technological solution.

Mission oriented innovation systems differ from technological innovation systems in the sense that mission oriented innovation systems encompass all actors and institutions that contribute to the realisation of a societal mission. These actors may work on different technological and non technological solutions and may be part of several sectors.

The challenge for an mission oriented innovation system is that on one hand coordination is highly needed to reach the societal missions within the given time frame while coordination is also very hard through the large variety of stakeholders involved with very different backgrounds.

This paper will do a number of things:

1. define a mission oriented innovation system
2. characterise expected dynamics in a mission oriented innovation system
3. explicate the policy challenges of guiding a mission oriented innovation system

Background:

Mission oriented innovation policy is a new policy framework that is rapidly gaining momentum. Yet, a proper framework that helps policy makers how to design mission oriented innovation policy is missing. Existing frameworks do not provide what policy makers need. Therefore, we propose a framework that is specifically tailored for this purpose and rooted in the long tradition of innovation systems thinking of the EU-Spri community

Methodology and empirical base:

The paper is an analytical think piece that proposes a new framework and elaborates what this framework can do for mission oriented innovation policy

Results:

The result will be the explanation of a new mission oriented innovation systems framework that can be used to map progress in the realisation of societal missions and for designing policy interventions.

The paper will be written in the month to come and therefore no detailed results can be delivered at this moment.

Conclusions:

A new framework is needed to understand progress made regarding societal missions. The mission oriented innovation systems framework is well suited as an analytical framework for this purpose. Specific characteristics and differences with existing frameworks will be specified.

Abstract 64

LEGITIMATION AND EFFECTS OF MISSION-ORIENTED INNOVATION POLICIES: A SPILLOVER PERSPECTIVE

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Introduction:

Rooted in science and technology policy, public expenditures on business R&D are commonly legitimized by economic reasoning regarding the existence of spillover externalities (Aghion & Jaravel, 2015). The lack of possibilities to appropriate all value created through innovation activities prevents firms from investing in R&D. Across the majority of at least OECD countries, the common response has been to internalize spillovers in the economy by providing compensation – e.g. as subsidies or tax advantages (Guellec & Van Pottelsberghe de la Potterie, 2004). This way of solving market failures should encourage firms to undertake R&D and innovation activities they would otherwise consider too risky.

As science, technology and later innovation policy have been evolving, attention arose also for issues like the circulation and application of knowledge stemming from regular R&D policies. Currently, innovation policy is increasingly moving towards approaches that even surpass improving just the level of knowledge production and diffusion (Mowery et al., 2010; Boon & Edler, 2018). Instead of hoping that policy-induced innovations will also have a positive impact in terms of mitigating complex societal problems, like climate change and health concerns (often resulting from earlier innovations), contributing to solutions for such challenges is becoming a key policy objective (Borrás & Laatsit, 2018; Foray, 2019). Mission-oriented innovation policies (MIP) driving the search for solutions are therefore characterized by their directionality, as opposed to the generic scope of traditional innovation policies (Mazzucato, 2018). Directionality entails collectively focusing innovation efforts on overcoming the inertia that keeps a mission's focal problem in place (Cantner & Vannuccini, 2018). A large body of studies on innovation systems and transitions has shown that the very amassing of a wide range of innovation activities and institutional changes is crucial for socio-economic transformations to occur – and thus for missions to succeed (Weber & Rohracher, 2012).

The rationales for mission-oriented innovation policies are markedly different from only internalizing spillover externalities. At the same time, as governing transformative change entails steering private (along public) interests in the direction of collective benefits, this almost inherently involves evoking policy outcomes going beyond the value that private firms can appropriate individually. Surprisingly little attention has been paid to the question what type of externalities this would be, despite recent advances in heterodox economics, innovation studies and transition studies.

The primary objective of this paper is to synthesize the range of spillovers that are relevant to consider in light of currently unfolding MIP policies. We present a comprehensive framework, linking the various types of spillovers that may be at play. The framework, which we will also illustrate in an empirical setting, offers a basis for reflecting on what dynamics may be expected when encouraging private firms to contribute to the collective exploration of new innovation paths.

The emergence of mission-oriented innovation policies:

Recent years have witnessed a rapidly increasing interest in so -called mission-oriented innovation policies (Robinson & Mazzucato, 2018). As the name suggests, these policies are primarily marked by the objectives they set – i.e. the missions they are pursuing. Mission-oriented innovation policies (MIP) entail policy strategies aiming to provide novel solutions for specific societal goals with public relevance beyond or even instead of boosting economic growth (Mazzucato, 2018). Although there exceptions, MIP are mostly focused on problems in which the developments on a wide range of factors are deemed crucial (e.g. technology, regulation, behavior). As this requires cumbersome alignment processes and continued commitment, such problems are often also referred to as ‘grand’ societal challenges. Essential for these challenges (and addressing them through policy) is their systemic nature, i.e. the problems are kept in place due to a variety of techno-economic as well as institutional factors. A second key feature of MIP is that they rely on (or at least involve) mobilizing innovation as a means to provide solutions. In practice, scholars and policy makers differ in their appreciation of how important (technological) novelty really is and how novelty-based solutions can best be elicited. While some argue for starting out with spurring the development of better technologies, others point at the relevance of first disentangling the nature of a wicked problem (Wanzenböck et al., 2018). In any case, there seems to be consensus on the importance of directionality as a distinctive feature of mission-oriented innovation policies (Boon Edler, 2018). Such policies should overcome inertia by steering entrepreneurial experimentation towards cumulative development pathways (Cantner & Vannuccini, 2018; Schot & Steinmueller, 2018).

Almost without exception, contributions on the emergence of MIP outline how such policies mark a change with respect to other types of science, technology or innovation (STI) policy (e.g. Robinson & Mazzucato, 2018; Foray, 2019). This typically also involves a discussion of dominant rationales, like solving market failures, fixing system failures or overcoming transition failures (Mazzucato, 2016).

While it is common to contrast system and transition thinking against a market perspective, scholars have repeatedly stressed that the creation of markets is in fact of utmost importance for the widespread diffusion of viable solutions. (Mazzucato, 2018). Furthermore, emphasis has been placed on the importance of transformative activities (Rodrik, 2004; Foray, 2019) and transformative innovation policies (Schot & Steinmueller, 2018; Janssen, 2019). Originating from transition literature as well as modern industrial policy literature (Rodrik, 2004), transformative innovation policies cover the range of interventions aimed to eliminate barriers hampering entrepreneurial exploration of new economic opportunities. These interventions have been characterized as systemic, preferential, experimental, cumulative, and adaptive (Janssen, 2019; Foray, 2019). Since offering transformation possibilities is regarded as essential for accommodating disruptive change, many of these characteristics are reflected in current thinking on mission-oriented innovation policies (Mazzucato, 2018).

Clearly, the succinct description of MIP characteristics already touches upon a broad range of changes in why, how and even by whom innovation policy is formulated and executed. A close look at the emerging literature quickly reveals different conceptions on issues like the importance of novelty, the link with specialization and industrial policy, or the different ways a mission can be framed.

Although the outlines of the shift towards MIP policies are widely recognized, few attempts have been made to systematically describe on what accounts the associated strategies have been evolving. In other words: the direction of policy evolution is clear, but there is no

comprehensive overview of the steps taken nor of the key characteristics of each of these steps. We address this lacuna by distinguishing policy approaches associated with four consecutive stages in the trajectory from fixing knowledge related market failures to implementing effective solutions. Critical in this respect is the main objective a policy approach aspires to, which can vary between simply boosting innovative economic activity, spurring innovative activities with wider societal impact, eliciting coordinated solution development for societal problems, and facilitating search for solutions not necessarily depending on innovation.

Taking the perspective of economic rationales, the suggested classification elaborates the distinction between neutral R&D policy and higher forms of policy intervention aimed at solving market failures, coordination needs, and directionality problems (Foray, 2019). Particularly relevant to stress is that the four proposed approaches are not just independent alternatives. Instead, each approach has a distinct place in the spectrum of neutral versus mission- or even solution-oriented policies. This spectrum, depicted in Figure 1, is closely associated with the hierarchy disentangling missions into mission projects (Mazzucato, 2018).

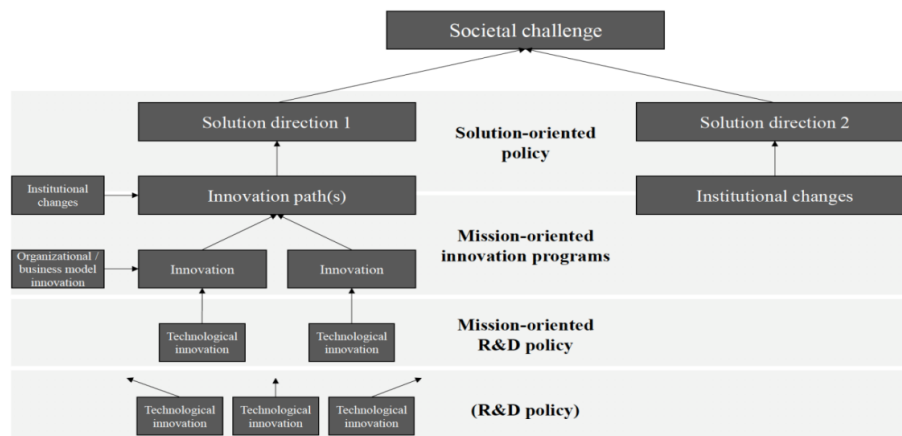


Figure 1: Hierarchy and the focus levels of each innovation policy approach.

Before addressing the role of spillovers in the four policy approaches, we describe their most eminent features in more detail (see Table 1). The overview gives rise to the question what is being expected from each MIP type, and why. In the next section we address this by revisiting the spillover perspective underlying traditional R&D and innovation policy interventions.

Table 1: Characteristics of three types of mission-oriented innovation policies, in relation to regular R&D policy.

	R&D policy	Mission-oriented R&D policy	Mission-oriented innovation programs	Solution-oriented policy
Objective/ Policy priority	Boost innovative economic activity	Boost innovative economic activity with wider societal impact	Spur complementary innovative solutions to societal problems	Search solutions, with or without innovative market parties
Rationale	Market failures	Same, especially coordination failures. + System failures (NIS)	System failures (TIS) / directional failures	Transition failures
Mechanism	Push: Generic innovation policy	Push: Targeted innovation policy	Pull: Demand-driven innovation policy / programs	Disentangle challenges into underlying problems/solutions
Transformation focus	Knowledge creation	Novelty creation	Novelty implementation + institutional change	Institutional change
Responsibility	Industry (or science; not both)	Industry-science complex	Triple helix coordination	Policy makers + citizens + societal parties
Governance	Via policy execution agency	Priority setting (Top-down, or bottom up)	Facilitate collective roadmap development (top-down-bottom-up)	Organize debate, select solution directions, execute projects / policies
Suitable instruments	Tax credits for R&D costs	Subsidies (e.g. a call for 'green' technologies), vouchers	Purchasing (PPI), norms, legal exemptions, spurring broad interaction	Public discourse, nudging, prizes, contests, non-innovation policy
Monitoring	R&D expenditure, patent rate, etc.	Do R&D and innovation efforts follow priorities?	Are regime pressures converging and cumulating?	Are we reaching the actual goals?
Challenges	Trickling down of knowledge production	Accumulation of inventions	Conflicting solution paths, market distortion	Identifying most urgent and manageable problem

Spillovers as a rationale for innovation policy:

Spillovers are often regarded as the unintended spread of results stemming from R&D investments (e.g. Coenen et al., 2015). A key element of the definition adopted here, following the standard economic view on externalities, is that spillovers concern the value R&D-investors create without being able to appropriate it (which is precisely what legitimizes policy intervention). One might thus speak of spillovers as the collection of all imaginable innovation externalities (Breschi & Lissoni, 2001).

Stemming from a market perspective, the notion of spillovers might seem fundamentally at odds with the systemic and transformative perspectives underlying the various MIP types. However, as already noted in the previous section, ignoring market dynamics altogether is like throwing the proverbial baby out with the bathwater – precisely the formation of new markets is an essential (yet far from the sole) condition necessary for socio-technical transformations to succeed. The creation of markets is a process susceptible to market as well as non-market value creation and value exchanges, some of which will fall into the externality based definition of spillovers. That is, in as far as MIP policies involve private entrepreneurs contributing to the emergence and strengthening of promising innovation pathways, interventions will aim to elicit benefits extending beyond the value that can be appropriated by individual firms undertaking R&D investments. If not, we would be either facing regular generic R&D policy or the other extreme – planned economic strategies based on expectations of rational firm behavior. Characteristic for the industry-targeted aspect of MIP policies is that they encourage firms to experiment and thereby initiate, participate and accelerate transformations also yielding returns for competitors as well as the society demanding a mission-based solution. Clearly, such returns to firms' private innovation efforts fit the notion of spillovers.

Just like literature on innovation policy, research on spillovers has been evolving within different bodies of literature (notably: heterodox economics and innovation studies). Advancements therein provide a basis for reconsidering the way particular types of spillovers are of relevance for the various policy approaches discussed earlier. Figure 2 synthesizes the literature by showing which spillovers may be expected from MIP policy types targeting (or at least involving) firm -level innovation activities.

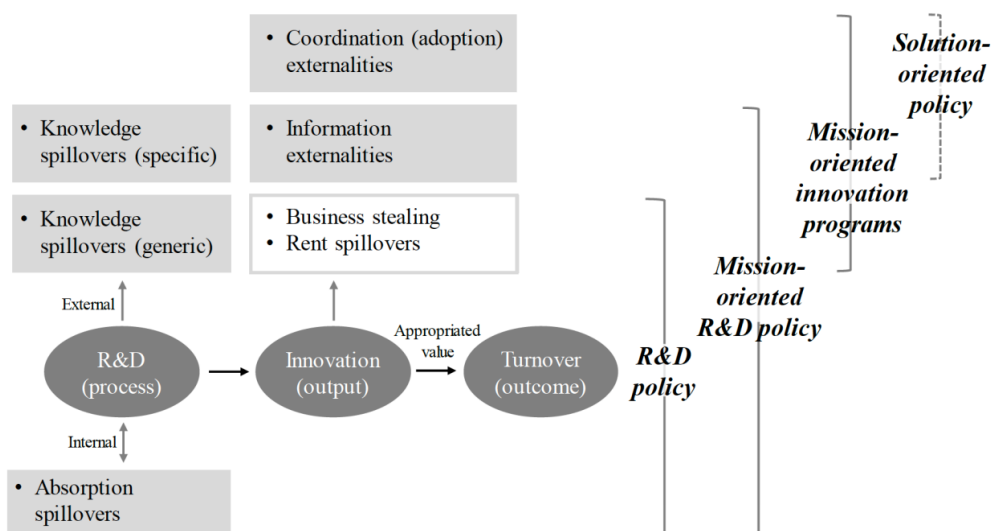


Figure 2: Integrated framework of spillover types and the policy approach for which they matter most.

Ideally, policy effects are in line with the rationale for the type of policy that was implemented. Due to some spillovers being largely neglected in existing bodies of literature, little is known about how they are manifested in actual policy implementations.

Results:

Focusing on the typically overlooked types of spillovers, we illustrate our framework with a case study on SBIR policy instruments in the Netherlands. The overall objective of this policy scheme is to challenge and support firms in providing innovative solutions for societal issues. The three underlying instruments, largely corresponding with the three respective MIP types, consists of a 'Valorisation Grant' for societally relevant academic start-ups, a catalytic form of public procurement of innovation (PPI), and a 'direct' form of PPI. See figure 3. Just like PPI policies have been linked to mission-oriented innovation policy before (Edquist & Zabala-Iturriagagoitia, 2012), also the Dutch national government has now positioned its SBIR policies as an exemplary approach for solving societal challenges (Ministry of Economic Affairs, June 2018).

Our analysis of the spillovers of Dutch SBIR policies is based on the response of 276 respondents in an online survey (Dialogic, 2017). A selection of findings from this survey is shown in figure 4. Firms involved in valorisation and catalytic PPI seem to yield the newest knowledge, but the latter group systematically reports more contributions to transformative change. The catalytic PPI group also seems to generate more coordination (adoption) externalities when compared to firms developing solutions through direct PPI.

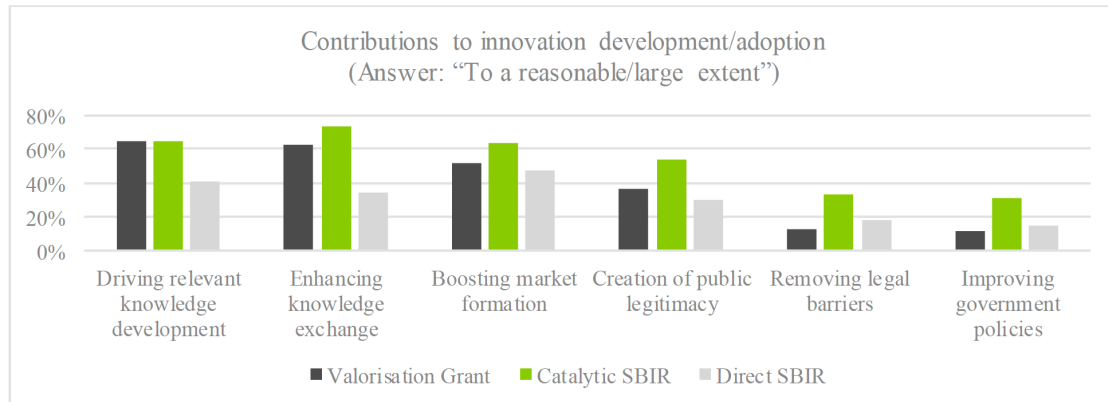
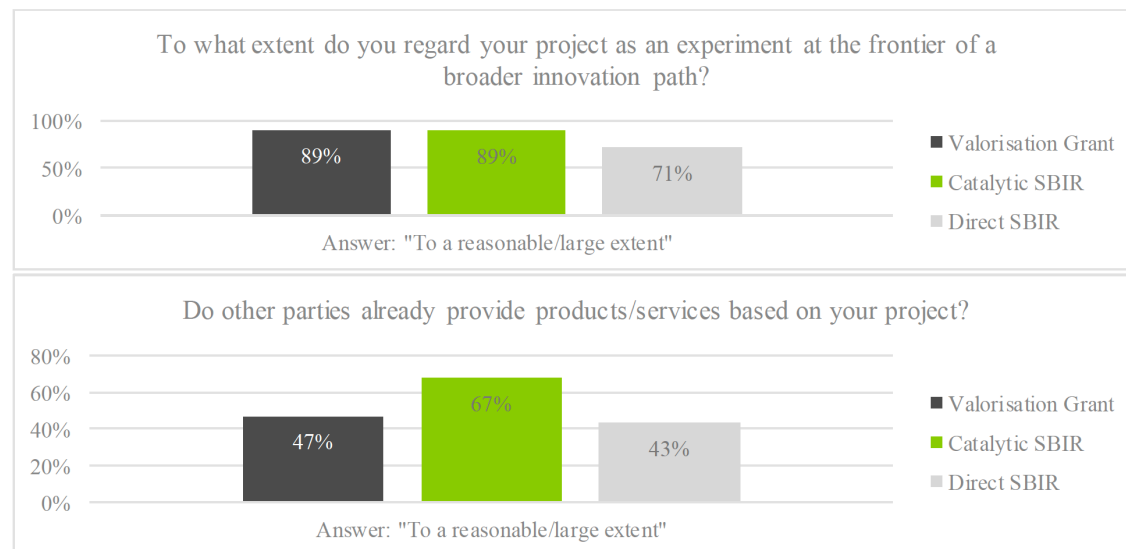


Figure 3: Response to survey questions on the wider impact of innovation projects with SBIR-support (n=276).



Discussion and policy implications:

Policies on the solution-oriented side seem to face a trade-off when specifying the scope of the solution they like to see fulfilled. Although a strong demand-side focus may open possibilities for innovations to truly take off, there is a risk that a narrowly formulated challenge in fact elicits solutions with only a minor potential for being implemented at a larger scale. This caveat of responding to incidental problems by developing 'local' solutions is widely known to innovation strategy scholars (Danneels, 2003). Yet, overseeing the literature on mission-oriented policies so far, few authors have warned for stepping into the pitfall of specifying myopic MIP policies.

A second remark concerns the variation in the reported impact of policy-supported innovation projects. Apparently, the SBIR policy approaches differ in their ability to drive innovation dynamics extending beyond the activities of directly participating firms. As far as stated in policy documents and the publicly available evaluation of 2017, there are no clear indications that specific measures have been taken in order to prioritize policy support or accelerate the diffusion of spillovers.

Much of the attention has been devoted to examining whether SBIR firms themselves increase their business performance in terms of turnover and profits. In that respect it is striking how the Dutch national government is increasingly presenting SBIR as a major element of its ambition to move towards a mission-oriented innovation strategy. While there are indications of some SBIR lines indeed offering possibilities on this account - albeit with significant differences amongst them -, one would perhaps expect a more explicit plan on how to leverage the instrument for setting transformations in motion. Such apparent reframing of existing policy goals without altering its mechanisms is in many ways reminiscent of policy drift as encountered also in the context of sustainability policies (Howlett & Rayner, 2007; Kivimaa and Kern, 2016). Given the relatively sudden renewal of interest for mission-oriented policies, it is possible that also other governments might overstep by updating their ambitions without adjusting the policy instruments they have in place.

MIP policies are emerging out of a growing preference for innovation policies yielding 'broad' social returns, beyond economic welfare only. Picking up on the discussion on policy drift, a pertinent question to elaborate on in the light of policy implications is how the various MIP

approaches should be regarded (and governed) in relation to each other. Drawing upon literature on the evolving composition of instruments in policy mixes (Howlett & Rayner, 2007), we recognize two ways of looking at how policy strategies themselves develop over time. The first point of view is to consider the rise of MIP policies as a new generation of strategies replacing the traditional ‘neutral’ approach to spurring R&D. The figure below shows which routes may be followed to arrive at mission-oriented innovation programs or even solution-oriented policies. Instead of stages in policy evolution, the MIP approaches can also be regarded as offering an additional set of interventions that can enhance the impact of generic R&D policies, and thereby the overall policy mix. In this view coordination and alignment efforts come on top of R&D support, without one being inherently better than the other.

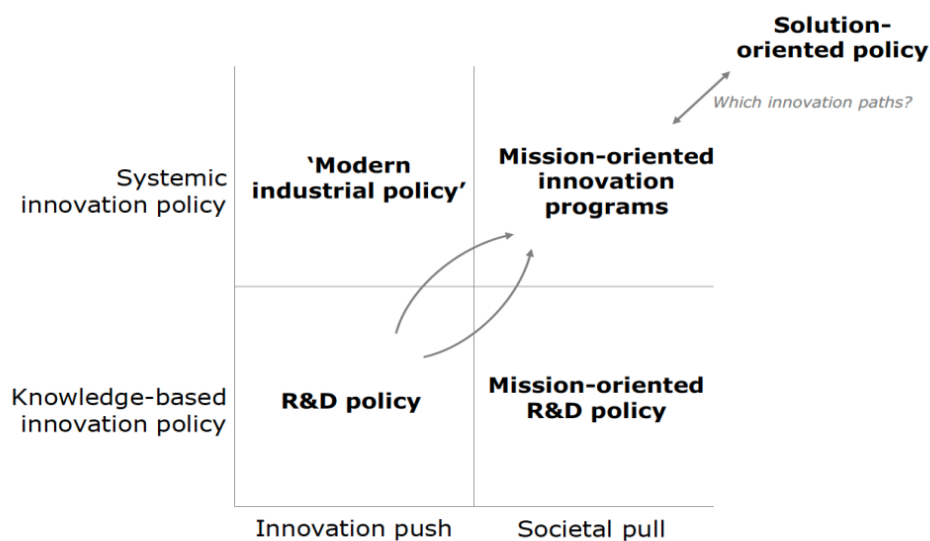


Figure 4: Alternative routes for moving from generic R&D policy towards mission-oriented innovation programs.

Conclusions:

Earlier research on mission-oriented and transformative innovation policy has pointed at the imperative of maximizing spillovers (Rodrik, 2004; Janssen, 2019; Foray, 2019), without clearly specifying which kinds of spillovers this would concern. We have taken up this challenge by elaborating what particular spillovers can be associated with particular MIP types.

A first contribution of this paper is a comprehensive overview of emerging approaches to mission-oriented innovation policy. In our view there is no such thing as MIP theory; the literature on this account is merely a theory-informed characterization of a topic rapidly gaining interest amongst policy makers. As the hype unfolds, more and more concepts and actual instruments are being labeled as being characteristic for ‘the MIP framework’ (Cantner & Vannuccini, 2018). To structure the debate and encourage productive communication, we suggested a distinction between three types of MIP evolving out of ordinary R&D policy. With each type having its own objective and rationale, also governance, implementation and monitoring issues are markedly different between the various MIP types.

Second, we have sought an answer to the question what variety of spillovers is relevant to consider when facing different approaches to spurring (mission-oriented) innovation. Our review of distinct literatures acknowledges spillover categories normally hardly captured in a single study. Spillovers often remain regarded as belonging to the sphere of market logic, despite the claim that creating markets is key for solving grand challenges by (also) mobilizing industry efforts. Moreover, taking the definition of spillovers as innovation-induced benefits not entirely appropriated by the originator, also pressures on socio-economic systems are essentially manifestations of innovation externalities. Particularly remarkable is that firm-based contributions to socio-economic transformations can be positive for the firms as well as society at large.

Building on the first two contributions, we presented an integrated spillover framework as a basis for prioritizing what effects policy should achieve (given their rationale / MIP approach). Finally, the empirical illustration based on Dutch SBIR schemes suggests it is not evident that MIP policies are coherent in their rationales and interventions. Our findings, although stemming from an anecdotal illustration, point at the risk of drift in the context of mission-oriented policies. We echo the importance of aligning measurement instruments with actual policy goals (Arundel et al., 2019). Our case study also points at the 'myopia' risk of directing firm-based innovation activity towards highly context-specific solutions. As indicated by the poor level of collective effects for direct PPI, exerting a strong demand-pull might go at the costs of the wider transformation potential of mission-oriented innovation experiments.

Policy drift and myopic policy are not new phenomena: the claim made in this paper is that a more detailed focus on spillovers unveils innovation dynamics at play in various forms of MIP. Our tentative investigations suggest that policy makers should be wary of using undifferentiated and possible outdated policy instruments (as well as effect measures) when pursuing mission-oriented policy goals. Further research is needed for more rigorous spillover measurement, as well as for analysis of possibilities to combine the merits of distinct MIP types within a single policy mix.

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C7 HIGHER EDUCATION

Wednesday 05 June 2019 from 16:30 to 18:00

BENEDETTO LEPORI, Chair

Abstract 127

LINKING OPEN RESEARCH PRACTICES TO RESEARCHERS' PORTFOLIO OF ACTIVITIES: AN EXPLORATORY STUDY FROM THE SPANISH CONTEXT

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Introduction:

The concept of open innovation, introduced by Henry Chesbrough in 2003, has become a hot topic over the last years, emerging as a widely used concept in the academic, industrial and political spheres (Bogers et al., 2018). As recently defined by Chesbrough and Bogers, open innovation can be understood as “a distributed innovation process based on purposively managed knowledge flows across organizational boundaries” (Chesbrough and Bogers, 2014: 17). The improvement that open innovation offers is that of better flow of knowledge from the places where it is held to the places where it can be exploited and make a difference.

However, despite the great attention that the open innovation concept has received in the academic literature (for a review see West and Bogers, 2014), most of this literature has addressed open innovation in firms and non-academic organisations, while little attention has been devoted to explore the role of openness in the academic context. At the same time, we notice that there is a long-term, persistent critique in literature of academic knowledge for not being relevant or useful enough. Therefore, we believe that this issue of ‘openness of academic knowledge’ need necessarily be better understood before it is possible to meaningfully address open innovation systems.

In order to deal with this gap, this study focuses on the adoption of what have elsewhere been termed open practices by researchers working in academic organisations for the production of new knowledge (i.e., conducting their research) by incorporating external (non-academic) knowledge and ideas into their research practices (Olmos-Peñuela et al., 2015). Open practices are those that make knowledge more usable by potential users by making it cognate with those users’ own understandings, by incorporating various kinds of user knowledge in their research activities. Specifically, we aim at analysing how researchers’ openness practice may affect the management of their portfolio of activities; that is, the extent to which they are involved in the following regular academic activities: scholarly publications; interaction with external entities (i.e., knowledge transfer and exchange activities) and science dissemination.

This paper aims at contributing to three distinct elements of contemporary debates around academic knowledge and innovation. First, it contributes to the literature on open innovation by bringing the openness approach to academic organisations. This is particular relevant in the current context where researchers are increasingly asked to orientate their research towards the production of relevant knowledge that can achieve societal impact (Hessels et al., 2009).

We respond to the call asking for the production of useful knowledge that makes real contributions to society through the analyses of researchers’ open behaviour, a kind of researcher more sensitive to incorporate external user needs and ideas in their research

practices. Implementing an open behaviour through the different research practices (Olmos-Peñuela et al., 2015) may lead to the production of knowledge more easily absorbed by non-academic users as a result of the cognitive proximity that emerges as a result of this joint knowledge-building processes (Neff, 2014). Second, prior studies have analysed the determinants of researchers' engagement in different academic activities such as research (scholarly publication), knowledge transfer, teaching or dissemination; however, little is known on the role of openness in researchers' portfolio of academic activities. Third, conversely to the majority of studies that analyse researchers' involvement in activities as independent decisions (for an exception see Landry et al., 2010), in this work we use a multivariate path analysis to take into account the fact that researchers may simultaneously consider whether to participate in the different academic activities.

Overall, in this study we aim at analysing whether researchers' demonstrating an open behaviour at the different research practices are related to researchers' portfolio of academic activities (namely scholarly publication, knowledge transfer and exchange, individual and institutional dissemination); and how these academic activities are connected between them (whether researchers simultaneously decide engaging in these activities). In so doing, we address the following research questions: a) To what extent researchers' openness in different research practices are related to their involvement in the different academic activities that make up their portfolio? b) What are the relationships between these academic activities?

Conceptual framework:

Researchers' openness

The open innovation concept has been widely analysed in the organisational non-academic context and has responded to the call for innovation processes that "eagerly seeks external knowledge and ideas." (Chesbrough's, 2003: xxxi). The openness approach can also be applied to the academic organisational context to address the concern about the disconnection between academia and society and the lack of relevance of the research conducted within the academia (Thorpe and Rawlinson, 2014; Mosey et al., 2015, Amara et al., 2018).

Thus, we respond to the call asking for increasing the production of useful knowledge that make real contributions to society through the analyses of researchers belonging to public research organisations. Academic organisations grant to researchers a high degree of freedom and autonomy to establish their research agenda and to choose their behaviour (Tartari and Breschi, 2012). Individual decisions related to academic activities may be influenced by non-academic external users in different stages of the research processes, such as in setting the research agenda, in executing research project or in transforming the results into practical outcomes (Kitcher 2001; 2002). This knowledge resulting from conducting research more open to these external ideas is more contextualized (Nowotny et al., 2001), which is a desirable characteristic that may increase the likelihood that research results make an impact into the socioeconomic environment by being more easily taken up by non-academic users and incorporated into their practices.

In this context, Olmos-Peñuela et al. (2015) identify open researchers as those academics willing to incorporate these external (societal) knowledge in their research practices. Specifically, these authors decompose the research process into five different stages or research micro-practices in which researchers can demonstrate an open behaviour by incorporating these external influences. During the inspiration stage, open researchers

identify potential research question being inspired by users or external non-academic issues that help them to set a concrete future research project idea; during the planning stage, open researchers consider external knowledge resources within their research proposal; during the execution stage open researchers incorporate these external knowledge resources in the implementation of their research project; during the dissemination stage, openness researchers are involved in popularisation activities that allow users to provide feedback and inspire new insights or future orientations for relevant research; finally, as a result of all the research activity conducted, during the reframing stage open researchers may set their future personal research agenda shaped by their past research which has been affected by these external influences.

We here choose to rename the fourth of these variables, dissemination, because they are referring the extent to which researchers incorporate their knowledge in third party products controlled by others, in ways that may reduce their own rights to use the knowledge. We therefore refer to codification to make this clear, and in particular, to be clear that this does not relate to all dissemination activities, but rather user-engagement activities that may have consequences for future knowledge use opportunities.

Researchers' portfolio of activities

Over the last decades, researchers have been asked to expand their portfolio of activities beyond the traditional academic activities of conducting research projects and scholar publishing. Thus, academic activities with a more societal orientation (i.e., connecting scientific and societal domains), such as knowledge transfer and exchange and dissemination activities, have been included in their academic portfolio of activities.

However, managing this portfolio of activities is not a straightforward task. From a "time restriction argument", engaging in a wider variety of activities "within the already-overstretched job description" assigned to the academic profession is becoming rather complicated (Burchell et al., 2009: 2). This difficulty is even higher in a context where we can still appreciate a contradiction between, on the hand, discourses promoting the production of relevant research and the involvement in activities with a more societal orientation (knowledge transfer and societal dissemination), and, on the other hand, the prevailing scientific evaluation systems that mainly considers publications in impact journals as the main criteria of scientific excellence valid for researchers' promotion (Amara et al., 2018).

As far as we know, there are no studies addressing how researchers' openness may influence researchers' academic portfolio of activities. By proposing a model that considers researchers' openness and the management of their research portfolio, we intend to address the challenge that open researchers (more willing to incorporate non-academic issues into their research processes) may face when deciding to conduct more relevant research and to engage in more societal-oriented academic activities. This challenge is twofold and may have negative consequences in terms of the extent to which researchers are involved in scholarly publications.

First, open researchers may deviate from the "Mertonian's ethos of modern science approach" by conducting research that takes into account external non-academic interest that might be regarded within the academic community as having little rigour (Merton, 1973). Secondly, drawing on the "two communities' argument" (Caplan, 1979), different tensions may arise between academic and non-academics as a results of their different interests and goals (Sauer mann and Stephan, 2013), thus difficulting open activities. However, we could also expect open researchers to be able to successfully expand their portfolio towards more societally engaged activities (e.g., knowledge transfer and dissemination), thus fulfilling their societal role, especially in the case of public funded research (Hessels et al., 2009).

Methodology:

Context of the study and data collection

The empirical analysis was conducted on the the Spanish National Research Council (CSIC), the largest public research organisation in Spain. Unlike researchers affiliated to universities, teaching activities are not among the regular activities of CSIC researchers; thus, they have not been included in the empirical study as part of researchers' portfolio of activities.

The population of the study was the 3,199 permanent CSIC researchers identified by the Human Resource Department of CSIC. Data collection took place between April 2011 and May 2011 through an online questionnaire sent to the researchers. The final sample analysed in this study was 1,295 permanent researchers. Respondents were asked about their research micro-practices and their portfolio of scientific activities, including their involvement in knowledge transfer and exchange, in individual dissemination activities and institutional dissemination activities. Information about researchers' publications was obtained from the Thomson Reuters' ISI Web of Science.

Analysis and variables:

We conducted a multivariate path analysis to assess the relationship between the five openness micro-practices and researchers' portfolio of scientific activities. This analysis simultaneously estimates four OLS regressions to also explore the correlates of the dependent variables referring to the four researcher's scientific activities. This is an interesting analytical approach since it allows to assess whether researchers make joint decisions for multiple scientific activities or whether they treat them independently (Landry et al., 2010).

The four dependent variables considered in this study captures the extent to which researchers have been involved during a three years' period in the following academic activities: knowledge transfer and exchange, individual dissemination, institutional dissemination and scholarly publication. Regarding our independent variables measuring researchers' openness, we drawn on the measures proposed by Olmos-Peñuela et al. (2015) corresponding to five variables, one for each of the five stages of the research process namely inspiration, planning, execution, codification and reframing. A number of control variables where also considered in the multivariate analysis namely researchers' research field (8 fields), seniority (3 categories), gender, non-competitive funds received, research unit size.

Preliminary results:

Regarding the relationship between openness variables and the four scientific activities considered, results indicate that depending on the stage in which researchers demonstrate an open behaviour, it differently affects the scientific researchers' activity. For example, those researchers that demonstrate openness at the inspiration stage report higher levels of engagement in individual dissemination, whereas those that demonstrate it at the planning stage report higher levels of engagement in all the societally-oriented activities (individual dissemination, institutional dissemination and knowledge transfer and exchange), but no relationship with their level of scholarly publications. Thus, we can anticipate that results suggest differences in how demonstrating an open behaviour in different research micro-practices differently affects the academic activities in which the researcher is involved.

Moreover, the empirical results indicate the existence of complementarities between all the scientific activities considered in the study, except for knowledge transfer and exchange and

scholarly publications. This means that all the activities related with a wider societal engagement (knowledge transfer and exchange and dissemination) go ‘hand-in-hand’ since they are positively correlated. Likewise, also scholarly publication and societal dissemination seems to be activities that reinforce each other as suggested by their positive and significant correlations. Conversely, scholarly publications emerge as an activity in which researchers are involved independently of their participation in knowledge transfer and exchange activities, thus suggesting that interacting with external partners is not necessarily detrimental for research performance (in terms of scholarly publications).

Emergent discussion:

These preliminary findings provide us with the means to address our three research questions. Regarding our first research question, we observe that, at the level of the individual, there is indeed an association between open/ non-open research micro-practices and the balance of portfolios. Overall, interactions with non-academic users are associated with open research micro-practices, individual dissemination is associated with openness in inspiration, planning and codification, whilst institutional dissemination is associated with openness in planning and codification. Our second finding was that scholarly publication and our societally engaged activities represented clearly coherent different types of activities, and it makes sense to treat portfolios separating these two main kinds of activities. Generally speaking, scholarly publishing is reduced by openness (at the execution and codification stages), whilst societally engaged activities are increased by openness (depending on the precise activity, but potentially in all four stages).

Regarding the managerial and policy implications from the study, and here there is a clear message emerging, in that there is an association between open research practices and the balance of researcher output portfolios. We observe that academics that have a primarily scholarly profile are those who tend to have a less open profile and we contend that researcher openness is expected to lead to a higher usability of that research in society.

Our finding indicates that producing scholarly outputs does not demand an open profile from researchers, and this therefore associates with a reduction in the overall societal usability of the knowledge emerging from those knowledge creation activities.

If managers and policy-makers are seriously interesting in stimulating open innovation and open practices, then it is clear that a pressure to publish in scholarly journals will reduce the overall mobility of the resultant knowledge, and hence its overall value to open innovation systems. Conversely, if policy-makers are interesting in maximising the value of academic knowledge to users in open innovation trajectories, then incentives need to be created to stimulate the micro-practices which incorporate user knowledge in research processes.

Some of these are quite widespread, such as meaningful planning or undertaking research with users; however, others are not, such as co-generating research questions or codification. We see for example the introduction of the recent knowledge “transfer sexenio” in Spain as a serious attempt to incentivise diverse portfolios by rewarding those that are able to demonstrate the production of user-facing outputs. But this seems rather perverse to have to introduce one reward to offset the results of another intervention, the traditional “research sexenio” that rewards with extra salary those who demonstrate the production of scholarly publications. If research policy-makers are serious about increasing societally engaged activities and products, then they should seek to encourage open micro-practices amongst all the activities of the research system, rather than treating the symptoms of perverse incentives that arise elsewhere. We are not contending that knowledge transfer

should not be rewarded, only that policy-makers who want to improve knowledge transfer outcomes would do better to do this in an integrated planned way, driving openness, rather than having to repair the damage done by other policies.

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Abstract 48

HEIS PARTICIPATIONS AND MOBILITY IN THE EUROPEAN FRAMEWORK PROGRAMMES

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Abstract:

In this paper, we analyze changes in the participation of European HEIs to European Framework Programmes between 2008 and 2015. The goal is twofold: first, with the help of a transition probability matrix, we describe the mobility of HEIs in the considered period from and to a “core participant” network; a specific index will score that mobility. We then aim at identifying variables that help in explaining mobility of individual HEIs. In detail, we suggest that the probability of a change of the HEI’s participation is influenced by endogenous variables such as individual characteristics, or by external ones, mainly country economics variable, different national research policies/strategies, as well as changes in the FPs’ composition. Results represent the base for several public policies considerations and suggestions on how to strengthen the European Research Area.

Introduction:

There is a vast literature on patterns of participation of Higher Education Institutions (HEIs) to European Framework Programs (EU-FPs), as well as on the factors influencing that level (see Lepori, Heller-Schuh, Scherngell and Barber 2014; Enger and Castellacci 2016). A common finding of this literature is the presence of a small, central core of HEIs with high levels of participation to the EU-FPs, which is lasting over time. This structure has been explained by the importance of relational ties in establishing European consortia, but also by cumulative effects (Merton 1988) related to the concentration of academic reputation at a few places in Europe. According to the EU-FPs policy goals, such a structure might be welcome because it concentrates resources and achieves excellence, but raises concerns in terms of cohesion of the European Research Area, given that the core is strongly concentrated in few countries, typically located in Western Europe. While the literature on the determinants of the participation is huge, the investigation on the institutional mobility with respect to their level of participation to EU-FPs, respectively of entry and exit to the core of regular participants, is still limited. The analysis of factors and variables (endogenous and exogenous) that affect the probability of an HEI to change its membership to this participants’ core could help the current debate, also supporting policy makers in their decision process. The available literature suggests a number of potentially relevant factors, including changes in the HEIs’ resources (possibly as an outcome of changes at the national level in research strategies or financial policies), changes in the HEI’s reputation (as the key factor associated with EU-FP centrality) and, finally, changes in the orientation of the programs, like the introduction with the Seven Framework Programme (2007-2013) of the excellence-oriented European Council Grants, ERC (Nedeva 2013, Luukkonen 2013).

Given the above considerations, the present contribution has a double objective: first, we want to describe and analyze this HEIs’ mobility from and to the “core participants”; second, we aim at identifying variables that help in explaining changes in the number of participation.

With reference to the latter, we speculate that the probability of a change of the HEI's EU-FP participation (measured with an index of class mobility) is influenced by endogenous variables such as individual characteristics, or by external ones mainly country economics variable, different national research policies/strategies and /or differences in the FPs' composition.

Main literature and current debate:

Research funding programmes such as FPs and Horizon2020 have registered an impressive rise in importance during the last decades, and this relevance has been reflected also in the academic debate. A large body of the literature has been devoted to the study of the main characteristics of the participation process and of the factors that may influence university participation in EU-funded R&D cooperative projects. The first line of analysis is dedicated to the investigation of the participation process. Main results point out that several characteristics influence HEIs' level of participation; scientific capabilities of applying institutions (publications and academic reputation) seem to be crucial (Geuna 1998; Seeber, Lepori, Montauti, et al 2015; Nokkala, Heller-Schuh and Paier 2011; Henriques, Schoen and Pontikakis 2009), as well as prior experience and relational capital are predominant factors in determining the involvement of HEIs (Nokkala, Heller-Schuh and Paier 2011). Project administration, administrative/bureaucratic effort seems to be relevant as well, especially for HEIs located in Eastern Europe or of small size (Mataković and Novak 2013), as well as lack of practice in competitive fund raising (Geuna 1998). Numerous high reputational organizations (mainly in UK) display a lasting high level of participation and assume a central position within the participation networks (Heller-Schuh, Barber, Henriques, et al 2011; Barber, Krueger, Krueger and Roediger-Schluga 2006;). Nokkala, Heller-Schuh and Paier 2011 investigated the influence of HEIs ranking position, which seems to be relevant only for project coordination. Large attention has been dedicated also to the analysis of the network structure of participations, adopting methods from social network analysis. Main results highlight an integrated and tightly-knit network (Scherngell and Barber 2011). Less experienced groups face barriers in entering in the EU competition; their participation remains marginal (Primeri and Reale 2012). A second line of analysis is aimed to the study of the exogenous conditions that influence participation. Results shows that the structure and the design of national funding strategies are relevant and interact with changes in EU funding policies (Luukkonen and Nedeva 2010). Also national economics matter: HEIs from richer countries show higher involvement due to their greater industry orientation and experience in collaborative research (Nokkala, Heller-Schuh and Paier 2011). In a dynamic perspective, literature detected that the programmes participation path has led to the creation of a group of persistent "happy few", whose level of participation is very high and stable over time, while remaining organizations participate occasionally or do not participate at all. It is thus interesting to investigate about the mobility between these groups. Our research hypothesis mainly rely on the idea that a change – positive or negative - in the degree of participation at individual level could be affected by a series of characteristics/factors that could be roughly classified as follow: a) individual characteristics such as size, reputation, subject composition; b) national economics; c) differences in national research policies and strategies; d) differences in the FPs composition.

Methodology and data sources:

The paper is based on an extended version of the European Tertiary Education Register database (ETER; <https://www.eter-project.com/>). ETER is the reference dataset on European higher education. It provides a comprehensive coverage of European HEIs graduating at least at the bachelor level and includes a wealth of statistical data including institutional characteristics, revenues and expenditures, students and graduates. The extended version of ETER that has been developed within the RISIS project ([risis.eu](https://www.risis.eu)) includes data on scientific publications from the Leiden ranking database and the number of participation in EU-FP projects. The dataset also include 2008 data with the addition of EUMIDA information. Data include information on 28 countries for 2 years, 2008 and 2015, with 1,239 HEIs and 2,478 observation in total. The sample provides a good coverage of Europe, including some Nordic European countries (DK, FI, LT, LV, NO, SE), Western Europe countries (AT, BE-Flanders, CH, DE, IE, LU, NL and UK), Southern Europe countries (CY, ES, GR, IT, MT and PT), as well as a number of Eastern European countries (BG, CZ, EE, HU, PL, RO, SI and SK).

Variables included in the current step of the analysis are listed below. For all of them, absolute values and the difference between 2015 and 2008 have been calculated.

Number of EU-FP participations: number of participation for each institution for starting year. In a further step, a network centrality measure will be included (we expect this measure to be strongly correlated with the number of participations).

Size measure: we use the total academic staff in FTE (Full Time Equivalent).

Education intensity as the ratio between the total number of undergraduate students and the total staff in FTE.

Research volume: approximated by the total students enrolled in a doctoral course normalized by the maximum in our sample.

Subject specialization, measured by the Herfindahl Index of the distribution of the doctoral students by the ten fields of educational statistics.

National economics (GPD per capita in PPP, research and development expenditure by sector) Information about the composition of different FPs.

As a first step, we provide descriptive analysis of changes between the two years by grouping the HEIs in our sample in classes according to the number of participations. Classes are defined as follows:

Class 0: no participation

Class 1: from 1 to 4 participation

Class 2: from 5 to 14 participation

Class 3: from 15 to 40 participation

Class 4: more than 40 participation.

Class ranges has been defined according to the number of participation corresponding to precise percentile of the sample (50%, 75%, 90%, 95%, 99%) according to the statistics of 2015.

On this basis, we firstly build up a transition probability matrix, highlighting the probability of transitioning from one state to another:

$$p_{ij} = Pr\{X_t = j | X_{t-1} = i\} \quad (1)$$

A transition probability is the probability of being in state j at the end of the branch given that the process was in state i at the start of the branch. In our model, t is 2015 and $t-1$ is 2008. i and j represent different classes of participations corresponding to different groups in the selected years. We consider transitions between the year 2008 and 2015, a time period which includes four different FPs (from FP5 to Horizon 2020) and is sufficiently long to observe a relevant, if present, mobility.

Once defined the above-mentioned probabilities, we investigate the variables that affect probability for an HEI to move between classes, upgrading or downgrading the intensity of participation at individual level. To do this, we group the in and out mobility from 2008 to 2015 as follows: “group -1” includes HEIs that move from an higher to a lower class, “group 0” HEIs in the same class both in 2008 and 2015 and “group 1” HEIs that move from a lower to an higher class.

As further steps of the study we:

- will further refine the class identification with the help of the “k-means”, a method of vector quantization used in the cluster analysis (to identify “natural breaks” in the distribution);
- will more accurately define some variables such as , especially the one related to the research volume and the number of participation, testing also a measure of network centrality;
- will investigate on factors and variables that affect the transition probabilities between status (in terms of class of participation) mainly with a Markov Model with covariate dependence (Muenz and Rubinstein 1985). In detail, the authors model the transition probabilities between status (initially 0 and 1) 00 and 10 by the following logistic regression:

$$p_{00}(b'x) = \frac{\exp(b'x)}{1+\exp(b'x)} \text{ and } p_{01}(d'x) = \frac{\exp(d'x)}{1+\exp(d'x)} \quad (2)$$

where x is the vector of covariates for the i -th HEI, a parameter vector for the transition from 0 and d a parameter vector for the transition from 1. Covariates relate to the initial state. Vectors b and d are then obtained with maximum likelihood estimation. A slightly different model will be adopted when some or the totality of covariates are permitted to change with time.

Preliminary results:

Figure 1 displays the transition matrix for the period 2008-2015. Within this matrix, in 2008 the HEI i is in a specific state (class) x_i and at the time $i+1$ the same HEI changes to state (class) x_{i+1} according to the given transition probabilities.

		2015					
		class					
2008	class	0	1	2	3	4	Total
	0	591	87	3	0	0	681
		86.78	12.78	0.44	0	0	100
	1	77	156	33	0	0	266
		28.95	58.65	12.41	0	0	100
	2	2	46	72	22	0	142
		1.41	32.39	50.7	15.49	0	100
	3	0	0	31	80	11	122
		0	0	25.41	65.57	9.02	100
	4	0	0	0	9	19	28
		0	0	0	32.14	67.86	100
	Total	670	289	139	111	30	1,239

Figure 1. Transition probabilities matrix

Numbers in first row of each class refer to the number of HEIs that belong to a selected class in 2008 and in 2015, while the second row refers to the corresponding transition probabilities. For example, the probability that a HEIs belong to class 0 both in 2008 and 2015 is 86.78%, while the same probability for the same HEIs to shifts from class 0 in 2008 to class 1 in 2015 is 12.78% while from zero to 3 is even smaller (0.44%).

As expected, the matrix displays a good deal of stability. Overall, % of HEIs in our sample stayed in the same class in both periods. At the same time, a certain mobility between classes emerges. Compared to 2008, in 2015 90 HEIs shift their status from not participant to participant, and 66 (33 from class 1 to class 2, 22 from class 2 to class 3 and 11 from class 3 to class 4) will register a positive shifting. On the other hand, 165 HEIs moved from a higher to a lower class. Looking at the transition probabilities, it is interesting to note that the probability of an out-mobility with a downgrade in previous classes is higher than the corresponding probability of an upgrade (due to a rise in the number of participations). For example, the probability that an HEI belonging to class 2 in 2008 will transit to class 1 in 2015 is 32.4 % while the same figure for a shift from class 2 to class 3 is about 15.5%. Overall, the core seems to have become slightly smaller over time, even if the differences is limited. Interestingly, mobility between the participant and non-participant group is more limited than vertical mobility, suggesting a strong entry barrier for non-participating HEIs.

Looking to countries, a certain pattern seems to emerge with some countries displaying clear patterns (upward or downward), others. To take into account the scale of status variation, we decide to compare countries through a mobility index. For each country, that index will weigh the magnitude of the status variation of HEIs: if an HEI shifts its status of two classes then its weight will be -2 while for the opposite the weight is +2 and so on. Figure 2 illustrates the results.

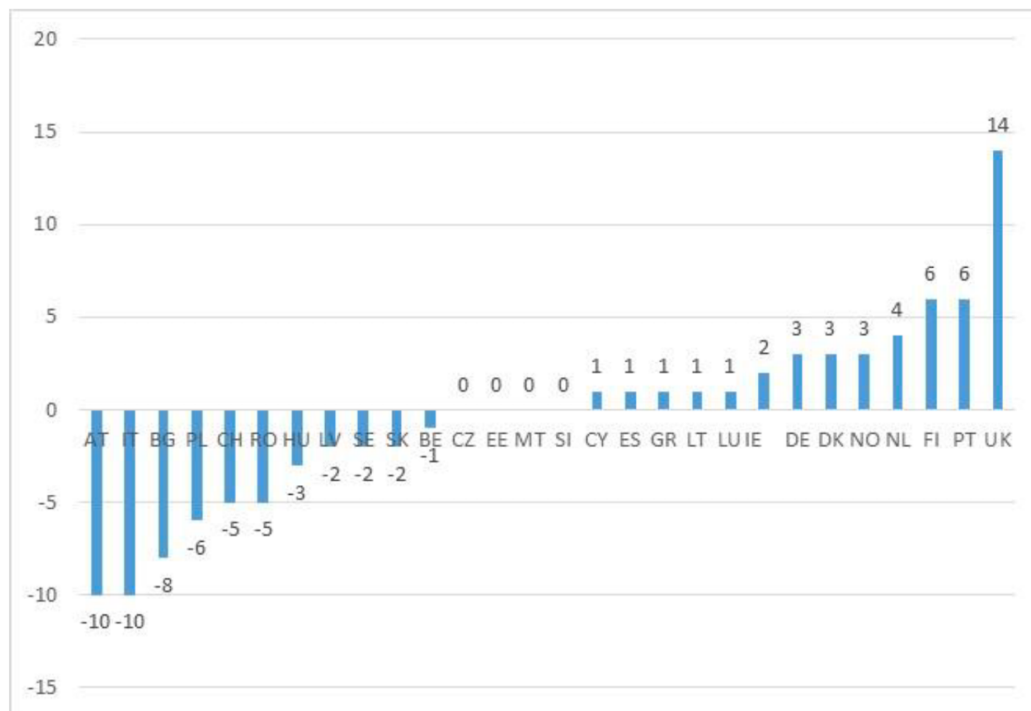


Figure 2. Weighted in and out mobility index

Mobility index scores evidence that countries with significant out mobility are Austria, Bulgaria, Switzerland, Italy, Poland and Romania. For Switzerland, this downgrade is mainly referable to the fact that the country was not fully associates from the beginning to H2020, causing a significant drop of participations in the recent year. Within this group, we notice the presence of three east European countries: BG, PL and RO, a worrying finding in terms of cohesion in the European Research Area. A more precise picture of the mobility between classes and groups claims for the analysis of 2008-2015 differences for size, education intensity, research volume and subject concentration variables; we then compare the median values of changes of these variables between 2008 and 2015 between three groups of HEIs: those that did not change of class (0), those that moved to a lower class (-1) and those that moved higher (1). This comparison could permit to capture differences in the main characteristic shaping the HEIs. This comparison helps to develop a more accurate analysis: for example, institutions included in class zero in 2008 that did not changes their status in 2015 might differ by some characteristics from those that shifted to group 1. We then performed a k-sample test on the equality of the medians, for absolute values and differences between 2008 and 2015, with the reference to the median of HEIs not changing their class. Figure 3 summarizes results for two variables that are likely to be associated with mobility, i.e. the size in terms of academic staff and the research volume.

	<i>Academic staff FTE</i>			<i>Difference 2008-2015</i>		
<i>Class</i>	<i>-1</i>	<i>0</i>	<i>+1</i>	<i>-1</i>	<i>0</i>	<i>+1</i>
0		133	322***		19.7	37.93
1	402***	645.5	846	42.56	37.91	194.14***
2	794.3***	1247.5	1153.4	136.14	248.85	142.52
3	1871	1878	2733.78***	317.50	346.02	515.50***
4	2431	2927.3		453.78	581.00	
	<i>Research volume</i>			<i>Difference 2008-2015</i>		
<i>Class</i>	<i>-1</i>	<i>0</i>	<i>+1</i>	<i>-1</i>	<i>0</i>	<i>+1</i>
0		0	.00423***		0.0000	0.0004***
1	.00876***	.02793	.03534	0.0005***	0.0015	0.0057
2	.05406***	.06765	.10210***	0.0051***	0.0040	0.0116***
3	.13321	.13525	.20550	0.0028	0.0206	0.0586
4	.17662	.21446		0.0438	0.0424	

Figure 3. Median of the difference 2008-2015 for few selected variables

Figures point out that:

- HEIs that shift their status from not participant to participant: these HEIs had already in 2008 a larger size and higher research volume than those that continued not to participate and had a greater increase as well (difference is however non-significant for staff). This might be interpreted as 'screaming out' the large and more research oriented non-participating HEIs. The opposite applies to HEIs that ceased to participate.
- In nearly all cases, HEIs that shift their status to a more intense participation (group 1) have usually larger differences in median values than HEIs that shift to the lower one (group 1) or are invariant. This applies both to 2008 values and to changes over the considered period. The opposite applies to HEIs moving downward.

We have to keep in mind that data for shifting HEIs for class 3 and 4 are based on a very small number of observations – due to the limited number of HEIs interested. This of course affects statistical significance.

Discussion and further work:

While most of the literature focused either on stability in participation networks, or on factors affecting the participation level in a static (cross-sectional) perspective, this paper aims to shed light on the extent of change over time and on its determinants. Overall, we could show some degree of change in participation over the considered period; a more fine-grained analysis suggested that, while there is closure in the group of participant HEIs, level of participations might vary significantly over time. In a further step, time-series analysis might allow a more precise distinction between transient participants and regular participants. Preliminary results also display meaningful patterns in terms of starting conditions and of change over time in HEI characteristics for those HEIs that changed significantly their participation level. As expected, size and research volume seem to have a direct impact on mobility.

Moreover, the analysis displays a clear country pattern in participation mobility, with several selected countries, partially located in the Eastern Europe, more interested by an out mobility. In general, the probability of a status downgrade is higher than the corresponding upgrading one. In status shifting, size and research volumes seem to directly matter: their rise will probably

positive impact on mobility. Focusing on median values, upgrading HEIs have higher figures, while for downgrading ones groups' medians appear to be closer; this seems to suggest that there could be different variables, possibly exogenous, that could affect their mobility.

As highlighted in the methods section, more refined statistical methods will allow in a further step a more precise identification of the respective role of different factors in participation change.

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D1 TRANSFORMATIVE INNOVATION POLICY 1

Thursday 06 June 2019 from 11:30 to 13:00

CINZIA DARAIO, Chair

Abstract 32

FUNCTIONAL PROCUREMENT FOR INNOVATION, WELFARE AND THE ENVIRONMENT

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Keywords: Public Procurement for Innovation; functional procurement; functional specifications; framework.

Abstract:

Grand challenge mitigation is framing many innovation policies and strategies worldwide (Mazzucato, 2018). In this context, Edquist and Zabala-Iturriagagoitia (2012) introduced the potential of public procurement for innovation as a relevant policy instrument aiding in grand societal challenge mitigation. According to the results of the ERAC consultation (see ERAC 1209/15), the latest estimations for public procurement expenditure on works, goods and services were close to €2.3 trillion per year, equalling 19.4% of European GDP.¹ In particular, in Sweden public procurement amounts to SEK 683 billion per year (i.e. 17.5% of GDP).

Public procurement thus represents a substantial portion of the EU economy and the economies of many countries around the world. However, the share of the whole procurement spending used to stimulate innovation remains insignificant, even if no comprehensive statistics exist as to date about this. Innovation-related procurement is acknowledged as a relevant policy instrument, particularly as a mission-oriented innovation policy instrument related to grand challenge mitigation, but in terms of its implementation and the mechanisms for its effective rolling out, it is still at its infancy. This is related to the discussions that are increasingly taking place in the academic realm as to the need to address the “implementation” of innovation policies (see Robinson and Mazzucato, 2018).

The purpose of this paper is to analyse how public procurement can enable and be a driving force for innovations. The paper is about public procurement that requires or facilitates innovation. Therefore, an important task is to distinguish such procurement that leads to, or can lead to, innovation from such procurement that does not lead to innovation or prevents innovation. The paper argues that the most important way of achieving a higher degree of innovation in procurement is to conduct functional procurement (i.e. to formulate functional requirements in the procurement documentation).

Therefore, the focus of this paper is on functional procurement, and thus it will not treat traditional/regular public procurement where one describes and purchases well-known products (product procurement) more than as a starting point (although this type of product procurement still constitutes the largest volume of all procurement spending). The important issue is how product procurement can be converted into functional procurement in order to enhance innovation.

¹According to the data provided by the Tenders Electronics Daily, €450 bn is procured per year. Note however that it only covers projects above €5million for works, and above €200,000 for services.

Some of the main rationales for using public procurement to promote innovation include the following:²

- Creating markets to fulfil (agency) missions and/or needs;
- Speed up public sector modernization: improving the effectiveness and efficiency of public services;
- Promoting and diffusing innovations to existing private agents;
- Signaling the demand for certain technologies/products;
- Demonstrating the value of innovations to other users, producers;
- Strengthening key suppliers, providing new knowledge and capabilities that will be useful to them in the future, potentially breaking path dependencies and avoiding lock-in situations;
- Adopting/using cost-saving innovations;
- Incentivizing industry to invest in innovation, with potential substantial spillover effects (e.g. internationalization of local firms to inter-regional markets).
- Create growth and jobs in Europe (i.e. help innovators bring European R&D to the market)

A large number of regular public procurements are perfunctorily conducted; the procuring agency or unit describes the same product as in previous procurements in a routine manner (i.e. path dependency and inertias) (Edquist 2014). These products must obviously be existing ones, since they can be described by the procuring organization. Often this description is quite - or even very - detailed. They may even be obsolete. If that is the case, qualitatively superior, products (i.e. innovations) may be excluded in the procurement process. A routine of simply describing the previously procured products makes it difficult or impossible for new products (innovations) to be accepted. This is a major obstacle to innovation in public procurement. Hence, product procurement generally does not lead to innovation.

For several decades, many researchers, policy makers and procurers have used the word *“innovation procurement”*, probably because they have been interested in achieving innovations as a result of public procurement. Some have argued that we achieve innovations by describing products that do not exist (and which would therefore be innovations if they were developed). However, on reflection, this is an impossibility and the term innovation procurement in the sense of procurement of described innovations is therefore unsuitable. However, one can try to achieve innovations through procurement in other ways than by describing innovations (i.e. products that do not exist). Discussing how this can happen is the main objective of this paper.

Of course, the procuring organization wants to buy products to use them for something. In fact, with the help of the product you usually want to solve a problem or get a need or function fulfilled. And this is (mostly) done in the interest of the citizens.

²The guidance for public authorities on public procurement of innovation developed by the European Commission provides information about its added value, some policy considerations, tools that can attract suppliers to use this instrument, and tools to design innovation-friendly tenders. See: https://www.innovation-procurement.org/fileadmin/editor-content/Guides/PPI-Platform_Guide_new-final_download.pdf

An alternative to product procurement is that the contracting organization describes these problems, needs and functions in the procurement documents. When such a description exists, the term "functional procurement" is used in this paper.

Functional procurement can be defined as the procurement of products by an authority/unit that describes a function to be performed or a problem to be solved (functional specification) instead of describing the product that is to perform the function (Edquist, 2017)³. In functional procurement, a public agency specifies what is to be achieved rather than how it is to be achieved. Functional regular procurement is pursued by means of functional specifications instead of product specifications. Hence, it is a matter of the manner in which a procurement call is set up and the tender documentation is formulated. Needs are translated into functions to which potential suppliers can respond. Needs are accurately identified and presented as requirements in terms that suppliers can respond to. It opens up for innovation but does not require it. Innovations are not excluded or disadvantaged. However, it should also be noted that a functional tender requires a process by which the need is identified, accurately specified and that potential suppliers are informed and engaged prior to the formal (functional) tender⁴.

Functional procurement is thus innovation-enhancing in the sense that it opens up for innovations, but it does not require innovations per se as it happens in other forms of public procurement for innovation, such as direct and catalytic public procurement (Edquist and Zabala-Iturriagoitia, 2012). However, it does not necessarily have to lead to innovations - if the functional description includes existing products. What characterizes functional procurement is that the expected result is described as a function that must be fulfilled through the procurement.

Naturally, the different types of procurement can be used and combined with each other (and with other innovation policy instruments) in a complementary manner within an instrument mix, as they all contribute to the ultimate goal of innovation policy (i.e. to create the conditions and incentives for the systematic emergence, development and diffusion of innovations) (Borrás and Edquist, 2013).

A pre-existing product can still be procured, as long as it fulfils the - functional - specifications. Therefore, functional procurement does not (necessarily) mean that an innovation results from the procurement. Since an innovation is not required in functional procurement, the risk of failure is smaller with functional procurement than with (direct or catalytic) types of public procurement. The risk is thus smaller, in the sense that the lack of an achievement of an innovation is not required.

The risk is also smaller in the sense that the pre-existing product can always be procured. Functional procurement can thus be considered to have a larger potential for innovation than other types of innovation related procurement.

³ The perspective on functional procurement has been developed in Edquist (2014, 2015, 2016a, and 2016b).

⁴ In this regard, and according to the European directives on public procurement, there are different "procurement procedures" through which public procurement initiatives can be undertaken which allow that dialogues can be pursued in early stages. Examples are open, restricted and negotiated procedures, competitive dialogues and design contests

However, functional specifications can also be included in direct as well as catalytic types of innovation procurement, as well as in Pre-commercial Procurement (PCP). PCP is a matter of buying research results that solve certain problems. These research results are not known and cannot be described ex ante – which implies that PCP normally is a matter of functional specifications (of research results). It can thus be concluded that functional specifications are needed in all different kinds of procurement (direct, catalytic and pre-commercial).

The arguments above have led to the fact that, from the perspective of an innovation process, there is reason to talk about – i.e. construct or create - two main types of procurement:

- Procurement based on product specification (product procurement) is when a public organization describes products that they want to buy.
- Procurement based on functional specification (functional procurement) is when a public organization describes problems/needs/functions that must be solved/fulfilled through the purchase and use of products.

These two main categories are also enough if you want to pursue a procurement policy that leads to innovations. This is done by converting product procurement into functional procurement. These two main categories are both simple and effective for such purposes.

Functional descriptions may include old (existing) products or not. Including old products reduces the risk, but still opens for innovations. In addition, there are strong arguments for making the descriptions broad in order not to exclude unexpected innovations. The biggest difference when it comes to stimulating innovations is, however, the difference between product procurement and functional procurement as such. Product procurement can only exceptionally lead to the development of innovations. Functional procurement opens in principle all procurements for the development of new and better products. If you want to promote innovations through procurement, then functional specifications should be used as much as possible.

Explaining and defining functional specifications rather than traditional descriptions of product/process characteristics is key to support innovation-enhancing procurement. Innovations may, of course, sometimes occur in regular product procurement, even if it was not a requirement of the procurement - if the product description is generic enough to include innovations (better products) that emerge anyway. One of the roles of innovation policy is, however, to create conditions and incentives for the systematic emergence and development of innovations that help address and respond to socioeconomic and environmental needs, both in the present times and in the future. From this perspective, innovations may be very much facilitated by functional specifications, as compared to product specifications. To achieve innovation through public procurement it is, somewhat paradoxically, more important to emphasize functional specification than to pursue innovation procurement. Functional specifications opens up for innovations in all types of public procurements, and not only those requiring innovations.

Functional procurement is not one of the so-called “procurement procedures” in the EU regulatory framework for public procurement specified in the legislation, which has to be followed by all EU Member States. This is a legal fact and cannot be changed in the short term.

Functional procurement/specification is not a procurement procedure. The concept of “functional demand” is however found in the EU legislation. According to it, procurers may choose to describe a function or a product in the tender specifications.

There are actually no limits to this and functional demands can always be used in the tender specifications, without changing any laws or rules.

The EU procurement directives on public procurement are very important for all procurement in the European Union. In the new Directive 2014/24/EU of 26 February 2014 it is written:

“The technical specifications drawn up by public purchasers need to allow public procurement to be open to competition as well as to achieve objectives of sustainability. To that end, it should be possible to submit tenders that reflect the diversity of technical solutions standards and technical specifications in the market place, including those drawn up on the basis of performance criteria linked to the life cycle and the sustainability of the production process of the works, supplies and services. Consequently, technical specifications should be drafted in such a way as to avoid artificially narrowing down competition through requirements that favour a specific economic operator by mirroring key characteristics of the supplies, services or works habitually offered by the economic operator. **Drawing up the technical specifications in terms of functional and performance requirements generally allows that objective to be achieved in the best way possible. Functional and performance-related requirements are also appropriate means to favour innovation in public procurement and should be used as widely as possible**” (EU 2014: Recital 74 – extra bold type added by the author).

It is remarkable that the EU Directives so strongly stress functional requirements, and that they emphasize that they “should be used as widely as possible” to favor innovation (and competition) in public procurement. The rationale is to avoid favoring specific companies by defining the requirements too narrowly. There is actually a large number of case law dealing with these kinds of cases, which highlights the problem. Luckily, this emphasis also favors innovation, although it may only be the secondary reason for emphasizing this approach. In other words, the use of functional requirements in public procurement not only supports innovation, but also serves as a powerful instrument of competition policy. The mechanism is that opening up for competition between different products to satisfy the same need or solve the same problem is an important means of increasing competition.

Sweden is the only country where the government has so far developed a national strategy for public procurement where innovation procurement - actually meaning functional procurement - is central (Regeringskansliet, 2016). The government took a decision on that strategy in June 2016 and it is now in the process of being implemented (Edquist, 2018). The fact that functional public procurement is an important part of the Swedish national public procurement strategy will not mean any substantial new direct costs (except for education and training and some increased transaction costs) in the public budget.

It will be an alternative way of using the funds that are already allocated to public procurement⁵. Hence, the application of this new strategy has great potential to increase the resources that will be used to obtain products with a higher quality (innovations).

This, in turn, could lead to better needs satisfaction and/or problem solving and lower costs in the long run. The main reason for this proposal is that its implementation would release

enormous creativity and innovativeness among suppliers – and for the public sector - within a very large proportion of the economy as a whole.

The proposed approach would also lead to increased competition, not only among different potential suppliers of similar products, but also among radically different products that solve the same problem. All this leads to a higher quality of the public services (i.e. to innovations in the public sector).

Another example of functional procurement was found in the Netherlands, where the Dutch public transportation agency required proposals for “Noise reduction along secondary roads”, instead of describing a noise barrier (e.g. a fence) in the tender documentation.

This noise reduction can be achieved by suppliers/innovators in many ways (e.g. an earth wall, trees and plants, ‘silent’ asphalt, lower speed - thanks to surveillance cameras, something not yet imagined by anyone, etc.) – and which particular method or device leads to the mitigation of the problem does/should not matter. Spain is also applying this in the project NieblA-8 that had a public consultation lead by the Ministry of Public Works-DG Roads to learn technology or innovation market offers to solve the problems of salty fogs coming from the sea that obliges the police to cut traffic circulation during summers in a very important northern coast highway (A-8). Norway has also defined a set of guidelines to include functional procurement as one of the elements in public procurement calls, as a result of which four experiences have been conducted to date⁵. These guidelines include an introduction to functional specifications (incl. the characteristics of a functional specification and pricing of functional specifications), and step-by-step guidelines on conducting a public procurement based on functional specifications (incl. a check list).

There are many obstacles to pursuing functional procurement in such a way that it leads to innovations. One of these obstacles or challenges is the identification of needs/problems to be addressed. The ultimate goal of functional procurement is not just to support or stimulate the development of innovations, but rather to focus on stimulating innovation in order to solve problems. Needs or problems must thus be the point of departure for every functional/innovation procurement. Needs assessment is crucial for all innovation enhancing public procurement. This is a main obstacle to pursue functional procurement and considerable efforts should be made to understand the underlying reasons why it is difficult to identify needs and problems specifically enough to pursue functional procurement.

The most important task in preparing functional procurements is to identify the problems to be solved and the needs to be satisfied by means of the procurement. It is a question of specifying the goals (problems and needs). Developing an ability to identify needs, and problems and also evaluating the feasibility of proposed solutions are important. This might sometimes be quite difficult and may constitute an obstacle to innovation-enhancing procurement.

⁵If 10% of the 700 billion crowns used for public procurement will stimulate innovation in the future, this corresponds to 70 billion crowns (8 billion euros). The public annual research budget is 35 billion crowns (4 billion euros)

⁶See: <https://www.anskaffelser.no/verktoy/ytelses-og-funksjonsspesifikasjoner-veiledere-og-sjekkliste>

Knowing what central procuring entities or contracting authorities want/need is not a trivial task. It requires time and cooperation between departments which can be a barrier.

Sometimes the supplier may not understand the need properly, which in turn leads to a contract not fulfilling the expressed need. In this regard, detailed specifications can increase rather than decrease risk. Thinking in terms of what is needed rather than how the need is met requires a change in mind-set at the specification and the contract monitoring stage.

Identified societal needs and problems must be translated and transformed into functional requirements. This specification of functions is an early stage of the procurement process, and comes directly after identification of needs and problems.

It is important that the procuring authority/unit should limit itself to specifying the functional requirements. If not, the creativity and innovativeness of the potential suppliers will be hampered. It may also lead to development being locked into wasteful and ineffective paths. By the same token, too detailed functional specifications may also be an encumbrance for innovation. It may also be an obstacle to the simultaneous procurement of more than one attempt to meet the same functional demands, but in different ways. The products must be designed by the potential innovators/suppliers.

The innovation policy conclusion is that the proportion of functional procurement should increase, and the proportion of product procurement should decrease, if innovations are to be enhanced through public procurement. The conclusion will then be that it is not efficient in terms of innovation policy to add a functional specification without removing the product specification. Neither are both needed for a procurement to be carried out.

If functional procurement that leads to innovations is to be carried out on a broad front, an action plan for implementation of functional procurement is needed. Part of this paper is aimed at sketching how such a plan can be developed. The development and implementation of such an action plan will lead to creativity and innovation among suppliers, as well as increased competition between suppliers and products. This, in turn, leads to higher quality of public services (i.e. to innovations in the public sector).

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Abstract 33

UNFOLDING HETEROGENEITY: THE DIFFERENT POLICY DRIVERS OF DIFFERENT ECO-INNOVATION MODES

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Aim of the proposal:

The key role of public actions for sustaining pollution reduction while encouraging the development and adoption of environmentally beneficial technology is justified by the presence of market failures, that might be responsible for the suboptimal supply of both environmental protection and green innovations (Jaffe et al., 2005).

Within this framework, a broad research effort has been devoted to understand whether and to what extent public policies success in providing incentives for the adoption of better abatement technologies. Most of it confirms the relevance of both environmental (Aghion et al., 2016; Brunnermeier and Cohen, 2003; Calel and Dechezlepretre, 2016; Jaffe and Palmer, 1997; Popp, 2006; Triguero et al., 2015) and innovation policies (Costantini et al., 2015; 2017; Horbach 2012; 2016; Ghisetti; 2018) in fostering the pace of introduction and diffusion of environmental technologies.

These contributions make use of a broad definition of environmental innovation (here-after EI) or, at best, identify EI row classes (as for example efficiency-improving vs pollution-reducing, product vs process or end-of-pipe technologies vs cleaner production technologies) to scrutinize the impact of distinct institutional drivers in sustaining EI engagement.

However, a step forward in the identification of EI's features has been recently made by a recent stream of literature. This new approach claims that environmental objectives, representing the starting point of EI processes (Jakobsen and Clausen, 2016; OECD, 2005, Paulraj, 2009;), might be achieved through several technological trajectories (Castellacci and Lee, 2018) and distinct combinations among forms of knowledge (Marzucchi and Montresor, 2017). Accordingly, as environmental goals are strictly linked to policy drivers and distinct policies may induce to different EI behaviors (Marin et al., 2015), here it is argued that investigating the relations between environmental objectives and policy determinants is of paramount importance for launching accurate policy actions on EI activities.

In order to provide a contribution in this direction, the present paper bridges together these two research lines and investigates the policy determinants of distinct patters of environmental innovation, here-after "EI modes". In particular, our research question investigates whether and to what extent policy drivers are different with respect to firms with distinct EI modes.

To assess this issue, after reviewing both environmental and innovation policy drivers of EI and their potential links with different environmental strategies, a large-scale survey data provided by the Italian Community Innovation Survey is exploited in order to examine to what extent firms pursuing different approaches to environmental innovation differently "score" on policy measures.

This study contributes to the literature in two ways. The first contribution consists of the framework of innovation modes which, in the vein of the evolutionary theory (Nelson and Winter, 2009, Nelson, 1991, Tether and Tajar, 2008), provides evidence that firms pursue several approaches to EI. A related contribution is that this research directly keys into the

debate in the literature about to effectiveness of distinct public policies in spurring EI, with the added insight of recognizing the role of distinct policy tools in shaping several EI dynamics. Thus, an enriched and more nuanced view of EI processes is here provided, with important implications for theorizing about policies aiming at fostering the transition towards increased sustainability.

The remainder of this chapter is organized as follows. Section 2 provides a synthetic but extensive survey on the institutional determinants of EI while Section 3 discusses the research questions. Section 4 presents the data, the empirical application and illustrates the results. Finally, Section 5 concludes by discussing the main findings.

Background:

The key role of public policies in managing sustainable transition has been emphasized by a large number of empirical studies devoted at investigating the potential role of public policies in supporting the introduction and diffusion of new environmental technologies (Del Río, 2009; Foxon, 2013; Horbach, 2008; Mowery et al., 2010; Newell, 2010, OECD, 2005, 2010; Triguero et al., 2013). Among the several classifications proposed by scholars (e.g., Crespi and Quatraro, 2013, Crespi et al, 2015; Del Río et al., 2010; Kemp, 1997; Rennings, 2000; Wieczorek and Hekkert, 2012), policy tools may be grouped into two pillars belonging to environmental and innovation policy domain, respectively (see Crespi 2016 for a detailed list).

Methodology and empirical base:

The empirical analysis consists of two stages. The first one is dedicated to identifying distinct environmental innovation strategies (EI modes) (research question 1), while the second step investigates the link between the four categories of policy tools and distinct EI strategies (research question 2).

The dataset is based on data collected by the Italian Community Innovation Survey referred to the period 2012-2014. In particular, the 7th Italian CIS survey exploited for this analysis provides data on 17.532 firms belonging to manufacture and service sectors. Firms with at least 10 employees are identified through a stratified random sampling based on size, sector and geographical coordinates, while a census survey includes all firms with more of 249 employees. The web-based questionnaire is about 12 pages long and the response rate for wave 7th has been of 62,8%. The analysis has been restricted to manufacturing firms and the final sample is composed by 4.792 units.

In comparison with previous CIS waves, CIS7 has made up a step forward in the investigation of firms' environmental innovation strategies by collecting information on a wide range of aspects related to EI. Indeed, firms are asked about the type and the goals reached by the environmental innovation carried out over the three-year period as well as the degree of importance attached to its drivers (policy factors, private demand, cost-saving considerations and reputational motivations). In addition, the generic innovation-related module provides a set of quantitative and qualitative data about firm's technology innovation strategy, including information on firm's R&D activities and cooperation practices.

Results:

The identification of the distinct EI modes follows the approach proposed by Castellacci and Lie (2017) which consists of a clustering procedure preceded by a Principal Component Analysis. The PCA is carried out on ten variables (Table 1): six referring to the achievement of

environmental benefits experienced within the enterprises by innovating (namely ECOMAT, ECOENO, ECOPOL, ECOSUB, ECOREP, ECOREC) and four referring to the achievement of environmental benefits experienced during the consumption or use of a good or service by the end user by innovating (i.e. ECOENU, ECOPOS, ECOREA, ECOEXT). The sample is composed by 1.807 manufacturing claiming to introduce at least a process or product environmental innovation over the period 2012-2014., to properly identify distinct EI modes, a cluster analysis on the above six principal components is performed in two steps. Firstly, different solutions from several hierarchical methodologies are exploited to identify the optimal number of clusters (Hair et al, 2009). After comparing several clustering solutions ranging from two and eight, the optimal number has been chosen on the basis of their statistical significance and economic interpretation. The selected clustering method is the complete-linkage, which allows to minimize the within-cluster distance between observations. This strategy identifies a four-cluster solution as the most appropriate for our data. Secondly, a k-means clustering algorithm is applied to assign firms to clusters by imposing a four-cluster solution, as indicated in the previous phase.

The first group has a very high mean value for the first principal component analysis and identifies a large group of enterprises (481) introducing pollution-reducing innovations. The second cluster scores very high on the second principal component recycling, thus identifying 613 firms that carry out innovations to reduce the waste streams during the production process and new recycling technologies experienced by end-users. The third cluster has above-average values on the third and fourth components, classifying a less numerous groups of firms (219) that innovate along the energy-saving technological trajectory. Finally, the fourth cluster loads very high for the fifth principal component (material reducing), thereby identifying a group of firms that predominantly introduce material-reducing innovations. This latter group encompasses 494 firms.

Econometric analysis & Results

The characteristics of the four groups are detected by the econometric analysis (Table 10). The latter is carried out by running out four logistic regression models which estimate the probability of belonging to a given cluster. A set of CIS drivers grasping different dimensions affecting firms EI behaviors are using as regressors to perform the analysis (Table 8 and 9).

The logistic regression could be formally expressed as follow:

$$\text{Prob}(Y_i=1) = 1 / (1 + \sum_k \exp(\beta_k X_{ij})) \quad \text{for each } j=1 \quad (2)$$

where Y_i represents the set of clusters obtained from cluster's analysis, the vector X_i of explanatory variables and j reflects the vector of estimated coefficients for each cluster j .

The first set of regressors concerns environmental policies tools, grouped in CACs and MBIs. Specifically, CACs instruments are represented by exiting environmental regulation, while MBIs instruments are identified in the exiting environmental taxation. The second set of regressor embraces innovation policy instruments, respectively represented by supply-push measures, such as government grants, subsidies or other financial incentives, and demand-pull tools referring to specific requirement to meet within public procurement contracts. All the above indicators have been transformed in dichotomous variables that take value equal to 1 if firms assign them medium or high level of importance (value 2 and 3 of the Likert scale), and 0 otherwise. The third set of variables takes into account other drivers as firm's

reputation, cost saving motivations, demand from private actors and voluntary code, firm's technological capabilities (represented by internal R&D and technological and not technological cooperation activities with external partners) and finally, firms' individual characteristics, such as size, group and export dummies. Sectoral dummies calculated at a NACE 2-digit are included as regressors.

The main result of the econometric analysis is that policy drivers differently score across the four EI modes, thus confirming that eco-innovating patterns are inherently different. Regarding the role played by environmental policy tools, findings emerging from Table 9 show a strong and positive correlation between CACs and the probability of belonging to cluster 1. In line with empirical evidences by Frondel et al. (2007) and Demirel and Kesidou (2011), CACs instruments have been found to affect the introduction of less radical innovations, as in the case of pollution-reducing technologies that are usually included in the class of end-of-pipe technologies.

By looking at innovation policies, the role of supply-push measures turns out to be positively associated with energy-saving innovations, while demand-pull policies are found to positively affect recycling innovators. These findings may be explained by two facts.

First, energy-saving technologies achieve the double aim to reduce pollution while improving energy-performance, so that, their realization may involve a more complex and radical innovation process which, in turn, implies high degrees of riskiness that may discourage external investors. In this view, firms engaging in energy-saving innovations may make use of public financial sustain to a greater extent than those engaging in other, less risky, EI activities. This finding is inconsistent with evidences provided by Veugelers (2012) and Horbach (2008, 2016) where, contrary to the present analysis, use an ex-ante classification to unify energy-saving and material-reducing technologies into a single efficiency-improving class.

Second, green public procurement procedures, which essentially follow the LCA approach (Life Cycle Assessment), basically sustain recycling practices for minimizing services and products' environmental impact throughout their whole life cycle, i.e. from the materials production stage to the end-of-life. In this context, the need of meeting environmental criteria, as required by the public tendering, may represent a significant stimulus for the engagement in recycling practices aimed at realizing more eco-friendly goods and services.

Surprisingly, any correlation has been found between policy drivers and cluster 4 encompassing material-reducing innovators. This means that firms following this pattern are not triggered by policy factors and other external drivers, as reputation and cost considerations. Rather, the material-reducing trajectory is likely to stem from an "unconditioned" pace of technological progress.

To better explain these findings, we here summarize the main identified characteristics as follows:

- (i) Pollution-reducing EI. This mode is followed by 481 firms that attach great importance to CACs policies. However, a weak but significant impact on the probability of belonging to this cluster also arises from the supply-push indicator. Furthermore, compared to other environmental innovators, pollution-reducing innovators are found to be smaller and to belong to a group.
- (ii) Recycling EI. This group is the most numerous one since it includes 613 environmental innovators aiming at recycling goals at both process and product level. When compared to other eco-innovators, these companies turn out to be triggered by demand-side innovation policies and voluntary codes. In contrast, the exploitation of supply-side tools appears negatively correlated with the odds of belonging to this group. Finally, recycling innovators

are bigger than others and seem to show an own property structure.

(iii) Energy-saving EI. This cluster is the smallest one by consisting of 219 firms. For the group, the crucial policy driver is represented by financial support by governments. On the contrary, energy-improving innovations are not fueled by green public purchasing as well as environmental standards impositions. In addition, cost-saving motivations are also relevant for being part of this cluster.

(v) Material-reducing EI. This mode is followed by 494 firms. The probability of belonging to this group increases for companies that assign less or null importance to policy drivers, especially to CACs and supply-push measures. In addition, firms belonging to cluster 4 are less propense to cooperate with external partners and, as reported by Table 9, show the higher mean value for the internal R&D variable.

Conclusions:

In the European context, the transition towards a “resource efficient and greener economy” has been settled as a key priority (EU, 2011) by the Lisbon Agenda and Europe 2020.

To sustain such a convergence between environmental and economic issues, policy action plays a primary role in providing firms with effective stimuli to develop environmental-friendly technological. The need for public intervention is justified by the presence of many market-failures hindrances, that are supposed to affect EI to a greater extent than standard innovation. On the one hand, the “double externality problem” makes the typical appropriability problem of innovation exceptionally pronounced when green technologies are implemented as firms bear the costs of less pollution while the society benefits from it (Beise and Rennings, 2005). On the other hand, since as EI activities belong to a less mature field of innovation when compared to traditional technologies (Ghisetti et al., 2015), EI investments are perceived to be highly risky (Kapoor and Oksnes, 2011) and, as a consequence, external investors may be less attracted by them. All these conditions provide strong rationale for adopting policy measures.

The present paper goes in this direction by exploiting a wide array of policy instruments and their link with EI by accounting for heterogeneity among distinct EI patterns followed by firms. In so doing, a much richer and complex picture of environmental innovation domain is provided through the identification of four eco-innovation modes, namely (1) pollution-reducing, (2) recycling, (3) energy-saving and (4) material reducing, whose implementation turns out to be in most of these cases, positively correlated with environmental and innovation policy tools.

The main results of the exploratory exercise can be synthesized as follows:

(i) By paying attention on environmental policy drivers, it emerges that those firms grouped in cluster (1) are mainly driven by regulatory instruments (CACs) belonging to the environmental policy class. Consistent with previous analysis, this result confirms that environmental policies success in sustaining less radical EI activities, as in case of pollution-reducing technologies. In contrast, any significant relationship emerges for MBIs (environmental taxation), thus signaling that the price of polluting might be not sufficiently high to stimulate innovation activities with beneficial environmental effects. This arises the need to intervene under the aspect of the fiscal design.

(ii) With respect to innovation policy instruments, evidences of positive links with EI have been

recognized in two cases. First, energy-saving technologies (3) appear to benefit from supply-push measures while recycling innovations (2) are positively stimulated by demand-pull policies. Both results are in line with theoretical speculations about the corrective role of supply-side policies (especially in case of more complex innovation projects as energy-saving innovations) and the positive impact of green public demand in successfully stimulating recycling practices through the LCA approach.

(iii) With respect to other external drivers, it emerges that voluntary codes are relevant for cluster (2), while cluster (3) basically attaches more importance to cost-saving considerations and reputational motivations.

These findings give response to the research questions made in section 3, with some important contributions for the development of EI related literature. Firstly, thanks to the identification of distinct innovation patterns, a more complete representation of EI realm has been provided for the Italian case. Secondly, the key role of public policies in stimulating EI practices has been found to change in sign and magnitude across EI policy tools and modes. This means that, to increase policy efficiency, distinct policy actions should be set according to specific environmental targets (pollution-reducing, recycling etc..). In other words, this would make environmental and innovation policies more effective leverages to increase sustainability.

Abstract 53

MOBILITY BENEFITS AS A DRIVER OF SUSTAINABILITY TRANSITIONS: A SWEDISH CASE

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Introduction:

Mobility is undergoing a paradigm shift. Focus is expanded from the privately-owned passenger car to a landscape in which the car is one component but where electric bikes, public transport, car-sharing and mobility as a service (MaaS) also are feasible alternatives. In order to limit global warming in accordance with the Paris Agreement, this paradigm shift however needs to speed up. Transport is one of the main contributors to greenhouse gas emissions (IEA, 2019), which means that sustainable alternatives are badly needed. Sociotechnical transitions generally take a long time (Geels and Schot, 2007), but recent research has shown that this may be changing (Sovacool, 2016). The right policy may help drive swifter sustainability transitions (Bachus and Vanswijgenhoven, 2018; Edmondson et al., 2018; Kern and Rogge, 2016).

Policy and regulations may however become barriers rather than adequate mechanisms for encouraging new mobility options, if they are not developed in pace with the technology that they affect or govern. In order to really reap the potential benefits of technological change, policy may need to be adjusted quickly (Mergel, 2016). The quality of new policy and regulations must not be sacrificed for a speedy policy process, but policy development needs to follow new paths that allow for an iterative and inclusive problem solving. This may be achieved by policy labs, which borrow problem-solving methods from product and service design (McGann et al., 2018).

This paper presents a case study inspired by policy labs: Swedish taxation for employee benefits within mobility. In Sweden, employee benefits are generally taxed equally to monetary compensation from the employer. Policy is in place to promote sustainable mobility: company cars that are considered environmentally friendly get a reduction of the taxed benefit value. Meanwhile, other sustainable mobility benefits are taxed to their full value. Interest in providing mobility benefits other than cars, e.g. bicycles, public transport tickets and MaaS concepts, is rising. However, such offers are generally not considered attractive, due to high costs. The aim of this case study is to identify possibilities to reform the Swedish benefit taxation regulations in order to make sustainable mobility choices more attractive to employees and employers.

Background:

Policy labs

Policy labs work with policy- and regulation-related issues that arise with dynamically developing markets and technologies (Kimbell, 2015; Puttick et al., 2014). They are a growing phenomenon within Europe; currently, there are more than 60 policy labs in the EU (McGann et al., 2018). Their scope may be city, county or national policy, and they focus on different areas such as digitalisation, migration and sustainability (Fuller and Lochard, 2016). Policy labs apply people-centred and creative methods and integrate as many perspectives as possible.

Instead of developing a perfect, final solution for a problem, policy labs experiment, prototype, and pilot ideas in iterations before eventually scaling up (Junginger, 2016; Mergel, 2016). Key characteristics of policy labs are multi-disciplinary teams, agile innovation and co-creation (Hagy et al., 2017; Junginger, 2016; Mergel, 2016). Involving experts from different disciplines may provide a full-angle perspective and thus help overcome the silo structures that are characteristic in public institutions. Agility does not imply lack of planning but rather a flexible and adaptable design process.

Finally, co-creation may lead to greater acceptance and transparency of policy making. These characteristics enable policy labs to bridge two different worlds: the slow and risk-averse world of policy making on the one hand, and the fast and risk-friendly world of technology innovation (Keyson et al., 2017).

Benefit taxation:

Swedish employee benefits are generally taxed equally to monetary compensation from the employer. Most benefit taxation is administrated by the employer. Some benefits are tax-free, such as free coffee and fruit at the workplace. Another example of a tax-free benefit is the “wellness allowance” which is a sum of money that employees may spend on physical activities. Additionally, if a benefit is small enough that its value is considered negligible, it does not warrant taxation. In many cases, benefits are taxed according to standards rather than their actual value. For instance, the benefit of receiving a meal at a conference is taxed according to a standard value regardless of how fancy the meal is. This probably simplifies administration for everyone involved. Taxation for a car benefit is calculated according to a formula, which takes market value into account to some extent. However, the formula has received criticism as the taxed value may be calculated too low (ESV, 2018). Cars that are considered environmentally friendly get a reduction of the taxed value, in order to promote sustainable car choices. Other means of sustainable mobility do not get any tax reduction.

Methodology:

The case study presented in this paper was inspired by policy labs. A multi-disciplinary research team was put together to identify policy-related problems. First, a literature study was performed in order to understand the area of employee benefits and related taxation. Then, ten interviews were performed with employers from different public and private sectors, in order to understand how they manage benefits, how they would like the area of employee benefits to develop and what problems they experience in relation to benefits. Scenarios with various mobility benefits were conceptualised and discussed with the interviewees. The Swedish Tax Agency was also interviewed, to obtain their view and to better understand the system.

The material from the literature study and the interviews was analysed, and some core issues were identified. The intention at the time of writing is to use the material and the analysis as basis for a workshop, including employers, researchers and representatives of the Swedish Tax Agency, which will take place in March 2019. This will constitute the co-creation phase, where potential solutions to the identified problems can be created and discussed. Previous similar case studies have shown that Swedish civil servants are open to co-creation processes, with regard to issues that they may influence without being dependent on political decisions. When an issue may be decided by civil servants, the process can be very swift. Issues that

require political decisions of course result in a much slower process. This case study focusses on issues that do not involve political decisions.

Preliminary results:

Attitudes to mobility benefits

The interviews show that several employers, both public and private organisations, wish to widen the range of mobility products and services that they may offer their employees as benefits. Many employers offer car benefits to employees in higher positions. That is generally perceived as somewhat unmodern, but most employers find that it would be difficult to eliminate such car benefits. Instead, employers are looking for mobility benefits that may be offered to all employees, regardless of their position. In particular, they recognise that mobility benefits may attract younger employees who do not view a car as something desirable.

Generally, the employers wish to simplify everyday chores for their employees. They find it important that employees can easily get to and from work, and they are interested in providing benefits to facilitate that. Several employees are also concerned with climate impact and wish to increase the sustainability in business travel as well as commuting. Another aspect is that administration of business travel expenses can be costly, and employers wish to cut that cost by offering mobility schemes that involve less administration. For instance, if the employee travels on a public-transport ticket that has already been paid by the employer, the employee will not seek reimbursement. To achieve this situation, benefits need to be easily accessed and simple to use for the employee. Interestingly, the car benefit is perceived as simple to administrate, although it is based on complicated calculations. The perceived simplicity may be explained by the fact that most employers use a middle-hand for administrating car benefits.

Some sustainable mobility benefits already exist. For instance, some employers offer bikes and electric bikes in a benefit scheme where the employee gets a monthly salary reduction for two to three years and then has the option to buy the bike at remaining value if they want to keep it. This leasing scheme is generally considered attractive. A good example is Jönköping municipality, where 20% of employees have acquired a bike or an electric bike as a benefit. 10% of employees who acquired an electric bike have reduced the number of cars in their households (Gustafsson, 2018). Jönköping municipality believes that the success is due to the relatively low cost for the employees. A reduced benefit tax could make the offer even more attractive to employees with low socio-economic status.

Some employers offer public-transport season tickets as a benefit. The cost is equal to buying the ticket privately, so the benefit part of it is really that the cost can be deducted from the salary. Making the cost less noticeable might affect some employees, but it is generally not considered sufficient incentive. Studies show that the issue of abolishing benefit taxation for public-transport season tickets has been raised earlier, and that it would likely increase the use of public transport by commuters (Koucky, 2011; WSP, 2012). Likewise, several employers believe that abolishing benefit taxation for public-transport season tickets would make such a benefit more attractive. That is however a political decision, which means that it is out of scope for this case study.

Issues for a co-creation process

Upon analysing the interviews, it became clear that two issues in particular affect the attractiveness of mobility benefits. The following two issues will be discussed in a workshop, in order to identify potential solutions in a co-creation process, and the results will be presented at Eu-SPRI 2019.

- The benefit taxation on 'green' cars is reduced, compared to the benefit taxation on 'regular' cars.
This is meant to incentivise procurement and use of environmentally-friendly company cars. However, there is no corresponding tax reduction on other, more sustainable mobility alternatives. Bikes, public-transport tickets and MaaS subscriptions fall under regular taxation. Thus, it may seem that policy-makers do not consider sustainable mobility very important. How may policy be created to incentivise sustainable mobility alternatives equally?
- One advantage of mobility benefits would be that the employee could use the benefit both for travels to and from the workplace and for travels on the job, thus simplifying the administration for themselves as well as for the employer. However, different tax regulations apply to private travel and work travel. If employees use private public-transport season tickets for job travel, the employer cannot reimburse them. If employees use their employer's public-transport season ticket privately, they should pay benefit tax. Thus, combining mobility on and off the job may be too complicated for employers to try, even if it would be the sustainable choice. How may policy simplify the combination of private and work-related mobility?

Concluding remarks and policy implications:

Preliminary results from this case study show that benefit taxation policy in Sweden is not effective for achieving transport-related sustainability goals. Rather, it constitutes a barrier even to those employers and employees who want to adopt sustainable mobility behaviour. The existing tax reduction for 'green' company cars is an example of how policy to support a sustainability transition does not replace regular policy but complements it, and thus helps maintain the car-centred regime. This mechanism has been defined as a challenge for sustainability transitions (Edmondson et al., 2018). For a successful transition to sustainable mobility which is not focussed on the privately-owned car, benefit taxation policy rather needs to challenge the current regime. Incentives for public transport, MaaS, car-sharing and cycling are required.

These alternative mobility benefits need to be at least as attractive and easy to manage as the car benefit. However, accumulating policy can lead to a system that becomes too complex and entails undesired effects (Edmondson et al., 2018). In order not to risk creating policy that could counteract the transition to sustainable mobility, it might be wise to redesign the whole area of mobility benefits, including car benefits.

Redesigning policy is a slow political process. This could be a sign of inertia and path dependency, but it is also a sign of a democratically sound process which should not be rushed. Thus, a redesigning process might benefit from an initial focus on policy development regarding matters which civil servants may influence without being dependent on political

decisions. In this case, such matters could include creating schemes for estimating the value of combined and shared mobility services. This would make sustainable mobility alternatives more visible in the benefit taxation framework, and it could assist employers who engage in developing mobility benefits. Putting the spotlight on the value of different mobility options might also be beneficial for opening up an arena for political discussions on mobility benefits and their role in the transition to more sustainable transport.

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D2 GOVERNANCE 1

Thursday 06 June 2019 from 11:30 to 13:00

SUSAN COZZENS, Chair

Abstract 50

MODALITIES OF PUBLIC PARTICIPATION IN THE VISION-SETTING FOR TRANSFORMATIVE RESEARCH AND INNOVATION POLICIES: IN-DEPTH CASES STUDIES ANALYSIS

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Keywords: Mission-oriented R&I; Citizen involvement; Sustainable Transition; Public participation; Horizon Europe; Case studies

Introduction:

In June 2018, the European Commission announced that the next Framework Programme (Horizon Europe) will further orient the research and innovation (R&I) policy of the European Union (EU) towards missions. During the post-Second World War economic recovery, some countries already pivoted their R&I policies on the accelerated development of new technologies to ensure and strengthen their technological, economic and geopolitical leadership (e.g. sending a Man on the Moon). In most recent years, the concept of mission-oriented policies expanded to encompass transformative changes (JIIP et al., 2018a; Kuittinen et al., 2018) geared towards solving societal challenges such as the UN Sustainable Development Goals (SDGs). This reflects the emergence of a new paradigm in which R&I policy aims to contribute to attaining more sustainable and inclusive societies (Schot and Steinmueller, 2018). The directionality of such transformative R&I policies is crucial to their success (Weber and Rohrer, 2012) and often subordinate to the dialogue among a wide array of actors.

By considering these elements, Chicot and Domini (2019) contend that citizens should have an essential role in determining the vision of mission-oriented R&I initiatives and in granting them satisfying levels of legitimacy. However, in most mission-oriented R&I policies observed until now, public engagement was restricted due to policymakers' reluctance and practices.

By elaborating on Chicot and Domini (2019), this research explores how the public, including citizens, can contribute to setting the visions for transformative mission-oriented R&I policies. The analysis of three emblematic cases gives new empirical insights into the design of mission-oriented policies, which are currently high on the policy agendas of several major global economies. Such a focus on the public participation mechanisms and the actors involved aims to provide policymakers with valuable recommendations, while contributing to the literature on transformative R&I policy and on public participation in science.

Background:

Over the last decade, the idea according to which policymaking should be the exclusive prerogative of the elected officials has been increasingly criticized. Citizens expect and demand more transparent and participatory policymaking (OECD, 2001) and denounce interpretations of representative democracy that restrict their roles to passively casting their vote (Vigoda, 2002). These criticisms have led to the promotion of participatory democracy schemes (e.g. participatory budgeting), in which the 'will of the people' is determined through deliberation open to all individuals of a defined community instead of through bargaining of power between their elected representatives (Andersen and Jaeger, 1999).

New approaches to science and science policy diverge from the epistemological views that underpin an elitist governance of science and demonstrate that science is subject to the normative assumptions and societal values of the society in which it is conducted (Fischer, 1992). Moreover, in the context of multiple scientific and technological controversies (e.g. genetically modified organisms), citizens and civil society organisations increasingly question the assumption that technological research systematically leads to improved welfare (Escobar, 2014) and request to have a say in the orientation and practices of research (Owen et al., 2012; Stanley et al., 2018). In the late 1990s and early 2000s, pioneering organisations, such as the Danish Board of Technology, reacted and engaged the public in scientific and technological matters (Joss, 1999), mostly through participatory technology assessment exercises aimed at diminishing the risk of future controversies and increasing the societal acceptance of technological choices. They nevertheless raised criticisms partly due to disillusion in respect to their influence on decision-making (Delborne et al., 2013; Escobar, 2014) and their democratic legitimacy (Braun and Schultz, 2010; Pestre, 2008).

Public participation in policymaking gained a renewed interest during the preparation of Horizon Europe and the introduction of a mission-oriented approach into the EU R&I policies. High-Level Expert Groups to the European Commission (e.g. European Commission, 2018; JIIP et al., 2018b; Mazzucato, 2018) argue that the contribution of the citizens to the definition of these missions is crucial to their societal acceptance and their accomplishment. Chicot and Domini (2019) identify three cases in which public engagement in vision-setting is particularly justified: (1) when the missions relate to societal challenges affecting large portions of the population; (2) when citizens contribute to refining broad transformative policy missions into concrete problems and goals; and, (3) when the activism of grassroots movements in favour of specific missions supports the policy agenda of policymakers.

In contrast with past approaches of public engagement focused on technology assessment, the mission orientation of R&I implies that the public contributes also to the very early phases in the policymaking process, such as by defining the overall challenges and setting milestones (Edquist, 2011). Despite this difference, this research contends that the challenges observed in the earlier forms of public participation in science and technology are overarching and apply somehow also to forms of public engagement in vision-setting for mission-oriented R&I policies.

Promoters of public participation exercises must determine which type(s) of individuals to involve. Braun and Schultz (2010) distinguish four types of 'public', namely (1) the general public (generally participating in opinion polls and the like), (2) the pure public (i.e. citizens or laypeople), (3) the affected public, and (4) the partisan public. Chicot and Domini (2019) similarly contend that citizen involvement should be understood as consisting of initiatives aimed at engaging individuals ideally randomly selected and disconnected from organisations pursuing a specific policy agenda. However, participants already active in policymaking processes may be able to make a more effective, or at least influential, contribution to decision-making as they have experience in influencing policy agendas. In other words, organisers of public participation exercises have to make a choice between engaging laypeople for the sake of legitimacy, or more partisan actors for the sake of effectiveness (Braun and Schultz, 2010; Delborne et al., 2013).

A similar trade-off relates to the engagement of experts. These actors can provide policymakers with the knowledge required to make policy decisions relevant in respect to the problems that need to be solved. Therefore, Boedeltje and Cornips (2004) argue that, in some circumstances, citizens may prefer policymaking processes in which experts were involved to orient appropriately policy actions over processes that give priority to engagement of citizens for the sake of fairness. Against this conflictual view, Escobar (2014) observes that citizens and experts can form 'communities of inquiry', where they can exchange knowledge and views for a better understanding of the issues under investigation (Fischer, 1992).

The format of public participation influences the relationship and interactions between the public and experts. For instance, Andersen and Jaeger (1999) show that consensus conferences consist in dialogues between citizens and experts to clarify the issues under investigation, while scenario workshops rely on the crucial role of citizens in providing knowledge for the identification of relevant solutions to particular problems.

In view of devising policy recommendations for a participatory definition of the vision of transformative R&I, this research conducts an empirical analysis along these three dimensions and answers the following research questions: Who is the public contributing to setting the visions for transformative R&I initiatives? How should this public interact with the experts for an accurate definition of these challenges and problems? Which formats of, and instruments for, public participation are employed to meet the pursued objectives of public participation?

Methodology and empirical base:

The in-depth analysis of cases studies is deemed the most appropriate approach to scrutinize mechanisms for public participation in the vision-setting of R&I policy initiatives. It especially answers the aforementioned research questions, which relate to – besides which 'public' to involve – how this public is engaged and how it interacts with experts (Yin, 1999).

Firstly, by having the ambition of contributing to the understanding and development of new governance structures for R&I policies, this research cannot neglect the importance of the human factor. Given that policymaking processes highly depend on the behaviour of and interactions

among societal actors, “the study of human affairs is [...] at an eternal beginning” (Flyvbjerg, 2006, p. 224). In comparison with the purely speculative exercise of building overreaching theories, case study is a more viable approach to analyse such an empirical topic.

Secondly, transformative mission-oriented R&I policies addressing climate change – despite their similarities – highly depend on the contexts in which they develop. Case studies allow to capture the socioeconomic and history-related factors at play and their influence on the governance approach and policy decisions relative to public participation (Flyvbjerg, 2006).

Finally, in order to explore the aforementioned aspects of public participation into the shaping of new policies, this research cannot be limited to the observation of a single case. The analysis of multiple cases to draw parallels and make distinctions among them is the research technique expected to give the most compelling and robust findings (Eisenhardt and Graebner, 2007; Yin, 1999).

The selection of case studies draws on the categories of citizen involvement practices defined by Chicot and Domini (2019), and, more precisely, on their valuable examples (Siggelkow, 2007) of transformative mission-oriented policies which respond to the increasing demands for comprehensive policies solving climate change. Accordingly, this research conducts in-depth analysis of the German Energy Transition strategy (hereafter ‘Energiewende’), the Luxembourg 3rd Industrial Revolution (TIR) strategy, and policies for reducing air pollution in London.

The target of Energiewende, which the German government implemented in 2010, is a stable supply of energy, which is economically viable and environmentally friendly. Although Energiewende is commonly associated with the German post-Fukushima national energy policies, the notion of energy transition dates back to the 1970s, when Energiewende started as a marginal bottom-up initiative and was mainly driven by the anti-nuclear movement. Nowadays, the initiative is based on a broad political and nation-wide consensus on the need to restructure the Germany energy system via the demonstration of alternatives to the traditional energy mix based on hard coal, lignite and natural gas. The Federal Government currently coordinates the close and ongoing dialogues between the relevant stakeholders aimed at creating a high level of transparency and public acceptance of the energy transition. The citizens have a direct role in the energy transition, and they can be considered its main driving force: private households set up their own renewable energy installation (e.g. solar panels) and various forms of citizen-owned energy cooperatives have emerged.

The mission of the Luxembourg TIR strategy is to prepare the Luxembourg economy and society for the upcoming megatrends and inherent disruptive forces (linked to digitisation, automation, decarbonisation) and to foster their transition towards sustainable development. More specifically, the Luxembourg TIR strategy sets ambitious objectives which will be achieved by employing Internet of Things solutions and counting on the engagement of the citizens. In November 2016, the Government released a strategic study whose design and implementation phases were defined through an open and bottom-up approach via the involvement of more than 300 socio-economic actors in several thematic working groups. The implementation of

Luxembourg TIR follows a participative approach similar to the one adopted for its preparation. The thematic platforms consult the same types of actors via dedicated meetings to elaborate concrete actions.

The third case study is a compound of consistent policy initiatives of the City of London aimed at reducing air pollution and protecting the health of the citizens. They mostly rely on the replacement of both public and private vehicles (phasing out of older diesel buses, licensing only zero-emission taxis) and the introduction and progressive expansion of ultra-low emission zones. Prompted by the transposition of the 2008 EU Directive on air quality standards, the first 2010 Air Quality Strategy was adopted and regularly upgraded under the current Khan administration (2016-present). The initiative presents a high level of citizen involvement, with the deployment of sophisticated consultation systems particularly in the design phase. More specifically, in 2010, the overall strategy was subject to public consultations, as in 2016 for the newly elected Mayor's ambitious proposals.

In order to collect evidence on these three case studies, the research privileges desk research and interviews. Both primary and secondary documents (e.g. official reports, the Global Observatory of the Joint Institute for Innovation Policy¹) have been considered as valuable sources of information.

Given that desk research is limited by the fact that little investigation has been done so far about mission-oriented policies and particularly on the involvement of the public in their inception and development, interviews with key stakeholders play a fundamental role in collecting evidence. A "snowballs sampling" approach complements the pre-identification of relevant stakeholders through desk research. In total, 17 semi-structured interviews have been conducted with policymakers, representatives of civil society organisations, and experts in R&I and climate action policy. Sets of questions were developed and tailored to each of these categories.

Results:

The public participating in the vision-setting for transformative policies

The three mission-oriented initiatives analysed give evidence of a variety of factors urging for the participation of the public into the development of transformative R&I policies.

Citizens and civil society organisations serve first and foremost as sources of information. They can provide valuable insights – based on experience and/or value judgement – that policymakers could not obtain otherwise and that are crucial in the definition of long-term and comprehensive policy objectives for system transformations.

¹ JIIP's Global Observatory of Mission-Oriented R&I: <http://www.jiip.eu/mog> (last access on 21st June 2019)

Public participation in vision setting has also positive effects on the implementation of transformative policies by increasing their societal acceptance and ownership, reducing

opposition and encouraging the relevant actors to contribute to the attainment of their objectives. Policies whose vision were defined in collaboration with societal stakeholders appear also to be less subject to electoral cycles and therefore more effective in stimulating systemic changes in the long run. For these reasons, civil society organisations and citizens have been engaged in the vision-setting process in addition to socio-economic actors, such as businesses and industry representatives, trade unions and community groups.

The public involved in the three analysed cases of transformative R&I initiatives consist of: (1) the 'pure public', who is made of all citizens living in a territory; (2) the 'affected public', who comprehends the individuals affected by the identified societal challenges; and, (3) the 'participating' public, i.e. all individuals who somehow contribute to the implementation of the transformative policies. However, this research highlights the difficulties in distinguishing these three categories, as by definition societal challenges affect somehow everybody.

Interactions between the public and experts

Transformative mission-oriented R&I redefines the role of experts, who are not any longer the exclusive holders of the knowledge deemed essential by the policymakers to identify problems and elaborate relevant solutions. Citizens and civil society organisations contribute, with their ground knowledge and value judgement, to a better understanding of societal challenges and to the formulating of corresponding transformative policies. Public participation mechanisms for vision-setting must then assure that experts and societal stakeholders deliberate on a level playing field, even though the former might be given the crucial role of defining the scope and providing guidance for the deliberation. In some circumstances, experts may also consult societal stakeholders for obtaining value judgement and experience-based information deemed necessary for delivering comprehensive advisory services to policymakers. However, the three cases considered reveal that societal stakeholders have been developing in-house expertise, which makes the distinction between 'experts' and 'the public' fade away.

Formats of public participation in vision-setting

The three case studies enable the identification of public participation mechanisms where citizens and civil society organisations are given a prominent role in setting the vision for transformative policies.

In workshops (including working groups), representatives of different socio-economic actors share their views and confront their concerns. These fora may have different frequencies and purposes, and last beyond the policy design stage. Despite their challenging management, workshops can be a time- and cost-effective instrument to collect views from heterogeneous groups of actors. However, too many workshops may lead to a fragmentation of discussions, while too few run the risk of overlooking some important topics.

In contrast to workshops, citizens juries and focus groups involve individuals not on the basis of their affiliation with any type of organisations, but on the ground of their living in an area or being

affected by the problem to be solved. However, as they restrict the scope of the participants to those whose feedback is deemed the most relevant by the policymakers, they can hardly be considered genuine open participatory schemes.

Finally, online consultations efficiently collect inputs from a varied and substantial number of remote participants. They do not nevertheless ensure any interactions between the different actors and the policymakers may decide to weight differently the responses of some specific groups.

The case studies give evidence of good practices, which relate to modalities of organisation of these public participation schemes (e.g. the language employed during deliberations, the role of the moderators). Policymakers must additionally demonstrate commitment to public participation and ensure the transparency of its results. They also need to carefully consider the timing of public participation, as this has high influence on the legitimacy and success of policy interventions. Participants should also be diverse in order to guarantee a sound representation of society.

Conclusions:

This research reveals that the decision of policymakers to involve the public in vision-setting may follow two non-exclusive strategies. Firstly, public participation mechanisms can help the elicitation of information and specific knowledge from civil society organisations and individuals, which might be an essential driver in setting the vision for transformative policies. Policymakers obtain value judgment and experience by listening to claims of grassroots movements, without involving them formally in the decision-making process, or by inviting various types of stakeholders to exchange views and provide feedback about a range of policy options. Secondly, public participation schemes might improve the societal acceptance of transformative R&I policies, while facilitating their inception and design.

This research contends that policymakers aim to retain control over public participation mechanisms and do not admit any loss of power but rather seek a change in the culture of policymaking. Public participation in setting the visions for transformative R&I policy may prompt a transition towards deliberative democracy practices. Deliberation consists of dialogue in which participants exchange knowledge and revise their preferences to achieve common goals. Policymakers should divert from a technocratic view of policymaking that gives more importance to the knowledge held by experts than to those of socio-economic actors. Deliberation requires therefore spaces for open discussion. The participants in open policymaking processes should demonstrate a positive attitude towards dialogue, while understanding the complexities of policymaking.

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Abstract 59

RESEARCH POLICY GOVERNANCE: THEORETICAL CONTRIBUTION TO THE GOVERNANCE HYBRIDITY

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1. Introduction:

Public research is a policy arena going through complex governance changes. Firstly, new policy beliefs and rationales associated with managerialism and new public management came into place (Slaughter and Rhoades 2004), and consequently, the funding instruments shifted towards more competitive funding (Jongbloed and Lepori 2015, Geuna 2001). Secondly, there is increased complexity of research policy arena which at the same time pursues very diverse goals (Elzinga 2012, Braun 2006), and hence the diversity of funding instruments has increased making the systems more complex. These factors have created hybrid forms of governance in which old policy instruments were transformed or removed, and new ones put in place.

So far, a common way of conceptualizing the diversity of governance arrangements has been to distinguish between ideal types of governance that can be used as reference points to describe real cases and, specifically, to identify variations between countries and historical periods (Goertz 2008). However, these conceptual efforts risk missing a more fine-grained interpretation of the real content of the actual governance modes. Public policies are not homogeneous, and there is a number of dimensions in which policy instruments can differ drastically (Peters and Piore 2015). Even within a policy instrument there can be a number of conflicting ideal-type ideas or norms, displaying a hybridity of its governance mode. In the political sciences literature, this issue has been elaborated as notion of policy mix (Flanagan et al. 2011). In turn, New Institutional Theory provides conceptual lenses to analyze the type of pressures that trigger the process of hybridization, the role of policy actors and power in the process, as well as the types of hybridization that occurs (Greenwood et al. 2001, Skelcher and Smith 2015). Even though this notion gained a lot of attention in the literature, a problem of how we can grasp policy mix characteristics and observe its composition still remains.

The aim of this paper is to shed light on the analytical problem of identifying the characteristics of the actual modes of research governance and thus to unpack their hybridity. More specifically, we aim to:

1. Operationalize hybridity in terms of observable characteristics of research funding policy instruments

2. Empirically characterize the eight selected countries in terms of mix of their research funding instruments' governance modes, and hybridity.

2.Theoretical framing:

Capano (2011) builds a conceptual model for analyzing HE governance in Europe by focusing on the role of government in the governance. His model is preconditioned by the understanding of governance as the process by which decisions are formulated and implemented as a result of the interaction between different policy actors (Klijn 2008). In this view, the government is only one, but still central, possible actor in the governance process, and its role varies according to the structure of governance. Governance modes are different constellations of governments and other governmental, semi-governmental and non-governmental actors in the policy-making process, which involves determination of policy goals, and policy means to pursue them. The two relevant dimensions in his model are, (1) the level of governmental specification of the goals to be achieved, and (2) level of governmental specification of the means to be used. Depending on the level of government's involvement in the definition of these two, a policy instrument can fall in one of the four categories: hierarchical, procedural, steering-at-the-distance, and self-steering government.

However, while Capano (2011) managed to fit countries within each box, there is evidence that reality is more complex, and that policies are not as consistent as he suggests (Howlett 2011, Peters & Pierre 2016). In the subsequent work, Capano and Pritoni (2018) made an important contribution to the notion of hybridity, describing governance arrangements as hybrid forms made of "set of policy instruments belonging to different ideal-type governance modes and bearing different policy paradigms, beliefs and systems of ideas" (Capano Pritoni 2018). However, beyond their results, there is a need a) to characterize more systematically the different models of hybridity and b) to develop a robust methodology to observe hybridity through the analysis of characteristics of policy instruments.

Our starting point was to consult the existing literature on how hybrids are formed. From the literature on hybridization we selected decoupling, compromising, and compartmentalizing as the most fitted to the field of research policy (Skelcher Smith 2015).

Firstly, decoupling means symbolically endorsing practices prescribed by one logic (usually externally prescribed) while implementing practices promoted by another logic (Tilcsik 2010, Pache Santos 2013). In this strategy they conform to the normative or prescriptive structures, but do not attempt seriously to implement them at the operational level (Pache Santos 2013). This strategy might lead to a blocked hybrid, which refers to a "situation where the inherent tensions between logics cannot be resolved or managed, leading to organizational dysfunction" (Skelcher Smith 2015). Secondly, organizations can compromise by making an acceptable balance between different logics and demands (Kraatz Block 2008, Oliver 1991, Pache Santos 2013) within a single funding instrument. This solution leads to assimilated hybrid, which is when the original logic remains, but the organization adopts some elements of a new logic (Skelcher Smith 2015). In

public research funding (PRF), this could be an inclusion of additional policy goals to the existing policy instruments. Thirdly, organizations can go through compartmentalization¹, which is combining different logics into its practices (Kraatz and Block 2008). This process might lead to two hybrid models. The segmented hybrid² is characterized by compartmentalization within a single organization. In field of PRF, this can be having different instruments within the same funding agency. On the other hand, the segregated³ model is compartmentalization into separate department or unit (Skelcher Smith 2015). In field of PRF, this can be formation of different RFOs that follow different governance types.

3. Method:

To determine governance modes of funding instruments, we conducted following steps:

1. Formulation of the theoretical framework
2. Set theoretical analysis
 - Formulation of the truth table
 - Consolidation of truth table with help of familiar case-studies
 - Translation of the truth table into Boolean operators formulas
 - Conveyance of the data analysis in excel program
3. Weighting of instruments in terms of funding amounts

First, to determine governance modes associated with research funding instruments, we consider three dimensions suggested by the theory, i.e. the actors involved in the instrument implementation, the instruments' goals and the means of intervention. Each of these determinants was defined with set of indicators, and specific needed values for each governance modes.

¹Synonym: selective coupling (Pache Santos 2013)

²Synonym: blended hybridization (Greenwood et al 2011)

³Synonym: structurally differentiated hybridization (Greenwood et al 2011)

Table 1: Operational framework showing the dimensions of governance and the corresponding indicators that describe them

Relevant dimension	Policy means	Policy goals	Policy actors
Relevant indicators	Type of FI: Project/ institutional I Allocation mechanisms: Formula-based/ competitive bid/ historical/ negotiated funding	Policy intention: Knowledge creation / policy / economic innovation/ mixed intention	Composition of Managing RFO: decision making body: Governmental entities/ innovation agencies and other state-appointed entities/ research council Academics/ experts/ policy actors/ mixed

Second, we used Set theory method (Schneider and Wagemann 2007) to analyze the empirical data. This method groups sets of the same combinations of values having a particular relation to each other. The starting point was the formulation of Truth table- a reference point for all ideal-type governance modes, listing the combinations of indicator values they should possess in order to qualify as a certain governance mode. If an instrument fits perfectly in one of the outlined combinations in the Truth table, it will be assigned an ideal type governance mode. If an instrument, contains elements from different ideal-type combinations, it will be defined as hybrid instrument combining the two ideal-type governance modes. The second step was to test, and re-evaluate the truth table, by engaging in analysis of three familiar cases: Switzerland, Sweden, and Italy. The third step was to translate the final version of the truth table by assigning each governance mode a Boolean-operator-formula which was then run in excel program.

Third, once the instruments were assigned a governance mode, each of them was weighted in terms of funding amount, and how big share of the total public research funding it represented in a given year.

The data used in this study comes from PREF⁴ project, which is a large-scale study of public research funding combining quantitative data and descriptors concerning allocation modes and criteria, as well as information on the stream structure of public funding and on the research funding organizations and Umbrella Public Research Organizations managing funding (Reale 2017, Lepori 2017).

⁴PREF is a project funded by EC Commission, Joint Research Centre - contract no. 154321

For the purpose of this study, we use available data on Austria, Italy, France, Norway, Sweden, Switzerland, the Netherlands, and the United Kingdom. For dealing the data, we developed a Codebook encompassing detailed description of each indicator, as well as a concise guideline for translation, and numerical coding.

4. Results:

4.1 Identifying governance modes

Governance modes are shaped by factors connected to the specificities of the research policy arena. Some of the them are: 1) asymmetry of knowledge between the policy makers on the one end, and the researchers on the other end; 2) high level of unpredictability in the research policy, i.e. not knowing when and which research efforts will show to be novel and significant; 3) the diversity of tasks that research activities are expected to manage; and 4) the specificities of the fields that are funded. These factors are likely to transform the research policy arena into a hybrid governance where the decision making will include policentric types of actors and proliferation of funding instruments having diverse governance modes. The results of the analysis allow to identify the characteristics of funding instruments associated with ideal-type governance modes, as well as a number of hybrid constellations.

Instruments corresponding to ideal-type governance mode

Self-governance (SG) mode occurs in a form of project funding that is allocated through competitive bid where the policy intention is general advancement of knowledge. The academic quality is the main goal, hence the decision making body is made of academics. Example of this kind of funding are scientific-community-governed agencies such as Research Council with bottom-up funding schemes, and where the funding is delegated on the basis of research proposals. Other type of SG occurs when requirement-free institutional funding is allocated to universities on the basis of historical allocation.

Hierarchical mode (H) signifies top-down decision-making processes where the state funds performers directly with a clearly defined goal. This bilateral relationship allows the state to enforce public policy goals and means in a more direct way. It can occur in a form of project-based funding allocated through a competitive bid and institutional funding allocated through a negotiation process, or based on historical allocation in a case where this allocation has policy relevance.

Procedural mode (P) signifies tight bureaucratic control over procedures, but substantial freedom in the actual research goals and priorities. It occurs in a form of institutional funding based on historical allocation. However, while this kind of funding could be found in other policy fields, such as higher education (for example institutional funding based on number of students), in field of research funding, the decision making bodies have to take some decisions, at least about the amounts of funding. That is why, we are yet to find example of pure procedural funding instruments.

Steering at distance (SAD) signifies the typical NPM approach implemented in performance-based funding. It is institutional or project based funding allocated through formula-based

allocation. The policy goals can be diverse, the decision-making committee can be academic, experts, policy actors, or mixed, and it can be allocated by any kind of RFO.

Hybrid instruments

Out of six possible hybrid modes, our study identified only three. P-SG mode is indistinguishable from the ideal-type SG mode, hence it was placed in that category. On the other hand SG-SAD mode are not compatible, as it is not logically possible to, at the same time, steer at the distance, and not steer. Finally, H and SAD mode are not compatible because it is not possible that at the same time government steers directly and indirectly.

Hybrid procedural-steering at distance (P-SAD) mode occurs when historical allocation is combined with formula-based indicators. Here, in a original requirement-free procedural funding type, formula-based elements are added through which different requirements (the policy goals) can be put forward and greater steering can be exercised. It can be allocated by any kind of RFO, but most often by the responsible research ministries. This type of governance, is present in the instruments in average having the largest amounts of funding.

Procedural-hierarchical (P-H) mode is a type of institutional funding allocated on historical basis. The policy intention can be any (the element it gets from the procedural mode), while the decision making body can be made of experts, policy actors, and even mixed in the case of funding allocated by governmental entities, innovation agencies or other state-appointed entities.

Hierarchical-self-governance (H-SG) mode can be in form of institutional or project-based funding both allocated through a competitive bid. One it's form is when the policy intention is policy relevance, economic innovation (same as in the hierarchical mode) or mixed intention, but where the composition of decision-making body is academic or mixed (same as in self-governance mode). Other it's form is when the policy intention is general advancement of knowledge (same as in self-governance mode) or mixed intention, but where the composition of decision-making body is made of experts, policy or mixed actors (same as in the hierarchical mode). This governance is the most common governance mode in terms of the number of instruments it is displayed in (50 instruments), however it is displayed in the instruments with smallest amounts of funding.

The results point out at specific mechanisms through which hybrid instruments can be managed, given that they incorporate elements that are not supposed to belong together. To strengthen self-governance in a hierarchical steering mode, process of co-optation of scientists in the decision-making body is used. The opposite process, the infiltration of policy-oriented actors in an academic decision-making-body, is used in cases where the aim is to strengthen the steering of research towards specific research aims. A possible problem in this process is if the feedbacks process stops, for example when the academics giving the input into the decision-making-body, get detouched from the academic base.

Table 2 below shows that all countries considered are characterized by the presence of difference governance modes, as well as by a significant presence of hybrid instruments. In the following, we therefore analyze more in-depth the forms of hybridity.

Table 2: The number of, and the share of funding instruments carrying different governance modes in the total amount of public research funding

Country constellations:						
Number of funding instruments having different governance modes (share of the total public research funding)						
	SG	H	SAD	P-H	P-SAD	H-SG
CH	3 (13,3)	5 (13,5)	3 (13,8)	0	3 (57,3)	3 (2,0)
IT	4 (49,2)	7 (29,9)	2 (12,0)	2 (2,9)	0	9 (6,1)
SE	3 (18,2)	2 (14,3)	2 (11,7)	1 (39,6)	0	4 (16,2)
UK	5 (28,1)	3 (7,1)	20 (18,9)	1 (17,1)	0	12 (28,2)
AT	3 (6,8)	2 (5,7)	0	1 (3,4)	0	7 (84,1)
FR	6 (7,1)	7 (35,9)	1 (0,9)	0	1 (26,9)	6 (25,3)
NL	2 (6,2)	2 (1,4)	1 (27,8)	6 (60,0)	0	2 (4,7)
NO	1 (3,1)	5 (36,3)	0	3 (30,2)	3 (15,6)	7 (14,9)

4.2 Analyzing hybrid forms of governance

Our results identified three types of hybridization taking place in the research policy in the selected countries. We suggest that the type of hybridization in a certain country might be related to political costs, and specificities of the policy field of the funded research.

Decoupling is a process of fake hybridization that occurs on the organizational level when new instruments are created, but are not put into practice (instruments that do not get any funding from national budgets, or get very symbolic amounts of funding). Examples of such funding are Italian ministry for education and research funds for Big social challenges, and social innovation, and French BPIFRANCE program on strategic innovation.

Compromising is a hybridization on the level of instrument where new ideal-type elements are added onto already existing instrument. A typical example in research policy is a call for funding for research projects which has been added an element of societal relevance/ economic innovation/ gender equality. Hybridization on the instrument level occurs simply by adding or adjusting some of the five instrument determinants. The process can be illustrated on a case of basic funding to universities which is supposed to be institutional variation of SG funding, but exhibits different governance modes across countries. By adding the component of performance-based allocation, this type of funding is turned to the hybrid P-SAD, or is totally transforms into SAD mode. Also by adding the element of policy relevance into the decision making process, this funding type transforms into a hybrid mode P-H. This is how for example, a part of Swedish basic funding to higher education institutions exhibits P-H mode and the other part SAD mode.

Compartmentalization can occur on the organization level when, within an existing organization, new instruments are created. The hybridization on this level is also bounded by some limitations.

Firstly, organizations cannot have too diverse identity in terms of the type of research they support (in most cases we found combination of two governance modes, with exception of Norwegian RC which is exceptionally diverse). Secondly, they are limited in terms of the variety of ways they can delegate funding. To manage different governance modes and avoid the danger of instrument drift, RFOs create a separate decision making bodies which act semi-independently within the organization.

Compartmentalization also occurs on the system level when completely new RFO are created to accommodate new funding modes. This is, in terms of political cost, the most complicated type of hybridization, hence it occurs only in cases when it is evaluated that the policy imperatives cannot be satisfied with the earlier types of hybridization. Here

policy actors go around certain RFOs which might not be flexible to accommodate certain policy imperatives, creating new institutions and thereby making space for new types of funding.

When analyzing our case studies, we found very interesting structure of national systems, and that policy imperatives were accommodated in very country-specific ways. However, to understand the specific reasons for such constellations, and go beyond the above-stated general propositions about hybridity patterns, one would need to conduct a more in-depth study of the each system.

Finally, governance hybridity at the level of instruments is only one element of system-level hybridity. Our study looks only at funding instruments and how different (mixes of) governance modes are enacted through them. However, there are other ways through which governance is enacted such as, organization of the research policy in general, or through different legislative, informative or other kinds of policy instruments. This means that this study provides only a partial picture of research governance hybridity in the selected countries.

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Abstract 72

INNOVATION POLICY AND PUBLIC FAILURE

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Aim of the proposal:

The study of innovation policy has become a well-established discipline within the research on economic policy. Although there is still a heated debate about approaches and policy instruments, governments are increasingly recognizing that policy plays a central role enhancing innovation processes. In the last three decades we have witnessed a shift in the debate on the target of innovation policy, moving from the identification of market failures to the study of what has been known in the specialized literature as systemic failures. However, little has been said about the mechanics of government decision-making as a source of failure in innovation systems. In this paper, we develop an approach in which the government's goal of maximizing political support might explain the appearance of specific failures in innovation systems. The utility of our approach is illustrated with the case of innovation policy instruments pointing to correct failures in the formation and development of network for interactive learning and innovation, using quantitative and qualitative data from regional innovation policy in Spain. Results are consistent with the fact that some innovation policy objectives might be better aligned than others with the mechanism of government decision-making.

Background:

From its origins, innovation studies have developed theoretical frameworks as rationales for policy action, going from the traditional analysis of market failures (Nelson, 1959; Arrow, 1962), to a broader view of "failures" stemming from the systemic approach to innovation process (Carlsson and Jacobsson, 1997; Woolthuis, Lankhuizen and Gilsing, 2005; Bleda and Del Rio, 2013; Grillitsch and Trippel, 2016). According to these approaches, one of the key factors in the proper functioning of innovation systems is the flow of knowledge between agents through networks that encourage interactive learning for innovation. In this sense, a problem that should receive particular attention from policy-makers is the networks failure. In this line of thought, an obvious problem is undoubtedly the lack of linkages between actors, which results in a low use of knowledge within the system. This problem is known as "weak network failure". In the other extreme, we have the problem known as "strong network failure", which is a consequence of very strong linkages between agents, which generates system closed to new outside ideas and developments (Woolthuis, Lankhuizen and Gilsing, 2005). Consistently with this ideas, Bathelt et al. (2004) suggests that the formation of local innovation networks induces a better use of knowledge when combined with global networks. This need for balance has at least two reasons. In the first place, the connection of a region with external sources of knowledge provides access to a wider variety of knowledge, while intraregional collaboration facilitates the dissemination of knowledge within it. Second, the flow of interregional knowledge is often technical and codified due to the absence of personal interaction, while intraregional collaboration strengthens the elements that facilitate the transformation of this type of knowledge into tacit knowledge through interactive learning-

by-doing (De Noni et al., 2017). This idea came to be known as “the balance between local buzz and global pipelines”.

In this paper we will show that, under certain conditions, the decentralization of the innovation policy might be effective in generating "local buzz", while it could obtain very poor results in the formation of "global pipelines". Or, put another way, regional policies might be aligned with the solution of "weak network failure" but, at the same time, might favour the appearance of "strong network failure". The substance behind this hypothesis is the assumption that policy-makers maximize their political legitimacy (e.g., maximize votes) through the strategy of creating local networks, as opposed to the strategy of creating global networks. And this phenomenon is particularly important in the case of governments of regional political parties, whose legitimacy depends almost exclusively on the citizens of their region.

These basic assumptions can be traced back to the origin of the so-called Public Choice school of thought (see Buchanan, 2003, Lee, 2012). In our case, the aim of this research is not to raise suspicions about the relevance of the innovation policy, but rather to show how some policy objectives are more aligned than others with the mechanism of government decision-making. The study of these processes can give us more information about the realism of certain political goals, and about the need for stronger commitments to advance the development of innovation systems.

Although some authors have drawn attention to the fact that failures in innovation systems could have their origin in the functioning of governments (Goolsbee, 1998, Davidson and Potts, 2016, Kuhlmann and Ordóñez-Matamoros, 2017), there are little efforts to analyse this possibility both systematically and empirically. This paper tries to cover this gap.

Methodology and empirical base:

To test the hypothesis that regional governments find the formation of local networks more attractive than the strategy of creating global networks, we use a multimethod strategy combining quantitative and qualitative analysis.

A formal model is proposed in which policy decisions have the objective of maximizing the legitimacy of the political party in the government. At the micro level, the decisions of companies on the location of their partners are affected by political objectives through the conditions under which subsidies to innovation are granted. In this sense, if our hypothesis is correct then companies with a lower propensity to form global networks should be those where the reception of regional funds predominates over national funds. Using this formal framework we generate an econometric model that studies the relationship between, on the one hand, the ratio of local and national public funds and, on the other, the ratio of foreign and national partners. This model is estimated with data from the Technological Innovation Panel (PITEC, 2003-2015), built with data from the Community Innovation Survey of Spain (CIS-Spain). In contrast with other European experiences with CIS, PITEC is designed as a panel survey.

Our results are validated with in-depth interviews with experts from the three main regions in Spain (regarding the volume of innovative activity) –Catalonia, Madrid and Basque Country– coming from the academy, the administration and the private sector.

Results:

Our results confirm our hypothesis for the case of SMEs (but not for large firms). We also show that the regional support of R&D activities is particularly relevant in the case of the Basque country. On the other hand, the qualitative analysis throws light on the fact that political support in the Basque country is highly conditioned to collaboration with specific local partners (also partially financed with public funds).

Although in the other two regions (Catalonia and Madrid) the regional funds are relatively less significant, in all cases the experts confirmed that such funds always have conditions that lead to collaboration with local partners, and local authorities always show their reluctance to finance projects with relevant partners outside the region.

Conclusions:

The empirical findings of this paper are consistent with the hypothesis that regional policies might be aligned with the solution of “weak network failure” but, at the same time, might favour the appearance of “strong network failure”. In this sense, our results also show that certain policy objectives are more aligned than others with the mechanics of government decision-making.

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D3 SOCIAL INNOVATION 4

Thursday 06 June 2019 from 11:30 to 13:00

MARC BARBIER, Chair

Abstract 113

SOCIAL INNOVATION THROUGH STAKEHOLDER ENGAGEMENT. CO-CREATION IN PARTICIPATORY METHODS FOR ENERGY TRANSITIONS.

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Aim:

According to the experts, participatory action research (where co-creation becomes an essential process) is useful to understand system change and sustainability aspects for the exploration of paradigm changing. The generation of collaborative contexts where analysts and actors can combine problem-solving methods with data analysis and expert advice can foster a continuum of community knowledge transfer within communities of practice. The set of experiences presented in this communication aims to represent a sample of how science-based methods can be applied to solve specific social problems.

Background:

The multi-level crises of the early 21st century and their socio-economic consequences have challenged the way institutions understand their relations with civil, academic and corporate society. On the one hand, political institutions - both elective and non-elective - have been subjected to the scrutiny of the civil society that demands through its massive communicative events not only to be heard, but also to participate in the design of policies beyond the mechanics of voting: the dynamics of individuals acting together seem to be the general tone of this change in the way we understand society in the coming years. The processes of conflict regulation need to take into account both emotions and values and attitudes in terms of indicators. The demand for civil society participation also extends to the sphere of the economy, seeking to extend the scope of economic rationality to the "capabilities" not only of corporate agents, but also of social agents in search of a modification of the dominant socio-economic model.

Open knowledge movements seem to be essential tools within this required and apparently necessary process of democratization of knowledge to improve the intervention of civil society in decision-making processes, as efficiency and security are values in clear discredit for a public opinion that clearly wants to participate in the processes of democratic innovation and development since its inception. The processes of knowledge exchange derived from this democratization of knowledge seek to modify cooperative models, not replacing them with others but decentralizing and reorganizing them for improvement. In a global and multicultural context such as this, cultural differences must be taken into account as potential obstacles, although the wealth derived from their correct management may represent an asset for the institutional relations of the actors involved.

The shared knowledge basis of this informational relations featuring the communities of practice enables cluster firms to continuously combine and re-combine similar and non-similar resources to produce new knowledge and innovations, stimulating economic specialization within the cluster. Knowledge codification becomes highly valuable when fused with less

transitory knowledge as the tacit one. However, there is a danger of dispersion of knowledge that could increase the cognitive distance between involved agents in their on-going activities. This dispersion can be saved by the cumulative nature of the knowledge development, due to the fact that innovation is driven by interaction and that technological relatedness is linked to knowledge spill overs effects on urban and regional growth, the very point behind the social innovation concept.

Methodology and empirical base:

The main source of the methodology used in the experiences that are related in this conference is the theory of participatory action research. Three particular attributes are often used to distinguish participatory research from conventional research: shared ownership of research projects, community-based analysis of social problems, and an orientation toward community action. Its approach to complex systems conceives systems as a human reconstruction of the complexity upholding learning, providing a new dimension to participation. Besides some conceptions similar to consultation, participatory action research has become an ambivalent concept: it is a process in itself, but also a source of knowledge creation.

The participatory processes as the ones provides as examples for this presentation are inspired in some methodological references such as the Handbook of action research (Reason & Bradbury, 2001), or mapping toolkits (Emmel, 2008). Theoretical basis about stakeholder engagement (Van der Kerkhof & Wieczorek, 2005) or systemic action research (Burns, 2007) have been essential to develop our work. Our methodological proposal includes the application of semantic and visual tools to foster system analysis (Matti, Bauer, Granell Ruiz, & Fernandez, 2017; Matti, Juan Agulló, Hubmann, & Morigi, 2017). As we shall now see, the role of the participants is redefined through the application of a challenge-led approach. The main goal of this perspective is to increase the horizontality of the team performance. This fact enables a collaborative construction –and subsequent codification and diffusion- of knowledge through the active participation of researchers and participants, promoting critical and self-awareness that make able collective and social change. After this challenge-led approach and the use of visual tools, a key aspect of co-creation is the codification of knowledge that we have previously mentioned. In the experiences of the application of our approach, the codification of tacit knowledge allows the creation of practice-based and usable knowledge for policy makers, business managers and/or innovation leaders. A critical aspect to enable this step is the science-based design of the exercises that are based in visual tools in the overall logic of System Innovation and multi-level perspective introduced by transitions literature.

The specific methodology that we have used follows this scheme:

1. Problem definition
2. Co-creation process
 - a. Creation of delivery team
 - b. Process design
 - c. Tools and adaptation
3. Workshop design

- a. Selection of participants
- b. Materials provided and estimated timing
- 4. Workshop management
- 5. Workshop reporting
 - a. Knowledge codification & analysis
 - b. Communication & dissemination

The study analyses evidence from four experiences between 2017 and 2018 in the cities of Valencia and Malaga in Spain, Birmingham in UK and Valletta in Malta. The four cities presented requests on topics around sustainability and energy transitions. The aim of the four experience was to generate knowledge among peers through a 'negotiation of meaning' and favouring stakeholder engagement around the topics of urban sustainability and access to energy. The results of these four events are presented in this conference as an evidence of emerging mechanisms and practices that facilitate social innovation

Results:

The methodology applied in the four mentioned cities (from the definition of the problem from the talks with the local institutions involved to the interpretation and delivery of the data collected in the workshops carried out together with the stakeholders involved) has generated a set of indicators from empirical elements. The analysis of these has made it possible to elaborate a series of communications and recommendations to the institutions that commissioned the beginning of the participatory processes.

This feedback is built upon elements such as socio-technical mappings to visualize the relation between actors working on current actions or the potential opportunities merging from these links, rankings of actors to understand their relative weight on a specific situation, visualization of future impact scenarios depicted by a limited number of indicators or pathways to reach the desired future scenario. These elements among others are reported to the public institutions with the shape of infographs and explained orally in ulterior meetings.

The reports presented to the involved institutions have resulted in decision-making regarding the series of challenges initially posed in the four cities. These reports will be presented in oral communication as evidence of the generation of social innovation through science-based methods.

Conclusions:

The application of a participatory approach based on co-creation methods to respond to social challenges in the field of energy transition can be productive in terms of generating content to improve decision-making processes. The collaboration of stakeholders and institutions through the intermediation of a group of experts in facilitation with a structured methodological basis and the application of a subsequent interpretative analysis of the collected data can be productive for the solution of social problems.

The visualization of different elements and the analysis of their relations (priorities and resources, actors and gaps, and some others), and also the combination of knowledge areas and capacities provide a wide and deep understanding of a socio-technical system.

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About the authors:

Blanca Juan Agulló graduated with a Bachelor's degree in Audio-visual Communication at University of Valencia and afterwards gained a Master in Secondary Education at the same institution. After participating in several researches on the field of history of education, she attended University Pompeu Fabra where she gained a Graduate Certificate in Museum Management. She is currently studying a degree in Anthropology and Human Evolution at the Open University of Catalonia and participating in researches on the field of gender studies.

José Manuel Martín Corvillo graduated with a Bachelor's degree in English Philology at University of Valencia, also owns a Master in Research Methods and a PhD in Applied Linguistics in the same institution. His first studies focused on analysis of Political Discourse and methodologies of discourse analysis from social movements. He is currently working as a research assistant for EIT-Climate KIC and University of Valencia on the Transitions Hub project, developing analytical procedures for the transformation of stakeholder participation in relevant inputs for policy making.

Cristian Matti is an expert in sustainability transitions and environmental innovation. He is EIT Climate-KIC Transitions Hub Lead and visiting researcher at University of Utrecht. He contributes to regional and urban initiatives by facilitating science-policy-practice interface for the development and implementation of policy strategies and technical assistance. He has contributed to research projects on natural resource-based innovation, regional and industrial system of innovation as well as innovation policies for public and private organizations in Europe and South America. He has also experience as academic coordinator of professional education and postgraduate courses on sustainability and regional innovation.

Rocío Tiseyra works in innovation design and solutions mapping at EIT Climate-KIC. Previously, she has worked at TSPA, an urban planning office; as well as gender equality and women's empowerment at the United Nations Human Settlement Programme (UN-Habitat). Specifically, she contributed to the gender mainstreaming of indicators for Sustainable Development Goal 11 (Make cities and human settlements inclusive, safe, resilient and sustainable) and commitments of the New Urban Agenda (NUA). Both her BSc Social Anthropology (2008) and MSc Development Studies (2014) have been awarded by London School of Economics and Political Science (LSE). Before relocating to Berlin, she lived and worked in Buenos Aires, Mexico City, New York, London, Madrid, Nairobi, and Berlin.

Irene Vivas Lalinde is a Law Graduate and a Master on Public Policy and Human Development (UNU Merit – Maastricht School of Governance) who has started developing her career on environmental and gender issues. She is now a research assistant in Climate KIC but has also worked as an intern at the Committee on the Rights of the Child (UN), Women's Link Worldwide, among others. Currently, she is writing her master dissertation about the power dynamics of wastewater in Bogota and volunteering in Spanish and European green youth groups. Double Master MSc Public Policy and Human Development, UNU-Merit – Maastricht University.

Abstract 69

MAKING 'HIDDEN INNOVATION' VISIBLE? A STUDY OF AN INNOVATION MANAGEMENT SYSTEM IN NORWEGIAN HEALTH CARE

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Aim of the proposal:

In this paper, we investigate the development and early use of a national innovation monitoring system for health innovations in Norwegian public hospitals. Commissioned by the Norwegian Ministry of Health in 2011, the system has been developed, piloted and implemented in the 2011-2018 period. By interviewing stakeholders involved in both developing, commissioning and implementing the system at multiple levels, by reviewing available documentation and by interviewing hospital employees involved in innovation projects, the paper will look further into what characterises innovation activities in hospitals and the organisational and institutional contexts in which health innovation occurs. How innovation is conceptualised, evaluated and incentivised in health care is also discussed.

Background:

Increasing costs, longer life expectancy and rising public expectations towards health and wellbeing are challenging the sustainability of current healthcare systems and causes a demand for rethinking how health care services are organized and delivered. New digital technologies and innovative services and organisational solutions utilizing digital tools are frequently seen as part of the repertoire for handling the increasingly complex challenges of modern health care system. At the same time as innovation in health care is increasingly important, there is an acknowledged lack of adoption and diffusion of innovative solutions (Barlow, 2017, Oliveira et al., 2017). Much has therefore been written about the implementation gap and the "non-spread" of innovations, and the many and complex factors that underlie the diffusion and implementation challenges of innovations in health care (Ferlie et al., 2005). Legal boundaries, organisational boundaries, professional boundaries, lack of incentives and lack of leadership support, are factors that explain why implementation and diffusion often fail or at least is slower than desired. As in most organisations, the barriers exist at individual and group levels as well, in the form of the "not-invented here syndrome", exacerbated in organisations with significant status hierarchies and thick boundaries between professional groups, such as hospitals (Ferlie et al., 2005).

Partly due to these well-known implementation challenges and the wider trend of a more open and inclusive approaches to innovation where organisational developments and services and the role of regular employees in innovation is highlighted, many hospitals and health care systems have implemented systems to facilitate user-driven innovation (Thune & Mina, 2016; Salge & Vera, 2009). The idea behind such initiatives is that potential users and user contexts (both clinical and non-clinical) should be involved in innovation activities, particularly by defining the problems to be addressed and the determinants of the user contexts that will influence outcomes of innovation processes, and in some cases also participate in performing

innovation activities as well. A well-known understanding is that innovations, even highly technical ones, are bundles of technical and non-technical elements (Morlacchi & Nelsons, 2011). Implementing and diffusing innovations requires attention to the socio-technical systems that new solutions are part of, including existing practices and organisational arrangements, actor constellations and their interests, incentive structures, institutional factors, and more.

A better understanding of the user context and the existing socio-technical systems is important for succeeding with innovation in health care. Involving users or practitioners more generally can enable adoption, implementation and potential diffusion, according to an institutional perspective. Learning through professional networks and by observing and mimicking peers in communities of practice is seen as an alternative model of diffusing innovations (Compagni, et al., 2014; Ferlie et al., 2005).

Reflecting on the implementation gap problem and the turn to a service and user oriented perspective on innovation in health care, health care authorities and specific hospitals have taken steps to develop systems to manage, diffuse and incentivise innovation activities (Barlow, 2017). One rather fundamental problem is that innovation in user contexts and development of new services, routines and organisational arrangements have remained hidden, and therefore very difficult to incentivise or manage. Hospitals, and even health care systems, have become used to performance indicators where technical innovations (product innovations) (patents, licence agreements etc.) and economic indicators that are connected to revenues from product innovations have been in focus. Non-technical innovations, such as development of new services, experimenting with new solutions and building routines for use, new organisational arrangements cannot easily be captured by indicators (Djellal & Gallouj, 2005; Morlacchi & Nelson, 2011). Therefore, a significant part of innovation activities in health care systems remains “hidden” (Djellal & Gallouj, 2005; Garcia-Goni, et.al. 2007), and consequently difficult to manage. Attempts at measuring such innovation activity in hospitals in a systematic way have used indicators such as learning intensity and employee involvement in development work to compare hospitals (Salge & Vera, 2009).

But from a health care management perspective, more detailed knowledge of innovations, their adoption and outcomes is sought after. Developing a system that can capture a broader set of innovation activities in hospitals, and using such information strategically to select and support innovation and diffusion activities has become a priority (Oliveira et al. 2017). But as important innovation activity in hospitals is embedded in everyday practices and therefore remain hidden, it is not a straightforward procedure to develop something that really captures core innovation activities in hospitals.

This paper will look into this question by a study of how a tool for managing innovation in hospitals was utilized, and the complex questions of classification, valuation and management of innovation in practice.

Methodology and empirical base:

Data for the study was collected by interviewing stakeholders involved in developing, commissioning and implementing the innovation management system at multiple levels. We also collected and analysed all available documentation and data on innovation activities generated by the system. We have also interviewed innovation managers and hospital staff

in nine hospitals, about practices of innovation project classification and valuation practices in medical innovation, and about innovation management practices in hospitals and how this influence innovation activities among hospital staff.

Results:

Below some preliminary findings from empirical study is described. The empirical study will be completed in March/April 2019.

The traditional approach to monitoring innovation in hospitals

The new system for monitoring and managing health innovation in Norway was initially considered as an alternative and more encompassing way of measuring innovation in health care contexts, compared to traditional metrics. In the Norwegian public health care system, a national measurement system for R&D and innovation activity has been in place for more than 12 years, due to the fact that research became a legal obligation for hospitals in 2001. Promoting health innovation became a formal responsibility for hospitals by law in 2007.

Currently, on an annual basis, 45 Norwegian hospitals and care facilities (public and independent) report research and innovation activities and outcomes to the Ministry of Health, and based partly on such information, resources for research and innovation is allocated to hospitals. As an extension to the research activity measurement system in place from 2003, measuring hospitals' contribution to product innovation (measured by the number of patents, patent applications, patents granted and licences) was implemented around 2010. Technology transfer offices (TTOs) operated jointly with the universities are responsible for handling the commercialisation part of hospitals' innovation activities and also for the reporting on product innovation metrics to the Ministry of Health.

New product innovations, as measured by the number of ideas for new innovations, patent applications, patents and licences, by Norwegian hospitals, is rather limited. The four health regions reported in 2017, about 200 new ideas for innovations with a commercial potential, and on average around 150 new ideas annually since 2011. On average about 30 licence agreements are sanctioned each year, and a limited number of new business enterprises are developed based on hospital technology each year (between 5 and 0) (Source: Norwegian health trusts, 2017). The number of new ideas for innovative products and commercial outcomes are also highly skewed, and the by far dominating organisation is the research-intensive Oslo University Hospital.

The demand for an alternative approach

Partly because of the great mismatch between research activities and innovation outcomes, and the increasing awareness that an outcome based metrics system disregarded a majority of the innovation activities performed by hospitals and their staff, health policy officials and hospital managers saw the inadequacy of the existing approach and wanted to develop an alternative measurement system. What was asked for by the Ministry of Health was a system that was better at capturing the kinds and volume of innovative work carried out by most hospitals and hospital staff, particularly connected to service innovations and innovations that would be beneficial to patients but without a strong commercial potential, as stated in the "commission document":

There is a need to assess and develop the existing set of indicators for innovation in the health care sector. Measurement of innovation activity in health care organizations should capture all aspects of innovation, including changes that are results of process- and service

innovations. The indicators should include both commercial and non-commercial innovation activity (Ministry of Health, 2011).

The original commission from the Ministry and the working group that developed the first set of indicators in 2011 also offered a definition of innovation and an assessment of why non-commercial innovations should be supported (and measured in a more systematic way). The Norwegian health authorities offer a broad definition of innovation as “new products, services, processes or organizational models that have been implemented in health care”.

Whereas the traditional approach focused exclusively on product innovation and commercial innovation activity, the awareness that service and process innovations could improve quality and efficiency in the delivery of health care services, was seen as the most important drivers behind the need to first of all focus the attention on innovation, and also a more inclusive system to monitor and incentivize it (ibid). The overall goal with development of new indicators, as defined by the joint report on development of health indicators as “increase the prevalence of innovation in health care organizations, in such a way that they will become able to handle the continuous demands for change from its users and decision makers” (ibid).

Moreover, the development of the new indicators system was from the start resting on certain assumptions: first, that a lot of the results would be “qualitative” and that simple indicators would not capture the complexities involved. Second, it was also assumed that developing and implementing service and process innovations would take time, and that an indicator system should be targeted to capture benefits over different phases. Third, it was an ambition that the indicator system would lead to learning across hospitals and through this, increased uptake and diffusion across different hospitals. Finally, the goal was to create a parsimonious system that to the greatest extent possible could rely on available administrative data. Rather than creating a new indicator set, the proposal was rather to build a new management information system for innovation, and to use information available through this management system to report on innovation activity (towards funders).

The innovation management system was built on a phase-model, as initially proposed, where innovation project are described in five main phases: idea stage (idea reception and assessment), pre-project, (pilot) project, implementation and diffusion. The idea was that all kinds of innovations (both products and services) move through similar stages (length and activities might however be different) and that decisions (stop-go) need to be taken at important “gates”. Information available at key “gates” can then be used as information about innovation activities in aggregate.

Innovation projects are weighted according to the stage it is in, so that hospitals with several mature innovations (that has been able to push innovations further through the pipeline) are awarded more “points” in the system. Most importantly, the systems provides no impetus to generating many new ideas, as these are not awarded any points at all in the system. Rather the system incentivizes hospitals that select the most promising innovations and to support them towards the implementation and diffusion stages.

Moreover, since, the system moved from being a tool for measuring innovation activity to become a management tool, increased emphasis was put on the decision making part, and the assessments made by decision makers about the potential and value of the innovations throughout the phases. Assessing the economic and health benefits of the innovation projects was to be carried out by the hospital managers responsible for innovation, and should be carried out at each gate. The assessment part of the system has been in a development phase until 2018. The impact of innovations should, according to the development team be made up of three sets of considerations: impact for patients (satisfaction, clinical effects, reduced risks),

economic impacts (reduced costs or increased income) and organizational impacts (employee satisfaction, efficiency and reduced bottlenecks). These should also be assessed for level (no, limited and significant effects) and scope (local, national, etc). The assessments of impact are made by hospital managers and consequently are subjective. However, each assessment should be evaluated in terms of the reliability of the assessment, or stated differently, how documented the claimed impact of the innovation is.

Piloting a new national system

To support the health innovation management system, the Health Region South-East, that had been granted responsibility to lead the development and piloting of the health innovation indicator system, engaged a private software company - Induct, to develop a software that could be used by all Norwegian hospitals. The use of the software to manage and monitor innovation projects was voluntary, and some of the hospitals that were part of the pilot choose not to use this system. The tool was however intended as a way for hospitals to systematically manage innovation, and also to function as a platform for learning across hospitals. This was seen as a tool that could increase diffusion and reduce overlap and redundancy in innovation work across several hospitals.

The responsible persons and agencies that proposed the new system were aware that there was limited experiences both nationally and internationally on such a system would work within the hospitals. They consequentially visualised a long pilot and experimentation phase, with a focus on learning to use the system and to provide feedback on how the criteria for the phases, assessment criteria, etc. worked in practice. Moreover, as responsibility for carrying out clinical and administrative development work is decentralised in the hospitals, coordination and learning across a range of local solutions, were also necessary for a national system to work.

In the pilot phase (2015-18), selected hospitals that were part of a national network of health innovation in Norway, implemented the system. In 2016, six hospitals had implemented and tested the system, and in 2017, 11 hospitals were involved in the piloting.

The early adopters of the system emphasise the potential value of the system, as it contribute to a more systematic and effective way of working with development and diffusion of innovation within and across the health sector. However, the respondents also point to critical issues. One such aspect relates to the lack of a common understanding of the innovation height and scope of each idea. Some respondents were critical to the activity indicator as this causes uncertainty around what constitutes 'an innovation project'. According to the respondents, the database only covers a small part of the ongoing innovation activities in the hospitals. To the degree that important innovation activities are systematically left out, this represent a problem, as the whole rationale was to develop a broad-based indicator system. However, one of the strengths of the system is that it is transparent that might contribute to a common understanding over time about how an innovation project could be defined, reported and managed over time.

How hospital managers and staff use the system in practice will be the final part of the emprical study, and will be added in the full version of the paper.

Conclusions:

The emprical study is in the progress of being completed. A discussion and conclusion section will be added to the final version of the paper.

D6 MISSION ORIENTED RESEARCH 2

Thursday 06 June 2019 from 11:30 to 13:00

GIOVANNI CERULLI, Chair

Abstract 131

MULTI-SCALAR DIRECTIONALITY IN MISSION-ORIENTED INNOVATION POLICIES – A FERRYTALE FROM GREEN MARITIME

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1 Introduction:

Innovation policy has traditionally been aimed at addressing market and system failures with the ultimate objective of supporting economic growth. Increasing political and academic attention to overcoming grand societal challenges has led to discussions of which (new) types of innovation policies are needed to address such challenges.

It is frequently assumed that addressing such challenges requires ‘system innovations’ in addition to innovation in products and services (OECD 2015) and that such system innovations, in turn, require new types of supportive policies that go beyond supply-side thinking and economic growth objectives (Schot and Steinmueller 2018; Kemp, Schot, and Hoogma 1998; Boon and Edler 2018).

Above all the new context requires directed innovation efforts—directionality—which should be orchestrated by the state as the business sector alone is often incapable (Mazzucato 2018; Kuhlmann and Rip 2018). Attempting to steer not only the rate but also the direction of innovation implies a ‘normative turn’ in innovation studies. Innovation studies has historically achieved a sound understanding of the factors that influence the rate of innovation but remains immature in understanding the factors that influence its direction (Nelson 2012).

In response to this shortcoming, several diagnostic contributions to the literature have been made— including mission-oriented innovation policy, transformative innovation policy, and transition management—but there is still limited empirical analysis of recent and ongoing attempts at directing innovation towards solving grand challenges (Weber and Rohracher 2012; Smith and Raven 2012; Schot and Steinmueller 2018; Mazzucato 2018; Kuhlmann and Rip 2014).

The notion of directionality is typically understood as the strategic setting of collective priorities and the creation of shared visions (Weber and Rohracher 2012). Normative priority setting however inevitably brings politics and contestations into the discussion of directionality (Shove and Walker 2007; Smith, Stirling, and Berkhout 2005). This implies that the effectiveness and value of setting direction for a transition, depends on an alignment of interests and decision-making by a set of distributed actors (Kemp, Schot, and Hoogma 1998; Garud and Karnøe 2003; Andersen and Dannemand Andersen 2017). Indeed, it is often highlighted that engaging both public, private and third sector actors in the policy-making process is key to successful implementation (Fagerberg 2017; Mowery, Nelson, and Martin 2010; Mazzucato 2017). Such interdependence between setting direction on the one hand, and broad anchoring among diverse stakeholders and interests on the other, represents a challenge to arrive at transformative change. This topic is, however, scarcely investigated (Mazzucato 2017, 2018; Wanzenböck et al. 2019).

Attention is particularly needed to how geographical and multi-scalar dynamics can condition governance in processes of mission-oriented innovation (Wanzenböck et al. 2019).

2 Aims and objectives:

Against this background the objective of this paper is twofold; a) to contribute with an empirical case study that may improve our understanding of directionality in mission-oriented innovation policies; b) to improve our understanding of the interdependence between directionality and bottom-up broad anchoring of stakeholders, and how actor alignment is conditioned by geographical and multi-scalar co-evolution.

The empirical entrance point for studying these phenomena is an ongoing greening of the maritime sector in Norway. By 2022 more than 60 ferry routes along the western coast of Norway will be electrified as part of an ambition to reduce CO2 emissions in the transport sector with 40% by 2030. Anchored in theorizing on directionality in innovation policies (mission-oriented innovation policies, strategic niche management) this paper seeks to understand and interpret how this mission-oriented transformation process has emerged and unfolded. The paper explores the systemic underpinnings of the notion of directionality, and the conditions and capabilities for direction-setting among the various actors in existing socio-technical systems.

The research questions guiding the paper can be formulated as follows:

- Empirically, we ask (Responding to a lack of empirical analysis) how was directionality orchestrated across actors from different sectors and geographical scales in the mission to reduce CO2 emissions in the maritime sector?
- Theoretically, we ask (Responding to the need to investigate the interdependence between setting of direction and ensure broad anchoring among diverse stakeholders) how is directionality achieved across a broad array of diverse stakeholders at different geographical scales?

3 Theoretical framing: Directionality in mission-oriented innovation policies:

Recently, and in the wake of the transition and socio-technical change agenda, there has been an increasing interest and a revitalization of mission-oriented innovation policies (Mowery, Nelson, and Martin 2010; Nelson 2011; Fagerberg 2017; Mazzucato 2017, 2018). Here it is emphasised how traditional technology-based and supply-oriented research and innovation policies are deficient to address and tackle today's complex and integrated missions and societal challenges.

Mazzucato (2017, 2018) makes a distinction between old and new forms of mission-oriented innovation, where the old were defined by a small and centralised group of experts, oriented towards specified technology development, and where diffusion beyond these actors were of less importance.

The new mission-oriented innovation projects on the other hand are seen to comprise broader sets of actors involved in the definition of the direction of the mission, where the missions consist of both technical and societal objectives, and where diffusion of the solutions are paramount. Confirming such a perspective, in a review of the main drivers behind Danish windpower, the German energiewende and Norwegian electromobility, Fagerberg (2017) concludes that social movements and networks, in addition to demand-oriented innovation

policies, have been more prominent than the technologies themselves, which have often been around for decades. In parallel with the ability to formulate missions it is also seen as central to leave enough space for encouraging bottom-up experimentation across several types of public and private actors (Kattel and Mazzucato 2018).

A somewhat similar conclusion is arrived at by Mowery, Nelson and Martin (2010), who find that learning about new technologies in practical use should be emphasised stronger in public innovation and R&D policies. According to this study, the requirements for today's technology development differ fundamentally from earlier public policy programmes such as the Apollo programme or the Manhattan Project. Whereas these iconic mission-oriented programmes were oriented towards the achievement of particular and well-defined objectives and served the needs of a single public customer, today's innovation policy programmes should stimulate and trigger demand and require widespread adoption by several types of actors across public, private and civic sector (Mowery, Nelson, and Martin 2010; Mazzucato 2018).

Here innovative public procurement policies constitute a potentially powerful tool to boost the development and implementation of new technologies (Edler and Georghiou 2007; Aschhoff and Sofka 2009; Edquist and Zabala-Iturriagagoitia 2012; Edler and Yeow 2016; Bugge, Lars Coenen, and Branstad 2018).

Addressing the large range from old to new missions, a recent scholarly contribution presents a new framework for being able to distinguish better between different types of missions (Wanzenböck et al. 2019). The framework consists of a new problem-solution typology in which the degree of wickedness in different missions are decomposed according to how diverging (contested, complex or uncertain) or converging (uncontested, well-defined or informed) the problems and solutions in different societal missions may be.

In order to deconstruct and understand multi-scalar directionality in the mission of electrification of ferries the present study will apply this framework onto the case study of a green transition in the maritime sector: Although the literature provides us with several analytical concepts and dimensions, we need more knowledge about how directionality unfolds in practice; particularly relating to coordination and participation of various actors across sectors and at diverse geographical scales.

4 Methods and data collection:

The data collection for the case study consists of media analysis, document analysis, background quantitative data, participation at two policy & industry seminars and accomplishment of 25 semi-structured interviews with respondents representing policy formulation at national, regional and local levels, interest and industry organizations, shipowners, shipyards, maritime equipment suppliers and maritime services.

The case study specifically targets electrification of ferries which should be seen as a separate mission related to broader objectives on decarbonization of transport and achieving national and international climate targets for Norway (Meld. St. 41 2016-2017).

Moreover, the case study has a pronounced regional focus on Western Norway covering the four counties Rogaland, Hordaland, and Sogn og Fjordane and Møre og Romsdal. Electrification of the maritime sector appears to be a particularly good case for studying mission-oriented innovation policy as the process has largely been directed by ambitious policies on CO₂ emissions as well as innovative public procurement policies.

5 Context for the case study: The maritime industry in Norway

The maritime industry is one of Norway's oldest industries and currently it employs around 110,000 people and creates value for a total of NOK 175 billion annually (Menon 2015). The topography and the long, fjord-cut coastline made the coastal road the most natural mode of transport. Throughout the last 10-20 years the industry has become more concentrated in regional and specialized industry clusters (Regjeringen 2015; Menon 2015). At the same time the industry is very internationally oriented and has high export rates (Ibid). The strong position of the maritime industry in Norway should be seen as a result of the strong tradition of fisheries and the oil and gas sector, which in sum constitutes a cluster of related maritime industrial activities that have emerged from Norway's comparative advantage given the vast coastline, ocean space and oil and gas reserves.

The maritime industry is defined as 'businesses that design, develop, build, delivers, maintains, modifies, owns, operates and sells ships, equipment and specialized services for all types of ships and other floating units' (Jakobsen and Espelien 2011). The maritime industry consists of four main groups of activities; 1) shipowners (deepsea, shortsea, offshore and drilling), 2) shipyards (shipbuilding, maintenance, repairs and modifications), 3) maritime equipment suppliers (mechanics, electronics and operating control systems), and 4) maritime services (design, brokering, finance, engineering, classification, R&D, and logistics) (Ibid.).

Norwegian maritime businesses have to a large extent specialized in high-tech market segments, including dry bulk, chemical tankers, offshore ships and car freight, and are in the forefront internationally in the development and use of cleaner energy solutions, such as liquid natural gas (LNG) and battery (Regjeringen 2018). Norway is one of the few high-cost countries that still build ships. In return, these are very high-tech and advanced, which is an important competitive advantage for the shipyards.

6 Empirical findings:

The case study shows that the private and public sectors in collaboration created a platform / legitimacy for political action. After an early demonstration project, a political consensus emerged on electrification of the maritime sector through ambitious political objectives on CO2 emissions, as well as through the use of innovative public procurement of low and zero emission ferries orchestrated by the Norwegian Public Roads Administration (PRA; Statens Vegvesen). PRA is in charge of several ferry routes along the coast took a lead role by commissioning green solutions for their procurement of new ferries. In 2010 the Norwegian Public Roads Administration's decided to announce an environmentally ambitious development contract, and in 2015 MF Ampere was in operation, as the world's first 100% battery-powered car ferry. Succeeding the development of MF Ampere the Norwegian Public Roads Administration has continued the same type of innovative procurement for another 11 ferry routes. By 2021 there are expected to be more than 60 ferries in operation with battery installations on board.

The insights and experiences generated from the initial round of development paved the way for further greening of the maritime industry (Sjøtun 2018), and subsequently trickled down to both ferry operators, shipyards, the supplier industry and to the regional public administrations.

In Hordaland, Skyss, an agency owned by the County Council continued with the green development contracts initiated by the Norwegian Public Roads Administration and ensured a similar green profile in their procurement of ferries to operate the 17 coastal routes they are in charge of. In addition to the Hordaland County Council the municipality of Bergen has also played a proactive role in relation to the electrification of the maritime sector. As ship traffic accounts for a significant part of the local air pollution in Bergen the municipality and Bergen Port Control have contributed proactively to the greening of the maritime sector through electrification of the harbour and by introducing environmentally differentiated port charges in Bergen (Bergen Kommune 2016).

The paper identifies and outlines the various actors and factors across sectors and geographical scales that have been central to the directionality for the electrification of maritime transport. This account includes political regulation at international, national, regional and local scales, innovative public procurement of zero-emission ferries, initiatives by public administration and public support schemes for research and innovation, technical advice and consulting, networking and lobbying by civic sector organizations, and finally ambitions stated by the industry itself.

In parallel with a strong state setting the direction for greening of the maritime industry, existing industry actors has played a central role in advising the public authorities on technical engineering and innovative procurement processes. Moreover, the ambitions to decarbonize maritime transport in Norway goes way back and should be understood in relation to the long-term commitment and development of alternative energy sources such as LNG from the 1990s. For many years, the Norwegian Public Roads Administration has worked on environmentally friendly ferries. MF Glutra was put into operation in 2000, and today 21 LNG operated ferries are operating in the Norwegian ferry market.

In addition to innovative public procurement, other policy instruments, such as the Pilot-E scheme of the Research Council of Norway and Innovation Norway, the ENOVA funds, the NOx fund and the innovative public procurement by the Norwegian Public Roads Administration and Hordaland County Administration, have all contributed to the same overall goal to develop and implement new environmentally friendly technologies; e.g. rebuilding of existing ferries for full or partial electrical operations, and arranging for new ferries prepared for hybridization or full-electric operation.

In sum the sequence of and feedbacks between decision-making and priority setting across different actors and geographical layers provide an interesting case of mission-oriented innovation policy driven by distributed agency in the context of a sustainability transition.

7 Conclusions:

The case study of greening in the maritime sector in Norway may be interpreted as a hybrid between old and new types of mission-oriented innovation policies, due to an upstream (production) focus, and a corresponding lack of user involvement, but with active demand-side innovation policies in terms of innovative public procurement.

The paper shows how several types of actors across different sectors and geographical scales have acted in alignment to enact directionality to realize the ongoing green transition of the maritime sector in western Norway. What can we learn from our case about coordination when directionality is 'systemic and distributed across many stakeholders'? There has been

high political consensus and limited contestations and low uncertainty about the battery-driven solutions pointed at. Moreover, electrification of ferries has not been particularly challenging technologically. There have also been important complementarities between policy instruments and actors which have served to ensure the directionality observed.

The case constitutes an example where long-term existing industry structures and the persistency of their regulatory context should be seen as a precondition and a prerequisite for transformative change in the form of a green shift in the maritime sector. Certain conflicting interests exist, such as small shipowners with limited resources not being particularly proactive in upgrading their own fleet. However, these potential challenges have not prevented developments, flexibility and reorientation in other parts of the industry. The long history of maritime industry in Norway has ensured several strong actors and networks covering the entire value chain of the maritime industry. Moreover, the strong networks themselves have constituted a driving force for the green transition observed. At the same time the developments observed are conditioned by a clear direction and strong efforts by public policies. In this sense the case may be interpreted as exemplifying a co-evolution / interdependency between traditional supply-side thinking in innovation policy and the suggestions for new types of (transformative) innovation policy that aim at mobilizing users and the civic sector. This is an issue that requires further research attention.

Keywords: Mission-oriented innovation, transformative change, governance, directionality, geography, maritime sector

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Abstract 56

NEW MISSION-ORIENTED POLICY INITIATIVES AS SYSTEMIC POLICIES TO ADDRESS SOCIETAL CHALLENGES: A TYPOLOGY

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Aim of the proposal:

In this paper, we draw on an ongoing OECD project on ‘new’ mission-oriented policies as defined below in order to develop a typology of the different types of such systemic policies set up by countries to address societal challenges.

More precisely this paper aims to:

- identify and categorise the different ways in which governments design, fund and coordinate well-targeted and wide-spanning coordinated sets of policy measures to address societal challenges (i.e. mission-oriented policies as defined above);
- define the criteria that allows to discriminate between the different types identified;
- discuss the strengths and weaknesses of the different types of mission-oriented policies, building on lessons-learned from real cases;

Background:

Developed and developing countries are facing mounting societal challenges that will determine to a great extent people’s life and well-being in the not too distant future (OECD, 2016[1]). Research and innovation activities are expected to contribute significantly to solving these challenges by, for instance, reducing CO2 emissions, finding new solutions to improve health and healthcare or mitigating the negative effects of urbanisation in low-income countries. Significant progress has already been recorded in several domains like energy technology or health (OECD, 2018[2]).

However, although essential, scientific and technological progress in specific areas will not be sufficient to address issues of such scale and scope, like climate change or aging. The research and innovation activities relevant to societal challenges will need to be transformational, hence ambitious, spanning across various disciplines and sectors, and performed with a mid-to long-term horizon. Beyond science and technology, they will also have to be part of a wider set of well-coordinated social, economic and political changes contributing to what has been called socio-technical or sustainable transitions (Geels and Schot, 2007[3]); (Fagerberg, 2018[4]); (Schot and Steinmueller, 2018[5]).

The necessity to drive such paradigmatic changes through ‘purposive’ interventions has led many authors and policy makers to call for stronger strategic orientation of research and innovation activities towards ambitious and collectively-defined goals (Mazzucato, 2017[6]). Past examples of mission-oriented policies (Apollo, ‘French Grand programmes’, etc.) are often deemed too technology and/or economy focused, top-down and rigid, picking winners and selecting options with little stakeholder and citizen involvement in order to drive the necessary broad and ambitious socio-technical changes (Larrue and Rebuffet, 2008[7]) (Kuittinen H., Polt W. and Weber M., 2018[8]); (Kattel and Mazzucato, 2018[9]).

These policies were also very costly and would be difficult to implement in the current context

of stagnating or declining research funding in several countries since the crisis, despite the implementation of new funding instruments to orientate long-term research activities. More and better priority setting will be therefore needed, but it will hardly be sufficient since these initiatives face strong resistance in most countries and cannot allow the significant reallocations needed to create the necessary critical mass.

As ‘throwing money at societal challenges’ is therefore not an option, the coordination of efforts will be a key condition to any research and innovation policy that aim to tackle societal challenges in a meaningful way. A number of countries have therefore more recently attempted to design and implement new types of mission-oriented policies (‘MOIPs’ hereafter). The characteristics of these initiatives is their systemic nature and focused orientation. Building on recent work on these policies (Mazzucato, 2018[10]) (European Commission, 2018[11]), the general definition of MOIPs that is used in this paper is as follows: MOIPs are a coordinated package of research and innovation policy measures, possibly spanning the innovation cycle from research to demonstration and crossing various policy fields, implemented in order to meet ambitious and concrete goals in a defined time-frame.

Methodology and empirical base:

This research draws on extensive desk research, a review of possible indicators, a review of available policy documents (evaluations, various policy reports) and dedicated interviews with policy makers as part of the ongoing OECD project on mission-oriented policies.

As part of the OECD Science and Technology Policy division, we take advantage of the knowledge base in research and innovation policies, in particular the OECD reviews of innovation policy (France, the Netherlands, Norway, Sweden, etc.).

Results:

At this stage of the project, we have identified several types of mission-oriented policies to address societal challenges. This first attempt will be further elaborated in the coming two months.

Strategy-based mission-oriented policy initiatives. As revealed by a recent OECD survey on the governance of public research policy, most OECD countries have STI strategies explicitly referencing societal challenges. Out of the 35 countries surveyed, 33 (94%) have a national STI strategy or plan in place and meeting major societal challenges is an objective in most of these strategies (30 of 33 strategies). However, in most cases these strategies do not trickle down to implementation as addressing societal challenges is rarely the main rationale for STI policy initiatives. Therefore, only those strategies that have been followed by the implementation of concrete effort to coordinate the actions falling under the targeted priorities are considered as a possible type of MOIP initiatives (OECD, 2018[12]).

One example is the Norwegian Long term Plan for higher education, research and innovation. This national strategy assigns a prominent place to societal challenges, not only as one of the three overarching priorities, but also in the four thematic priorities that incorporate many of these challenges. Although it was found to stop short of proposing the systemic new policy approach and instruments that such bold ambitions call for, some laudable efforts took place in the force of interdepartmental steering groups set up at the administrative and political level in order to coordinate actions across policy fields in specific priority areas such as ‘seas and oceans’ (OECD, 2017[13]). The German High Tech strategy and the Dutch Top Sectors

strategic framework are other interesting examples of this type of initiatives.

Large public-private research consortia: These large public-private integrated pre-competitive programmes were especially popular to improve national competitiveness in key sectors such as semi-conductors in the 1980s and to respond to growing environmental concerns in 1990s. Examples of the latter are to found for instance in the United States car industry where the Big Three automakers teamed up to establish common performance targets for electric vehicles battery and finance, with support from Department of Energy, the different options of battery technology available at the time. This systemic approach conducted in the United States Advanced Battery Consortium allowed to systematically explore the technology landscape and reduce uncertainty on the best options for battery technology (Larrue, 2003[14]). Such consortia were also implemented in Japan and Korea.

Public-private coordination platforms: As governments searched for new modes of coordination more flexible and less heavy than research consortia, they increasingly relied on coordination platforms where a wide range of stakeholders in a technological area gather regularly to discuss common challenges and opportunities, from research to demonstration and regulation. An example is the Fuel Cell Conference of Japan (Larrue P. and Harayama Y., 2004[15]) (Harayama, Larrue and Honda, 2009[16]) and, more recently, the 21-Platforms in Norway. The latter are actor-driven strategy initiatives commissioned by the government or a ministry to serve as advisory bodies and stakeholder forums in priority areas. These initiatives represent a significant effort towards mobilising stakeholders beyond public R&D funding. However, they do not offer a holistic approach to addressing societal challenges (e.g. in the health area), since they are too limited by sectorial boundaries (OECD, 2017[13])

Delegated community programmes. Some governments have tried to delegate selected responsibilities related to strategic orientation and coordination to relevant stakeholders in key priority areas. Significant lessons learned for the governance of mission-oriented policies can be learned from these initiatives that aim to support the development of ecosystems in targeted areas. This is the case of the Strategic Innovation Programmes 'SIO' initiative in Sweden. The initiative set out to prioritise cross-sectoral areas considered of strategic importance to Sweden, either to improve international competitiveness and/or find sustainable solutions to global challenges, by enhancing interactions between the many varied actors and support research and innovation programmes or projects within each of these areas by developing bottom-up strategic innovation agendas. The innovation agency VINNOVA finances and selects these initiatives and, in a later stage, fund programmes that are relevant to these strategies (OECD, 2016[17]). Another example are the Finnish Strategic Centres for Science, Technology and Innovation (SHOKs) established in 2006, such as the CLEEN in the area of Energy and the environment (OECD, 2017[18]). These initiatives were evaluated in 2014 and phased out gradually in 2015.

Interministerial coordination groups. Addressing grand societal challenges requires breaking silos across different policy areas. Societal challenges have a complex and multidisciplinary nature, requiring efforts that fall outside the boundaries of individual ministerial departments. An example of approach relying on the coordination of multiple policy areas is the energy transformation initiative in Germany, widely known as the Energiewende. Energiewende represents Germany's planned transition to a low-carbon, nuclear-free economy, which goes beyond just transforming Germany's energy production system. The initiative includes, for example, a transformation of Germany's energy consumption and distribution aiming at

increasing energy efficiency and reducing emissions. Defining and adjusting the design of Energiewende is conducted at the federal level by several ministries. The Ministry for Economic Affairs and Energy (BMWi) and the Ministry for Environment, Nature Conservation, Building and Nuclear Safety (BMU) typically draft most relevant legislation (Egenter, Russell and Wettengel, 2017[19]). The Ministry of Research and Education (BMBF) funds scientific and technological research in sustainability through e.g. its flagship FONA programme. The Ministry for Transport and Digital Infrastructure (BMVI) is responsible for legislation on transportation and the Ministry of the Interior, Building and Community (BMI) is responsible for urban planning and buildings' energy efficiency. All new bills related with Energiewende follow a process of consultation between all relevant federal ministries to assure policy coordination.

In Japan, the Cross-ministerial Strategic Innovation Promotion Program (SIP) was launched in 2014 by the Council for Science, Technology and Innovation (CSTI) as it exercises its headquarters function to accomplish its role in leading science, technology and innovation beyond the framework of government ministries and traditional disciplines. CSTI has identified 11 themes that will address the most important social challenges facing Japan, as well as contribute to improving national competitiveness such as; next-generation power electronics, structural materials, ocean resources exploration, automated driving system, infrastructure maintenance renovation and management, cyber-security for critical infrastructure. For each theme, CSTI has selected Program Director among top-class leader either from academia and industry to pursue each program with the budget of around 3 billion yen/year for R&D. Each program is supervised by a 'promoting committee' consisting of related ministries and funding agencies for. The objective is to combine different policy instruments to make R&D consistent with achieving societal challenges; from deregulation, support for intellectual property to the promotion of international standardization. Since 1st term SIP (2014-2018) has been assessed as successful, CSTP has decided to start 2nd term SIP from 2018 as 5 year program.

Cross-sectoral project-based programmes to address societal challenges: the coordination that is needed to address societal challenges is carried out in these programmes at the level of projects. This is the case of Vinnova's UDI programme that support projects that are: focused on the demand for society and industry, not the technology; cross-functional and cross-sectoral approach, since solutions to societal challenges are rarely found in one traditional sector or a single research field; using a systemic approach in order to ensure that solutions can be implemented, and resistance from the system in which the challenge has emerged can be overcome; geared towards long-term effects that will occur many years after project closure, and not just short-term results that can be realised within the timeframe of the project. This may, for example, mean that projects need to engage in discussions with politicians and civil servants (OECD, 2016[17]).

Transformative umbrella programmes: these programmes gather a wide range of initiatives loosely coordinated under a common institutional framework. The 'Investments for the Future' Programme (Programme d'investissements d'avenir) implemented since 2009 in France includes a number of different programmes, combining various methods of funding (loans, own resources, subsidies) and different approaches per sector, per institutions (creation of new institutions, such as the SATTs for improving knowledge transfer, ITEs, IRTs) and per technology linked to a target issue (e.g. car of the future). The PIA is piloted and co-ordinated by one dedicated organisation, but the different initiatives are operated by various existing organisations.

Conclusions:

In this section we will develop criteria to differentiate these different initiatives. These criteria will be further elaborated and discussed in the complete paper.

We first identify the basic characteristics of the initiatives (size, policy scope, scientific scope, sectoral scope, timeframe, objectives and targets, governance structure, selection process, etc.)

From these characteristics, we will derive a typology of MOIPs in terms of:

- Level of directionality and intentionality: the extent to which initiatives are directed towards specific and well-articulated goals and clearly set timeline and milestones (European Commission, 2018[11])
- Level of coordination: from weak (provision of non-binding advises and broad recommendations) to strong (decisions directly influencing actions and funding of the concerned stakeholders)
- Level of flexibility: how the initiatives respond/adapt to changes of context and lessons-learned from on-going activities.
- Level of stakeholder involvement: the extent to which different types of stakeholders are involved in different decisions related to the design and implementation of the initiatives.
- The role of governments in these initiatives (from observer in some platforms to leader in other initiatives);

In a last section, we will developed lessons learned on (to be developed in the full version of the paper):

- The variety of MOIP initiatives, their main common features and challenges, the added value of the concept of mission-oriented initiatives as systemic policies;
- the respective merits of the different types of MOIP initiatives to coordinate different interventions (supply and demand-based, etc.) address societal challenges;
- the extent to which these initiatives provide new leeway for government to steer research and innovation activities in desirable directions;
- the linkages of these mission-oriented initiatives with basic research and different types of 'non oriented' policy schemes.

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Abstract 137

MATCHING TYPE OF MISSION AND GOVERNANCE IN MISSION-ORIENTED R&I POLICY: CONCEPTUAL IMPROVEMENT AND GUIDANCE FOR POLICY

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Keywords: mission-oriented R&I policy, case studies, typology, governance, Horizon Europe

Aim:

This contribution aims to take a more differentiated look at mission-oriented R&I policy initiatives, and describes different types of missions that can be observed in practice. It is based on an extensive review of empirical case studies gathered in studies for the European Commission. The different types of missions have different implications and requirements for governance. Here, we aim to derive some common governance patterns that can be identified for the four types of missions.

Background:

In recent years, there has been renewed interest in the concept of so-called “mission-oriented research and innovation (R&I) policy” (for an overview see Kuittinen, Polt, and Weber (2018)). By mission-oriented R&I policy we understand “initiatives [which] typically are ambitious, exploratory and ground-breaking in nature, often cross-disciplinary, targeting a concrete problem/challenge, with a large impact and a well-defined timeframe. [...] they have a clearly defined (societal or technological) goal with preferably qualified and/or quantified targets and progress monitored along predefined milestones. Directionality and intentionality of these initiatives is what differentiates them from other types of initiatives, such as systemic or challenge-oriented policies” (JIIP, 2018a, 4).

This development has to be seen against the historical backdrop of how R&I policy has evolved since 1945. A first wave of [“traditional”] mission-led policy approaches evolved during the 1940s (WWII) and the 1950s (emerging “Cold War”) and addressed primarily key military technologies. What we can observe today is a “new” mission-oriented approach which looks different than the “old” one, by focusing on new societal developments and challenges as main policy targets.

While so-called “horizontal”, “generic” or “systemic” approaches to R&I policies which were developed during the 1980s and 90s have by and large been successful in improving the general innovation performance in many countries, limitations were perceived in terms of sufficiently addressing so-called “grand societal challenges”. In addition, the success of mission-oriented approaches in countries like Korea, China and the United States in boosting technological development and competitiveness also gave rise to re-considerations of the role of government in technological change.

While there was earlier conceptual work (e.g. Soete and Arundel, 1993), in European policy, it was not before the mid-2000s that the notion of “missions” was taken up again, e.g. in the Aho Report (Aho et al., 2006) and the subsequent expert group on European Research Area (ERA) rationales (Georghiou et al., 2008). The Lund Declaration of the European Council (2009) stressed the key role of the ERA for strengthening Europe’s ability to tackle such challenges. In one of the pillars of Horizon 2020, this approach was put into practice. It was soon recognized, though, that H2020 stuck to the model of previous framework programs; and in the course of the preparation for Horizon Europe it was suggested to develop a more ‘mission-oriented approach’ to tackle societal challenges. Likewise, several member states embraced similar concepts for re-shaping their R&I policies, with innovative approaches being piloted in the Netherlands, in France, in Sweden, in Germany and some other countries (Dachs et al., 2015).

It is against this backdrop that the specification of “missions” at an intermediate level of granularity was suggested as a focusing device to bridge the gap between societal challenges and specific R&I projects (Lamy et al., 2017). With the recently published programmatic paper on mission-orientation in European R&I policy (Mazzucato, 2018), the rationales for an increased role of a mission-oriented approach have been visibly spelled out. This debate is backed up further by the recommendations from other expert groups (ESIR, 2017, RISE, 2017), two major empirical studies on mission-oriented policies (JIIP et al., 2018a and 2018b) (JIIP, 2018a, 2018b) and foresight activities (Weber et al., 2018).

However, despite of the recognition of the importance of a shift towards a mission-oriented approach at a programmatic level, there are still serious limitations in our understanding of how to devise new corresponding forms of governance and how to implement them in practice. A first step in this direction is a more nuanced understanding of the specificity of the various types of missions. In this vein, we propose to distinguish between four different types of missions (or mission-type initiatives). We then move on to elaborate on these four types in more detail, underpinned by some examples. Finally, we want to elaborate a nexus between the different types of missions and the most appropriate forms of their governance.

Conceptual framework:

There are substantial differences between the old and the new mission oriented approaches. Today, missions would have to reflect the complexities of societal demands and technologies alike. While asking for more directionality, the old, very centralized forms of governance seem to suit only specific types of missions. Instead, we found a considerable diversity of mission-oriented policies currently in place – also exhibiting different degrees of success. Here, we advocate introducing a more systematic approach to differentiating current mission-oriented policies, by focusing on four main dimensions of these policies:

- *Motivation* (aspirational vs. problem-driven): Many of the missions currently under discussion are driven by the perception of mounting problems, e.g. in relation to climate change, the state of the environment, in terms of social disparities, security matters, or health risks. Reference to the UN Sustainable

Development Goals is often used to provide rationales for the pursuit of such missions.

- *Intention* (understanding vs. solutions): Missions differ in terms of their “intentionality”. The key question here is whether a mission-oriented R&I policy aims at better understanding a phenomenon, which is often the case in large-scale scientific missions, or whether it aims providing a “solution that works”.

- *Target & Scope* (well-defined vs. ill-shaped): Missions differ from other types of R&I policy approaches by being focused on a clearly identifiable target. This target can be well defined in terms of the ambition pursued as well as the outline of the envisaged solution (e.g. bringing and returning man to moon, using a multi-stage rocket, or the doubling of the range of electric vehicles).

- *Means* (scientific-technological vs. socio-institutional): Many traditional missions have been technological in nature, as demonstrated by a recent review (Research Policy Special Issue, 2010/2012). Their widespread uptake, however, may require organisational, institutional and behavioural adjustments (e.g. in the medical or military domains). Other missions, however, may take social, economic or environmental challenges as their starting point (e.g. poverty) or require at their core social or institutional innovations.

Not all combinations resulting from these four dimensions can be identified in practice. The analysis of more than 200 examples of mission-oriented policies and programmes has led us to categorize missions in predominantly four types: *Science missions*, *Technology accelerator missions*, *Transformer missions* and *Umbrella missions*. These will be described below.

Empirical findings: characteristics and governance issues related to the four types of missions

The following findings are based on case studies undertaken in projects on behalf of the European Commission (JIIP, 2018a; JIIP, 2018b). The empirical work included a compendium of very different types of mission-oriented R&I initiatives in terms of scale and scope and policy instrument applied, all cases being strongly rooted in temporal, geographical, political, and thematic contexts. The main characteristics of each type of missions are the following:

Science missions

Science centric missions can have a wider or narrower scope. The wider scope missions are aimed at boosting the development of entire scientific fields allowing the research and technological development to take various paths. The ongoing US Cancer Moonshot initiative is an indicative example of a science-driven mission aimed at archiving in five years the advances in cancer research and treatment that without the initiative might take at least a decade. Other examples include the historic US government mission War on Cancer, or contemporary initiatives such as EU Human Brain Project Flagship or US BRAIN Initiative that are targeted initiatives with primarily scientific goals.

One fundamental characteristic of science missions is the fact that the course of scientific progress is very hard to predict. For instance, cancer research has significantly advanced through the successful mapping of the human genome, inherently not directly related to cancer research. The War on Cancer initiative, in turn, did not only contribute to enhanced

treatment of cancer but also came up with cure on AIDS. The serendipitous manner in which science is advancing would suggest that the governance of such 'science missions' would be of a different nature than for the other types of missions.

Technological missions

A technological ('accelerator') mission is targeted to advance technological development faster in order to achieve clearly predefined targets. They often have well-articulated and time-bound objectives to make significant advances in technological development and deployment. Although the fundamental character of accelerator missions is to achieve radical innovation and technological breakthroughs, they can also have societal targets or lead to important (unintended) societal and economic effects. The initiatives are (and have to be) often based on a strong R&I ecosystem, e.g. it may be based on decades of prior basic and applied research. The Apollo Programme, in essence, was a large demonstrator project bringing together and upscaling many technologies and was founded on the long-term research of NASA.

Accelerators can also take the form of more narrowly scoped technology focused "moon-shots" that have a more precisely defined technological target, such as the Apollo mission, aimed at taking a man to the moon and back, or the pan-European Concorde mission with a supersonic aircraft as a target. The technological accelerator missions can also occur as shorter-term funding impulses to rapidly solve an urgent problem, such as the development of the Malaria and Ebola vaccines.

At least for some of these technology accelerator missions, public policies directly or indirectly supported the demand for the new technologies. E.g. in the Apollo Programme, the Dutch Delta Programme or in health missions, governments were important stakeholders and prime users of some of the new technologies. In the same vein, public procurement or regulatory policies have been instrumental to promote certain technologies or applications.

Transformative missions

Compared to science and technology missions, the transformer-type of initiatives are targeted towards a change from existing, prevailing system trajectories to a new, emerging systemic trajectory. These types of initiatives often involve a systemic change for which a more profound change as to how technologies are embedded in society and applied by consumers is needed. Transformative missions either set out to change existing systems on a large scale, like in the case of the German "Energiewende" or the "Hydrogen Society" initiative in Japan. Or they can be targeted at transforming a part of the system such as the electric mobility initiatives of China and Norway, or initiatives targeted to enhance the development of solar energy in the cases of US SunShot and Chinese Solar Energy Policy.

Many of the initiatives deal with global societal challenges and require an integral and holistic policy approach, often beyond the scope of R&I policy alone. Transformative missions respond to challenges that are complex and systemic (so-called 'wicked problems') and inherently involve a transition to a new technological trajectory, characterised by competition against the incumbent technologies and challenges related to system inertia and the high transaction costs of changing the prevailing system.

We found the success of these policies being largely dependent on the match between the new technological solutions and the needs, acceptance and support of society. Thus, these initiatives necessitate more comprehensive policies, involving supply- and demand-side policy measures. In principle, the supply-side policies are oriented to support technological

development and the industrial capacities needed to facilitate the systemic change, whereas the demand-side policies are targeted to create or retarget demand, and to facilitate societal acceptance and change in consumer habits, including measures such as public procurement, incentives for users to adopt the technology (e.g. direct subsidies, indirect tax incentives), regulation and standard setting, smoothing the way towards wider market uptake and diffusion of the technology.

Umbrella missions

Umbrella missions can be considered as coherent frames for the long-term direction of public policies and private investments. The German High-Tech Strategy, the Top Sectors Strategy of the Netherlands or the French Innovation 2030 Commission are examples of such initiatives. We can find this type of missions also at international level and sometimes initiated by private/philanthropic organisations. Examples such as the Bill & Melinda Gates Foundation's work on poverty, health and education, or the global 'Mission Innovation' on low carbon energy are good examples of overhauling direction setting and providing an enabling, coordinating structure on tackling the global challenges as a common endeavour involving public policy, research, companies and society.

Governance challenges for missions

From these observations, it has become clear that the challenges for the governance of a successful mission-oriented policy are substantial (see Polt et al. 2019 for a survey on the respective perceptions). That holds true on the national but even more so on the European or international level. These challenges include coordination with sectoral policies, coordination with national policies, engagement of a wider range of stakeholders in the definition of agendas and the implementation of policies.

In operational terms, this implies a shift towards a new programming model, characterized by the following features:

- 1 ensure diversity by calling for broad range of possible inroads of "solutions-oriented research",
- 2 an embedded scaling and selection process,
- 3 users/beneficiaries involved at many stages of the process - through to different degrees,
- 4 a much stronger role of programme management in ensuring the integration of different activities towards the "mission",
- 5 a new approach to monitoring and evaluation (outcome focus) to ensure reflexive and a dynamic policy design.

While the extent to which these requirements matter differs from mission type to mission type, all of them are prerequisites for a successful mission-oriented policy. In the final elaboration of the paper, we will try to relate systematically the types of mission to the specific challenges for governance.

Conclusions:

It has become evident that the programmatic change in Horizon 2020 of giving high prominence to the notion of societal challenges is not enough to reorient significant parts of R&I activities towards more ambitious and longer-term goals. As long as the modalities of Framework Programme implementation remain largely the same as in the past, the gap between ambitious long-term and higher-order goals, on the one hand, and the prescription

of specific topics as defined in work programmes, will continue to be too wide to lead to the ambitious and sometimes even transformative solutions needed to tackle grand societal challenges. Moreover, without a serious embedding of R&I agendas into the wider political agendas in key policy areas such as health, environment, transport, energy, etc., the wider uptake of novel R&I-led solutions is going to be as uncertain as ever. Without improved coherence of policies and stakeholders' strategies, the grand challenges are likely to remain unanswered. Mission-oriented policies might be an answer to these pressing challenges.

Against the background of these findings, here we attempt to discuss the usefulness of the typologies of mission orientation in STI-policies for practical policy purposes, especially with respect to the challenges they raise for governance. It has become apparent that the different types of missions have very different requirements in terms of governance structures. Currently, both the EC as well as national governments are struggling to define and implement these appropriate governance structures. In further elaborating on the empirical findings on the different forms of missions as outlined above we seek to relate different forms of governance (centralised, decentralised, participative, agency-led etc.) to the different types of missions and hope to arrive at establishing design principles for governance which would be best suited for the respective type of mission. Thereby, we aim not only to contribute to a better conceptual understanding but also to help practical policy design.

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D7 PUBLIC SECTOR 1

Thursday 06 June 2019 from 11:30 to 13:00

SERENA FABRIZIO, Chair

Abstract 30

INFLUENCE OF SCIENTIFIC ADVICE TO DESIGN AND IMPLEMENTATION OF HIGHER EDUCATION REFORM IN ITALY

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Aim of the proposal:

Over the years, research has increasingly been called upon to provide useful elements for addressing and resolving problems of social relevance. However, for the research results can be translated into concrete actions it is necessary that policymakers include them in regulatory instruments aimed at countering the problems underlying social challenges. For this reason, it is important to monitor the ways in which policymakers assimilate the results of the research. In presence of a transfer of distorted and/or incorrect information between researchers and policymakers, the decisions made based on these elements could prove ineffective in terms of social impact. In this contribution, we aim to delineate the space of influence that research can have on the path of definition and implementation of public policies.

To do that we will take in consideration the literature that put in evidence a) the effects that research have on political decision, b) the elements that define the interest of both the actors (researcher and policymaker) in transfer of information among the two areas and c) the ways that politics allow to research to express its point of view.

The paper wants to test the hypothesis that a large and articulated political reform at system level, with relevant social implications, leave little space to experts' opinion, also to those that could help policymakers to take decisions useful to the general interest. Because it cannot be mandatory to consider scientific advice in legislative process, political will is more influenced by non-scientific elements than by research results.

Background:

Evidence-based policy (EBP) has become a relevant argument along the years in the analysis of the influence of research on social and political decision. According to this branch of literature, the policymaker can use a set of research results that describe in depth and in a structured way the state of the art of the issue faced, of the possible evolutions of the situation, considering different and sometimes opposite points of view. In this way, the policymaker can take decisions in the light of certain elements of analysis, "controlled" by the scientific rigor of the research process (Nutley et. al 2010). The desirable result is a choice taken avoiding as far as possible evaluation errors and underestimation of possible risks. In this sense, it is possible to look at the EBP as an almost perfect translation of information from research to politics sphere.

This ideal setting of the policy decision-making process assumes an approach in which the policymaker bases his choices only when he has been able to compare all the options provided by the research. There is the possibility that he uses, in a more or less conscious way, the research results in a partial way, altering the effectiveness of political instruments (Strassheim and Kettunen, 2014).

An element of alteration ascribable to the cognitive abilities of policymakers is the use of

research to schematize reality: policymakers are encouraged to focus only on some aspects, according to a representation of the reality that is congenial to their value, but with the risk to lose elements of complexity and completeness. The consequence is a self-sustaining vision of the world that excludes elements of knowledge contrary to this representation (Rayner 2012). This trend seems to be reinforced to the massive excessive use of knowledge production tools, such as statistical and mathematical models, in decision procedures: the risk is the paradox to use a tool considered rigorous that, however, could be incomplete and calibrated only on elements of interests (Saltelli and Giampiero, 2017). On a more general way, Heurtebise (2015) emphasizes how to use scientific results can help reduce the risk of political choices, but this risk cannot never be cancelled even by increasing the use of research results in decision-making processes. The persistence of the risk is linked to the impossibility of a perfect transfer of knowledge because on the one hand the tools of diffusion of knowledge have objective limits in terms of complete representation of reality. On the other hand, there is always the risk that policymakers will overestimate their skills, considering themselves able to handle the information provided by research. The result is that they will tend to select, sometimes in an unconscious way, only the set of information that are effectively able to understand.

As to the participation of research in political life, it is seen as an element that must be supported and expanded according to several authors. A direct involvement of researchers is supposed to allow them to express their point of view without the risk of alterations due to intermediaries, reducing the risk of misunderstandings or partial selection of topics by policymakers (Grundmann, 2009; Benneworth and Olmos-Penuela, 2018). The aim of the involvement of the research should be to provide a vision that is as broad as possible; for this reason, the debate should be structured in such a way as to give the possibility of expression also for those actors that present an alternative point of view but have a lower capacity to impose themselves (Kinchy, 2013). the need to broaden the audience of experts also responds to the purpose of presenting a complete scenario about the instruments, derived from research results, available to the policymakers and an approximation of the direct and indirect effects that these instruments could generate. Once these limits have been defined, the decision is made on which instruments to use in consideration of the social desirability of the various solutions proposed (Saltelli and Giampiero 2017). Finally, encourage the participation of new voices together with the incumbents can lead to the creation of proposals that are at the same time alternative and complementary, adding new solution to the proposed problem and could contribute to re design social interactions. (Schot and Steinmuller, 2018).

Thus, researchers have in principle free access to the political debate and the process of law formation as a rule. However, there is the limit of the space actually granted by the political procedures to researchers to expose their qualified point of view. Jasanoff (2011) puts in evidence the necessity to distinguish between different Policy Advisors according to their autonomy respect to the government, starting from the boards of experts internal to the ministries to arrive to the independent committees, passing through the public agencies. Other relevant characteristics are the composition of the board (academics with solid reputation vs stakeholders with technical skills) and the nature of the advice (Institutional advice representing all relevant views for the public sphere vs pluralistic information based on balanced opinions).

Political influence, however, is not the only factor that undermines processes of knowledge transfer between research and politics. It is necessary to understand the criteria for the formation of PABs. Strassheim and Kettunen (2014) show that in a context of absolute political independence, the more the participation in the board will be contested by external

parties, the higher the possibility that the composition of the board will be subject to temporary trends. The consequence is a weakening of the value of the advice provided, regardless of the commitment and intellectual honesty of the board members.

Finally, it is also necessary to consider the individual sphere of PAB components. Sutherland and Burgman (2015) suggest that, despite the best intention of the experts involved in the Advisory Board, they can suffer the social pressure of the community of reference to suggest some solutions that are commonly considered adequate even if are not the best response to the political problem.

Methodology and empirical base:

The quoted literature suggests that inclusion of scientific advices in the definition of political procedure is subordinated to several elements:

- policy makers must require a complete and precise set of information that are able to understand and handle, not just punctual elements that can justify their point of view;
- it is necessary to define procedures that allow the experts to present their analysis in a clear way, without possibility of interference by political actors;
- experts must be able to supply their scientific advice, without any ideological influence and without the risk of social pressure from their reference groups.

All these elements make the path of inclusion of scientific evidence in the process of law formation unstable di per se. This is true for all the fields of knowledge but seems to be more relevant for social science, where the evidence are more debatable than for the so-called "hard sciences". This creates a grey area where policy debate can shape scientific evidence according to convenience.

We test our hypothesis using a meta-analysis focused on the reform of Italian higher education system finalized with the law 240/2010 also known as "Riforma Gelmini". We consider the contributions of Reale and Primeri (2014) and Donina, Meoli and Paleari (2015) that analyzed the evolution of the text of the law from the first formulation to final approval, showing what are the main differences compared to the key points of the reform such as the spaces of autonomy granted to universities and the configuration of governance. We implement the work with the analysis of documents produced by the advisory bodies of the government, the parliament and other influencers such as think tank organizations, the Rectors' association and other representative bodies of society (e.g representatives of firms, local governments) in order to outline what kind of influence they have had, and for which parts the change has been inspired by scientific advice. The time span of the analysis goes from the formation of the first provisional proposal (25th November 2009) until the approval of the main text of the reform (30th December 2010).

Results:

The general outline of the reform at the very beginning of the process suggests a conformation of the Italian university system to the principles of the New Public Management narrative. The motivations of the reform were to generate a breakdown with the previous structure of the HE, promoting a deep change in the configuration of the system, in its organizational pattern and in the evaluation activities. The iter for the approbation of the law started in a moment of disrupt and university de-legitimation, to which the promoters responded by presenting the reform with the key-words "efficiency", "quality" and "transparency" (Capano, 2018). The law has the original goal to pursue a differentiation

between universities, giving them the possibility to change their status from public organizations to private nonprofit foundations; moreover, the law wants a) to improve the decision power of the leadership (rectors and administrative board), reducing the power of the Senate; b) simplifying the internal organization of the universities, articulated around a reduced number of university departments, in charge of both teaching and research tasks, c) eliminate the faculties; d) promoting a managerial drift of the university governance with a key role of evaluation as a tool for performance-based assessments, replacing to a large extent the collegial model. Hereafter we point out some preliminary results dealing with the items of the university leadership, the status of the public universities, the level of university autonomy.

University leadership

The "Riforma Gelmini" has undergone a gradual transformation during the parliamentary work, assimilating ideas and knowledge coming from different sources. Respect to the organizational pattern, the role of the rector was strengthened, with an enlargement of his responsibilities for political and strategic orientation, while the Senate was assigned decision-making responsibilities with regard to teaching and research. In addition, the Senate was given the opportunity to dismiss the rector by a two-thirds majority, decisively limiting his power. With reference to the latter, the preliminary analysis of the documents shows how has been developed a front of opinion contrary to a marked managerial approach. This point of view was well expressed by a series of documents produced by the Italian Conference of the Rectors (CRUI) and by the opinions expressed by its representatives during the parliamentary hearing. In these opinions, the concern for a structuring of research and teaching excessively linked to the opinions of the Rector was expressed with determination, using arguments coming from the HE literature. The results of the reform would be a "zeroing" of the opinions of the other members of the university. Moreover, an excessive power in the hands of the rector alone would have exposed the university to sudden changes in approach linked to the change of the person who holds the role of rector. A breakdown of responsibilities in the collectivist sense was suggested, while not renouncing a relevant position for the rector. In one policy advice formulated in September 2010, after parliamentary approval of the change in the governance structure with respect to the original text, the CRUI assembly expressed satisfaction for the government acceptance of the previously implemented balancing of powers.

Status of the Universities

Compared to the general configuration of the Italian University system, the first design of the law would allow universities to decide the change of status from public organizations to private foundations or the possibility of federating with other universities or research institutions. This issue generated a wide debate in which different visions of the structure that should have taken the university clashed. While CRUI argued, in a document produced shortly before the final approval of the law (November 2010), the need to preserve universities as public institutions, other voices supported the need to grant real self-determination powers to universities. However, in the final text these elements remained vague, even in the first implementing decrees. Also in this case, examples of different evidences coming from international literature were put in context.

Autonomy

National University Council (CUN), an advisory board of the Ministry of Education, Universities and Research, pointed out in two separate opinions, produced respectively before the approval of the law (September 2010) and after its approval (March 2011), as the possibility of granting the autonomy of universities with respect to the public sphere is focused only on

the rationalization of resources without adequate tools and incentives. The result highlighted by the CUN was a setting of the relationship between state and university unbalanced in favor of the former by the possibility of arbitrarily limiting the financing and management of human resources. In a more general way, both CUN and CRUI put in evidence in their documents a reluctance by Government to implement the principle of autonomy reported in the law that is a distance with respect of what autonomy is supposed to be according to the main results of the literature of the HE field (CHEPS, 2009).

Conclusions:

These elements suggest that in the process of approval of the law the parliament accepted some requests from the outside, which recall to some extent scientific results. The transposition of the external inputs, however, has not been homogeneous. The request from outside was in favor of the maintenance of a collegial approach in a context of greater autonomy of the universities from the State. In this respect, the process of selecting the scientific knowledge more adapt to reach the intended objectives is very clear. On the other hand, the requests for greater organizational autonomy of the universities have been disregarded by the policy maker, leaving the autonomy instrumentation vague compared to the strengthening of the external control of the state on the universities through budget constraints.

Abstract 43

THE ROLE OF HIGHER EDUCATION INSTITUTIONS IN REGIONAL INNOVATION AND DEVELOPMENT STRATEGIES

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Keywords: universities, regional strategies, innovation, regional development, policy-making

1. Aim of the Proposal:

In recent years, disciplines as varied as management, economics, sociology and public policy have explored the potential and effective impact of universities in innovation and regional development. With regions increasingly reliant on knowledge assets to find creative solutions to increasingly complex societal challenges and compete globally, universities are becoming recognised as crucial players in leveraging development gaps, as local ‘anchors’ of wider economic activity, and building innovative and competitive capacity (Arbo & Benneworth, 2007; Chatterton & Goddard, 2000; European Commission, 2011; Uyarra, 2010). High expectations are placed on universities to not just contribute to socio-economic development through their teaching and research activities, but to assume a more active regional role through a third mission of engagement, as institutions (assumedly) imbued with the resources, capacity and mission to do so.

In many regions, this participation in innovative and transformative development has been translated into the expectation that universities participate in the design, implementation and possibly even the governance of regional innovation and development strategies. The most prominent example of this being Smart Specialisation Strategies and the role of universities in the entrepreneurial discovery process. Universities are thus pushed towards engaging in tasks that are new to them and they might not be equipped for. At the same time, they have to build up new complex relationships with the other stakeholders participating in those strategies – facing new partners that were not part of their former reality (Jongbloed, Enders, & Salerno, 2008). As universities are individual actors with their own sets of interests, participation in regional innovation and development strategies might not be one of their priorities. We thus want to create knowledge answering the research questions 1) Under which circumstance do universities play what kind of roles in regional innovation strategies? And 2) Which determinants have an impact on their participation in those strategies? Research on the role of universities in innovation strategies has been sparse and we, therefore, aim to develop a deeper understanding of their contributions and thereby add to the innovation, regional development, strategy and higher education literature.

2. Background:

2.1. Variance in universities’ regional roles

Given the complex nature of development challenges, it is no surprise that the roles universities are expected to play are equally varied and multifaceted in nature.

Higher education institutions (HEIs) were initially viewed for their role as knowledge-disseminators and knowledge-producers, i.e. their teaching and research missions. Their direct economic effect was first measured in their impact as employers and purchasers of services, and in their broader role in attracting population to a region, in human capital development, capital investment, research-led technological innovation and in the support of knowledge infrastructures (Drucker & Goldstein, 2007; Uyarra, 2010). More recently, with the institutionalisation of the third mission of engagement in the face of rising expectations regarding universities' potential impact, other roles have been attributed to them, namely in knowledge transfer, regional leadership and governance, institutional capacity-building, network management and brokerage (Gunasekara, 2006; Pugh, Hamilton, Jack, & Gibbons, 2016).

Denominations abound for universities and their roles in a region: they are 'anchors' of wider economic activity (Goddard et al., 2014), 'builders' of regional innovation systems (Caniëls & van den Bosch, 2011), 'enablers' or 'animateurs' of regional development (Chatterton & Goddard, 2000; Pugh et al., 2016). Nevertheless, despite the multiple titles, there is still lack of definition on what exactly these roles entail and a tendency to conflate and homogenise them across universities, contexts and timeframes (Flanagan et al., 2010; Uyarra, 2010). The roles of universities, while provided with comprehensive frameworks in the literature, still lack a more detailed examination regarding their territorial and institutional variation, and certain particularities concerning the type of engagement activity involved. Likewise, there is still an under-exploration of the nature of universities' engagement with external entities besides business and industry, and the roles they end up playing in these contexts. We suggest that the growing involvement of universities in regional innovation and development strategies is a pertinent starting point to thus explore these variances in roles played.

2.2. Universities in regional innovation and development strategies

There has been a tendency in the last decades to call upon universities to participate in regional innovation and development strategies, agendas and policies. This aligns with the general idea of bottom-up, collaborative regional governance in which various state and non-state actors contribute to regional transformation processes that lead to advanced regional development and innovation (for a current analysis of regional governance see Willi, Pütz, & Müller, 2018).

A recent and prominent example of universities' role in development and innovation strategies is the emergence of the European Union's Smart Specialisation framework, in which universities are expected to become involved in different aspects of design and implementation of these emerging strategies (European Commission, 2017; Foray et al., 2012). Goddard, Kempton, and Vallance (2013) find that universities are important players in three areas of these regional strategies: (1) they participate in entrepreneurial discovery processes (EDPs) by generating knowledge and engaging with regional partners; (2) give academic support to government officials in defining the strategies; and (3) use their international connections and knowledge in order to connect the regional to the international scale.

Having zoomed in on the expected contribution of universities in regional strategies, we can see that, again, the actual tasks and activities this role entails is underexplored. We do not get a deeper insight into the type of participation in the strategies, the expected activities that would be understood as a contribution, or the conditions under which a university can become

a vital stakeholder within a regional strategy. The fact universities are actors with their own sets of interests must be considered. Regional strategies might not be on the list of their top priorities. Thus, diverse internal as well as external factors, the capacity for joint action and the motivation for participating in the complex strategy process, have a direct impact on the level of involvement of universities in the regional strategies.

2.3. Need for expansion of roles & research question

Details on why universities take certain roles and which influencing conditions are involved remains understudied. It is assumed that these roles are played through universities' multiple activities, but literature overlooks that in different contexts, and different areas of action, universities can end up performing different roles. For instance, in the case of universities participating in regional strategies, they can play very different roles in the phases of strategy design, implementation and evaluation.

In their study on universities contributing to Smart Specialisation Strategy processes, Elena-Perez, Arregui Pabollet, & Marinelli (2017) found that the way universities contribute to the strategies depends on a diverse set of regional configurations and instruments and that different dynamics develop according to those. Thus, although "HEIs with different characteristics, geographical location, intensity in global/local orientation, research/teaching intensity, can find effective ways to contribute to RIS3" (Elena-Perez *et al.*, 2017, p. 60), their participation will be very different according to particular internal and external determinants. Similarly, Gunasekara (2006, p. 138) argues that universities' roles are often based on assumptions and that clearness on what these denominations actually mean is missing. Concomitantly, universities have to play various roles simultaneously, which can give rise to "contradictions or conflicts of policy rationales and objectives" (Uyarra, 2010, p. 1229). Thus, there is a need to understand differences in these roles, and under which circumstance which roles and activities are prioritised.

This paper aims to introduce more detail to this underexplored area by asking the research questions: 1) *Under which circumstance do universities play what kind of roles in regional innovation strategies?* And 2) *Which determinants have an impact on their participation in those strategies?* Exploration of the engagement activities of universities in regional strategies is done to develop a clearer picture of the decisive aspects of universities' contributions.

3. Methodology and Empirical Basis:

In seeking to explore the character of universities' participation in regional strategies, a social phenomenon, this study is inherently interpretative and qualitative in nature (Bryman, 2012). A comparative case-study approach was deemed the most suitable as it provides a better understanding of contextual and institutional factors through the meaningful contrast of, in this study, four case-studies. By facilitating the drawing of patterns and conclusions across cases, a comparative approach also has the potential to enable and improve theory-building (Bryman, 2012, p. 73), therefore supporting replicability and more assuredly contributing towards enhancing knowledge in the field.

3.1. Comparative framework

This comparative research draws from four case-studies of universities in different countries and regional contexts: Aalborg University (Denmark), Autonomous University of Barcelona

(Spain), University of Aveiro (Portugal), and University of Twente (The Netherlands). Despite their varied backgrounds, these cases possess broadly comparable characteristics. All are relatively young universities created in the last 50-60 years, located in what are considered peripheral regions in their respective national contexts. The Autonomous University of Barcelona (UAB) stands out given it is situated within Barcelona's metropolitan area. Nonetheless, given the high number of universities within the city of Barcelona itself, the UAB is still relatively peripheral. Its insertion in this study is justified by the necessity to include variety in the comparison. Finally, all four universities, fruit of the context and motives of their creation, not only demonstrate an interest in extended engagement activities (such as regional development strategies) with their respective regions but have also adapted their organisational models to enable this interaction. Therefore, to identify the different roles universities play when interacting with regional authorities in this arena, an analysis of key themes and variables across the four case-studies will be presented. These include territorial variables (peripheral vs core region) and university-level variables, particularly focused on the actor level at which interaction occurs, such as top-management level (rectors and heads of office) and project management level (academics and other intermediaries like technology-transfer offices). Similarly, policy timeframe variables are included, i.e., the policy phase at which interaction and cooperation occur (policy-design, implementation, evaluation).

3.2. Data collection & description

Data collection took the form of semi-structured interviews, observation and document analysis. This allowed for triangulation of data and consistency of findings. Choice of interviewees was mostly through snowball sampling and/or considered their involvement in the strategy and the relevance of their position within the university, the regional authority or other relevant organisations. The final list of interviewees consists of actors in and outside of the university, who were involved in the strategy formulation, implementation and (when possible) evaluation process. They came from strategic/management levels as well as project/executive levels (Aalborg n=30; Aveiro n=37; Catalunya n=19; Twente n=32). Interviews were recorded and lasted between 60-90 minutes. They were transcribed and translated into English when necessary (e.g. interviews in Portuguese and Spanish). Interviews in Aveiro and Twente were partly conducted jointly, while interviews in Aalborg and Catalonia were conducted by one of the two authors.

Additionally, regional strategies, action plans, cooperation agreements and university documents were analysed. Closure was reached when no new interview partners were recommended, and topics were examined from all possible perspectives.

4. Preliminary Results:

According to the data analysed thus far, it is possible to conclude that different universities not only play different roles at different stages of the regional strategy process, but they do so not only from their own institutional volition but also from pressure of the regional authority. First, those universities located in more peripheral areas (AAU, UA, UT), as the sole universities in those regions, tended to engage more directly with the regional authority. This was mostly due to the context of their creation, strongly linked to regional needs and expectations, and the consequent development of their institutional strategy in close dialectic with the region and thus the regional government. In the case of UAB, its context of creation was more political than territorially-based, meaning that such direct interaction with both

local, county and regional government was difficult to establish. The presence of several universities in the region of Catalonia, and even within the metropolitan area of Barcelona, inevitably generates competitive dynamics and hinders more consistent university-regional government interaction during the policy process. This has started changing in recent years with a greater approximation to the more local and county levels, where while still not the only university, it benefits from proximity and institutional ties.

The second point distinguishes the type and level of engagement of the universities in different stages of the policy process. Given its already close contact with the regional authority and benefitting from a privileged position as 'partner' within the strategy, UA was very active in the formulation stages, contributing in the role of 'planner': providing useful analytical and diagnostic data while simultaneously managing actor-networks and actor relationships, as well as meetings and participation forums. On the other hand, in Twente, the university was involved in the design of the regional strategy through formal participation in the Twente Board. Nevertheless, active design was not part of their responsibilities, and instead, they became active participants in many of the projects that implement the strategy. They are thus an 'implementing actor' important for the successful realisation of the strategy. Third, in all the universities studied, interactions with the regional authority for realising the strategy occurred at multiple levels: top-management and project management level, with academics and transfer offices involved. However, an interesting dichotomy emerges – that between formal and informal modes of interaction. While agreements and other more formal, punctual and political-type of interactions are managed between the top tiers and leaders of both institutions, at lower organisational levels there is a tendency for more informal contacts to be established, which give rise to more continuous forms of interaction that in the end were considered key in ensuring the unlocking of stalemates during the strategy-process, and resulted in wider and often unexpected benefits (e.g. institutional capacity-building, network expansion and pedagogy). In North Denmark, this can be seen as the rector of AAU formally participates in the official partnership of the growth forum, where the regional development strategy is designed, and funding decisions recommended and taken. Concomitantly, it was the informal networks between academics and project managers of the region and municipalities that contributed to the strategy through their exchange of experiences and knowledge.

5. Conclusion:

The findings presented are preliminary, but they point towards an increased necessity of coordinated engagement between universities as well as potential new stakeholders and regional innovation strategies in the governance process. Further analysis will seek to unveil the multiple roles each university performed within the strategy process and look into the influencing factors for potential consequences of their enaction of these roles. The literature acknowledges that the nature of universities' participation in regional innovation strategies is reliant on the place and context and is, ultimately, path-dependent. This calls for more holistic approaches. Still, broader generalisations can be made – going beyond the four case studies – in that the regional setting as well as the different stages of the strategy process pose varied challenges, constitute opportunities and call for different approaches to stakeholder engagement.

In their work on territorial strategies, Valdaliso and Wilson (2015) point out that the rapid emergence of territorial strategies in the last decades has accelerated the creation and implementation of those strategies before a conceptual and empirical understanding about

them was established. Our findings confirm this, as it seems the particular role of universities has been developed 'on the go' in our case studies – with apparent flexibility but also vagueness in terms of what a university can contribute. We believe that through our case-study analysis, we offer policy makers an insight into how universities can take on strategic roles in regional innovation strategies in diverse settings and how these can be explored depending on regional context, and thereby contribute to the conceptual and empirical understanding of universities' roles in regional innovation and development strategies.

6. Acknowledgements:

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Abstract 147

A COLLABORATIVELY-DERIVED INTERNATIONAL RESEARCH AGENDA ON LEGISLATIVE SCIENCE ADVICE

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Aim of the proposal:

Using a three-stage research approach, we asked academics, science advisers, and policymakers across the globe to identify the most pressing research questions that will improve the practice of science advice to legislatures and broaden its theoretical and empirical foundations. We identify the research questions of most interest to the producers, providers, and users of scientific information; point to issue domains of highest priority; characterize the system actors and dynamics of most interest to the community; and suggest the range of disciplines considered most adept to study them.

Background:

The quantity and complexity of scientific and technological information provided to policymakers has been on the rise for decades. Yet, little is known about how to provide science advice to legislatures, even though scientific information is widely acknowledged as valuable for decision-making within many policy domains. Last fall, we asked academics, science advisers, and policymakers worldwide to identify the most pressing research questions that, if answered, could improve the practice of providing science advice to legislatures, and broaden our theoretical and empirical understanding.

Methodology and empirical base:

The study consists of three stages: research question collection, vetting, and prioritization. We coded the questions to analyse which aspects of the legislative science advisory system were the most frequent topics. The survey data further enabled us to identify the sectoral domains of most interest (e.g., environment, public health, agriculture), a range of promising theoretical areas, and the types of relevant academic disciplines. During a workshop at the International Network for Government Science Advice (INGSA) biannual conference in Tokyo in Nov. 2018, we asked participants to help us sort the questions into a subset that we present in the paper. Finally, more than 60 of the original survey participants—approximately half from developing, and half from developed nations—ranked the knowledge that could be acquired from answering these research questions according to their level of interest in learning the information. Using Q Methodology, we assess differences between respondents in their research interests, which may be used to explore how an international research agenda for legislative science advice will need to accommodate national differences in legislative science advice systems, as well as differing perspectives between academics, science advisers, and policymakers.

Results:

The 183 respondents, representing 53 countries, generated 254 questions. From the initial 254 questions submitted by respondents, we edited and condensed them into a set of 162 that was reviewed by workshop members. They recommended a subset of 49 original questions and 11 new additions. Based on their advice, we created two final sets of research questions on legislative science advice: a condensed set of 50 presented here and a full set of 100. The condensed set of 50 denotes the most representative questions from each of the categories. They were chosen based on workshop recommendations and author assessments.

Conclusions:

Supporting the capacity of legislatures worldwide to access and use scientific information in their decision-making is critical to their ability to lead their nations through periods of massive social, technological, and environmental change. Underpinning the outputs of this study are two main findings. First, experts generally agree that the state of understanding of legislative science advice is poor, especially for developing and lower-middle income nations. Second, many fundamental questions about the function and design of legislative science advisory systems remain unanswered. Fundamental questions, such as how legislators and their staff assess the credibility of scientific information, were among the most highly prioritized by experts.

E1 TRANSFORMATIVE INNOVATION POLICY 2

Thursday 06 June 2019 from 16:30 to 18:00

WOLFGANG POLT, Chair

Abstract 149

TRANSFORMATIVE INNOVATION POLICY: TOWARDS A RESEARCH AGENDA THAT RESPONDS TO POLICY NEEDS

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Aim:

With this paper, we aim to synthesise the insights gained from a series of conferences and workshops over the past year, starting with the EU-SPRI 2018 conference in Paris, about the emerging research agenda on transformative innovation policy.

Background:

The issue of transformative R&I policy has emerged on both the academic and policy agenda over the past few years. While this is not an entirely new issue, but one that has been addressed by the sustainability transition management community (Rotmans et al. 2001) as well as by the OECD in its work on system innovation (OECD 2015), it only gained significant momentum with the launch of the EU's Horizon 2020 programme for research and innovation in 2014. In parallel, countries in Europe and beyond have started to re-orient their policies for research and innovation, with the intention to go beyond established policy goals such as the strengthening of growth, competitiveness and employment, and better contribute to other higher-order political goals such as those reflected in the UN's Societal Development Goals. Overall, this normative or strategic shift can be regarded as one major dimension in the move towards next-generation R&I policies (Daimer et al. 2012; Weber and Rohrer 2012).

These new requirements, dealing with what R&I are actually expected to contribute to the advancement of our societies, emerge in parallel with significant changes in the conduct of research and innovation. These changes are enabled by the accelerating and disruptive power of digitisation and virtualization, and they are characterized by integration of a wider range of knowledge sources, by an opening up of innovation activities to a broader range of actors, by new types of digital coordination mechanisms (e.g. digital platforms), and by an intensification of internationalisation of R&I activities.

However, this ambitious programmatic shift has not yet been paralleled by similar advances when it comes to the actual governance of transformative change, and in particular the role of R&I policy. The future role of the State at its various levels needs to be reconsidered, and intervention capabilities revisited in the context of open democratic societies offering new opportunities for political participation.

Approach, methodology, empirical basis:

Starting with the syntheses by the authors of the EU-SPRI 2018 Conference Track on 'Societal Challenges and Implications for STI Policy', and refined in further presentations and

discussions at subsequent conferences and workshops in Vienna, Hannover and Utrecht, the contours of a research agenda on Transformative Innovation Policy (TIP) are emerging.

This paper brings together the findings from these various for a, as input for further debate at EU-SPRI 2019. Given the policy orientation of EU-SPRI, particular emphasis is put on research needs to inform and underpin the role of the state in its various forms in co-shaping transformative change together with other actors and stakeholders.

Results:

The new policy-oriented research agenda on TIP needs to address a whole range of issues, from fundamental questions about the types of transformations addressed to the specific design, implementation and learning processes associated to policy interventions in transformations.

1. The nature transformative innovation: towards a broader and more differentiated perspective

In recent years, the focus of R&I policy has shifted towards matters of transformative change needed to address major societal challenges, many of which are global in nature, but often require local solutions. There is yet another, sometimes inter-related, development going on that must not be ignored: In parallel to the demand-driven need for change there are other supply-driven forces pushed by 'disruptive' innovations, of which those associated to digitisation are the most prominent ones. They give rise to very fast transformative change processes, by introducing new platform-based market places and thus making existing business models obsolete, often with major economic and social repercussions, for instance in terms of work and employment. Of course, innovation efforts for addressing societal challenges also draw on disruptive innovations, but the key issue with disruptive innovations is that they tend to outpace the ability of the public authorities to frame and guide the associated change processes in a timely fashion. And the next disruptive developments are already emerging, in particular in relation to artificial intelligence and synthetic biology.

A future research agenda therefore needs to systematise the different types of change we can observe, together with the main types of demand-side and supply-side forces underpinning their transformative power.

2. The dynamics of transformative change: Understanding the generalization of innovations

Next to the overarching patterns of transformative innovation, it is essential to better understand the processes and mechanisms that drive, constrain and thus determine transformative change. In order to describe these dynamics in a meaningful way, we have a limited number of conceptual frameworks at hand, including co-evolutionary, multi-level or (complex) systemic models. It is on top of these basic models of transformation that more specific theoretical and empirical insights into transformative dynamics need to be interpreted. While a lot of research work has been done over the past years on how alternative niches, socio-technical experiments and other kinds of alternative practices can be

piloted, the major deficit still resides in a better understanding of how innovations with a transformative potential can be generalised, while at the same time prevailing systems, often showing strong path-dependencies of various kind, be reconfigured and – if needed – replaced ('exnovation', Dreher et al. 2018).

In the words of the multi-level perspective on transitions, this is about the movement from niches to regimes and the socio-political and institutional framing (including the reframing of existing markets) that is required in order to enable transformative change to happen.

The notion of 'generalisation' has been suggested to describe how the results of new experiments get out of their initial niches and are taken-up in multiple settings, up to the point of becoming the dominant solution. Generalisation encompasses elements of diffusion, scaling and adaptation of the experimental solutions to new environments.

3. Deeper and faster insights: from empirical observation to embedded research

A complex and co-evolutionary systems perspective offers a broad framework to guide the empirical investigation of transformative change. A lot of empirical work has pointed to the importance urgency on the one hand and new emerging opportunities on the other hand.

Guiding visions can provide orientation in change processes and enable 'soft' coordination among actors and stakeholders. Experimental settings allow for learning and adaptation of innovations as well as of social practices, organizational contexts, institutional, regulatory and political conditions. Individual and organizational capabilities are crucial for enabling the agency needed to lead and manage change.

These bottom-up processes are complemented by top-down elements, but their interplay (in time) is far from understood. For instance, infrastructures can be important guideposts for orientating research and innovation activities, but also for guiding investment into new solutions.

This empirical and action-oriented part of a future research agenda also needs to take account of the context-specificity of transformative innovation. Thematic, spatial and cultural conditions matter for the relative importance of various of the aforementioned levers of change. Transformative change also needs to overcome barriers and path-dependencies, implying that there will be winners as well as losers of transformative change.

In thematic terms, it is interesting to look at those spaces where transformative dynamics are particularly fast and wide-ranging. Urban areas are the powerhouses of change, where many forces of change interact, both on the demand and the supply side. A second important space to explore is virtual space, which transcends traditional geographical boundaries.

It is important to better understand the facets of these empirical phenomena and improve our empirical knowledge of transformative change, but at the same time, we constantly face new change processes, implying a need to give more prominence to 'real-time' and 'embedded' research practices, for instance in relation to newly emerging disruptive innovations or unexpected social changes.

4. The design and implementation of transformative innovation policies

Existing research and innovation policy falls short of the ambition to trigger transformative change. In fact, a revision of the entire policy cycle - new types of rationales; new demand- and supply-side instruments; programmatic and operational policy coordination; impact assessment, monitoring and evaluation approaches; more inclusive and participatory governance approach - are needed in order to move truly to transformative innovation policy. First of all, this revision of the policy cycle brings with it a more proactive understanding of the role of the state in innovation, in line with the higher ambitions pursued, while at the same time accepting the limited capabilities of the state in governing complex processes of transformative change. The key research issue in this regards is about finding the right balance between ambition and limitations of political governance.

Building on this new understanding of the role of the state need to follow several specific changes to governance and to the policy cycle, which so far are only poorly understood. New rationales for policy intervention need to be devised, which take sectoral policy concerns as much into account as those of R&I policy. Priority-setting needs to take societal challenges (and thus often sectoral policy goals) into account, but it equally needs to provide fertile and at the same time 'framed' ground for newly emerging technologies with a disruptive potential. The interplay of various policy instruments, including supply side as well as demand-side instruments, needs to be improved and requires policy coordination at strategic and operational levels. Experimentation is needed in order to better understand the complex interplay of these different instruments, and in particular to adapt them to specific local circumstances and conditions. And individual instruments, such as funding programmes, need to be based on entirely new design principles in order to enable a variety of possible approaches to be explored, thus striking a new balance between top-down planning and bottom-up exploration.

5. Making transformative innovation policy future-oriented and evidence-based

Of particular relevance to the STI policy research community is the final deficit, which is that current research on transformative innovation policy relies i) predominantly on a retrospective take and ii) on monitoring data, which rely on statistical categories that are not compatible with the exigencies of societal challenges and emerging disruptive technologies. If, however, longer-term societal challenges and emerging disruptive innovations are going to be main drivers behind future transformation, then it will become imperative for innovation policy to abandon a philosophy of 'remedying deficits' and replace it by a future-oriented approach of anticipating emerging challenges and opportunities and prepare for and shape in a timely fashion the future to come. And this future-oriented approach will need to be underpinned by corresponding (big) data structures and real-time monitoring.

Moreover, the long-term and high ambitions of transformative innovation policy equally require new approaches and methods of (ex ante) impact assessment and (ex post) evaluation in order to anticipate and trace impacts.

The final version of this paper will elaborate and specify research needs along the lines of these five dimensions, building on an assessment of the current state of the art.

Conclusions:

A research agenda on transformative innovation policy requires work along five main dimensions: i) definition and differentiation of transformations, ii) conceptual and theoretical fundamentals, iii) a new generation of empirical research that takes the far-reaching systemic nature of transformative innovation into account, iv) correspondingly, a revision of governance structures, processes and instrument along the entire policy cycle, and v) new concepts and tools for strategic policy intelligence.

A shift towards transformative innovation policy also entails a new understanding of the role of the state, which becomes more ambitious in terms of guiding and triggering transformative pathways, while at the same time recognizing the limited influence of the state as compared to that of other actors. 'Tentative' forms of governance, relying on design thinking and experimentation, need to be developed and tested (Kuhlmann et al. 2019). This development needs to be paralleled by an upgrading of the organizational capabilities of the state.

In order to support and accompany transformative innovation policy, new types of strategic intelligence need to be developed in order to anticipate and justify needs for policy action, and to assess, monitor and evaluate strategies, organisations and instruments.

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ADVANCING EXPERIMENTAL POLICY ENGAGEMENTS AS PART OF TRANSFORMATIVE INNOVATION POLICY

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1. Aim and background:

Contemporary societies are facing multiple interconnected challenges related to sustainability. Addressing these challenges, as captured by UN Sustainable Development Goals and the Paris Agreement, places new demands on innovation policy, as evident in the emerging framing of innovation policy for transformative change (Frame 3) and discussions about mission- and challenge-oriented innovation policy. In this context, the Transformative Innovation Policy Consortium (TIPC) undertakes a 5-year programme to advance policy practice, training, evaluation and research aligned with the emerging framing of innovation policy for transformative change (Frame 3)ⁱ. Transformative innovation policy is an explorative concept for which TIPC stands as a platform connecting researchers and policy-makers internationally in a process of mutual learning and experimentation.

To conceptualise transformations, TIPC draws from the sustainability transitions field. Being transformative means that socio-technical systems developed to deliver societal services (e.g. heat, power, mobility, food, water and healthcare) need path-breaking change to become more sustainable. This implies not only economic sustainability but also environmental and social sustainability, involving changes in technology and infrastructure, practices and routines, professions, organisations, and policies and institutions.

Although it is still rather unclear how to design, implement and evaluate transformative innovation policies, Schot and Steinmueller suggest that experimentation takes a central role.ⁱⁱ This is also supported by the role described for experiments in the sustainability transitions and climate governance literatures. The promise of experimentation for transformative innovation policy relates to three observations.

First, transformations are long and complex, open-ended processes involving multiple stakeholders, and where visions, expectations and problem-framings ought to be reassessed on an ongoing basis and reviewed under the light of new evidence, novel technologies and practicesⁱⁱⁱ. These processes demand reflexivity: stakeholders discovering ways of working and being, and exploring new values and routines questioning their existing ones (deep learning). Such reflexivity arises from practical experiences that can benefit from an experimental approach.

Second, transformations have a necessarily normative character, forcing questions of what the transformation should be for, and who should carry them out.^{iv} Technology and policy interventions are not neutral. On the contrary they favour or disfavour specific interests, beliefs and values, and questions need to be asked about transformation for whom? Spaces need to be created to play up and play out the politics of transformation. Experimentation is vital in facilitating the design, appraisal and the enactment of different alternatives and provide forms of tentative governance and deliberation about the desirability of particular pathways.^v

Third, experimentation can be a way for creating alignment between multiple socio-technical dimensions that are required for system innovation. Discourses, consumer practices, business models and policies all co-evolve alongside with technology.^{vi} Experiments can be seen as tools for building niches which are an important source for socio-technical change. In other words experiments are a means for opening up new socio-technical developments, challenging existing ones and setting collective priorities towards acceptable transformation pathways.^{vii} Experimentation has many uses and rationales. To explore the uses and approaches to experimentation that are relevant in the context of transformative innovation policy, TIPC proposes to use the term *Experimental Policy Engagements (EPEs)*. This is to stress that individual projects, programmes and even policies can be seen as engagements with a wider ongoing transformation process of which they are part. Yet they can also be delineated. (EPEs) are defined as:

The diverse ways in which policymakers engage with processes of societal experimentation for sustainable transformation: initiating, supporting or mobilising, and evaluating such initiatives for informing decision-making, enabling processes of social learning, developing alternative pathways and enacting desirable futures.

Understanding current efforts to engage in transformative innovation policy, and assessing whether they are effectual in promoting transformations is a central challenge. We aim to identify features in these EPEs that may be indicative of more transformative approaches. We draw on the sustainability transitions literature to identify what ‘transformative elements’ could be used to tease out the potential of ongoing EPEs and to design more transformative ones. Before outlining the transformative elements, we draw examples from ongoing experimental policy engagements carried out by TIPC member countries (Colombia, Finland, Norway, Mexico, South Africa and Sweden) to show that, currently, transformative EPEs seem rare. The early impressions from the member countries are based on one interview per member organisation, a half day workshop in the TIPC engagement week in September 2018, and additional ongoing bilateral interactions. We then create a list of transformative elements to be considered in revising existing EPEs or designing new ones posing relevant questions or issues for consideration.

2. Innovation policy EPEs in TIPC member countries

Our tentative insights from working with the TIPC member organisations (Research Council of Norway, Business Finland, Conacyt, Colciencias, Vinnova, and NRF) indicate that experimentation linked to innovation policy is not limited to those organisations taking part of TIPC. For example, in Finland, these activities include those conducted by the Prime Minister’s Office experimentation team. In Colombia, the policy innovation labs coordinated by the National Planning Department is another example. Overall, urban living labs are proliferating^{viii}, while there is also an increasing interest in policy labs in many of the member countries. Thus, the experiences of TIPC member organisations are not a depiction of the situation of each country but provide tentative indications of what is happening at innovation

agencies and what are the potential stumbling blocks or barriers to introducing a transformative, experimental innovation policy.

While all TIPC member organisations are focused on science, technology and innovation, they have differing mandates and organisational formats: government departments/ministries (SA, CO), research and/or innovation funding agencies (FI, NO, SE) and a council in charge of innovation policy (MX). Creating EPEs within the operational area of one organisation can be difficult in the sense of transformative change, and collaboration across government actors is needed. The most typical existing examples of potentially transformative EPEs within the TIPC member organisations are challenge-related research funding programmes that address social or environmental sustainability. The need to reach to other actors is often recognised, and some cross-domain initiatives, e.g. policy labs, exist.

The examples of EPEs provided by the interviewees were often mentioned to exist in the margins of the activities of the member organisations, while, as an exception, in VINNOVA (SE) they are getting more prominence. Support for living labs (SA), challenge-related and less output specific R&D and innovation calls (MX, CO), policy labs (SE) and innovation vouchers (FI) were mentioned as examples. Simultaneously, however, the challenge-related calls were reported to be somewhat negatively influenced by rules and bureaucracy regarding how innovation funding are conventionally organised (CO). Yet, some cultural changes towards experimentation were observed through a new generation of policymakers (CO), an increased focus on responsible research and innovation (NO) and government support given to an experimental culture across policy domains (FI). These examples provided, however, illustrate transformation to a limited degree, which is why new EPEs more explicitly embracing transformation are needed.

3. Transformative elements:

The set of transformative elements we propose draws from the sustainability transitions literature, particularly the literatures on Strategic Niche Management (SNM) and the Multi-Level Perspective (MLP). They, however, broaden out from the core issues arising from transitions research – directionality, societal goals, system-level impact, learning and reflexivity – to issues of conflict vs. consensus and inclusiveness that have only recently emerged in the debates on transitions. The MLP and SNM literatures indicate that a transformation of sociotechnical systems towards improved sustainability is a result of an *interplay between three processes*:

1. Successful niche building;
2. Niche acceleration and embedding (eventually turning a niche into a new socio-technical regime/system); and
3. Opening up of socio-technical regimes/systems, and unlocking path dependencies (responding to internal regime tensions and changing perceptions of landscape pressures)

The transformative elements, which are connected to each of the three processes, are not fixed solutions but rather can be used to draw attention to a set of questions and dilemmas to be addressed when designing and implementing EPEs in practice. They can be used for designing EPEs as well as evaluating them (in a formative manner). Table 2 outlines our proposition for transformative elements, connected to the three processes, and the questions

that should be asked in designing new or further developing ongoing EPEs, as well as some of the dilemmas involved. This list of elements is grounded in literature and presented in more detail in a paper that is work in progress.

Table 2: Transformative elements, questions for deliberation and dilemmas

Transformative elements	Example questions for EPEs	Related dilemmas
<i>Niche construction</i>		
1 Visions, expectations and directionality	Does the EPE include objectives for environmental or societal sustainability or does it address a specific transformation challenge? How does the EPE represent a change of orientation to current practices? How is the process for new vision creation enabled? How are different expectations accounted for and addressed? Is support available for multiple pathways addressing the challenge? What is the level at which directionality comes to play in: overall strategic level, or programme or project level implementation? How is directionality supported beyond the lifetime of the EPE?	Transformation implies a sense of direction, while this presents a lot of uncertainty regarding what eventually will be sustainable solutions in the long-term. Thus, the direction is not fixed and need to be amended along the way. Especially at niche construction phase, multiple pathways should be explored.
2 Learning – generating broad and deep learning to change routines	Are there explicit objectives for learning? How is deep learning encouraged? What support structures are created to enable crossing administrative barriers or reduce sense of risk to individual? How is risk of failure addressed? How is learning distributed or transferred and evaluated? Who benefits and who suffers from the learning generated?	Learning in multiple ways is crucial for transformation. Problems are created if learning remains within individuals or small groups, or if learning does not result in any change. Further, it can be difficult to detect whether more subtle and non-codified learning has taken place.
3 Networking – creating new kinds of actor network configurations	What range of different actors are included and supported? What does the new network aim at (e.g. new niche creation, niche acceleration or embedding in existing regime, unlocking path dependencies)? What is the degree to which incumbent actors vs. newcomers are involved in the EPE? How are new kinds of actors found and mobilised? How to involve incumbent actors but not let old views dominate? In case of business networks, how is balance created between small and larger companies? Who is coordinating the network, acting as an intermediary?	Transformation requires novel actors with novel ideas but they need to interact with incumbent actors to enable the diffusion of ideas of change to existing regimes. However, too many or strong incumbent actors can halt the process. The balance requires careful and continuous deliberation. Also, as networking is not the purpose but the means to seek transformation, the purpose of the EPEs defines in part useful forms of networking.
4 Broadening and deepening networks - creating an inclusive process	How different actors are included in the process or kept aware of the process (transparency)? To what extent the people included represent the needs of the EPE target group? How are more marginal 'voices' or groups taken into account? How are resistance and objections addressed? How is the transparency of the process guaranteed? How are the costs and benefits of the EPE distributed between different individuals, actors groups and the public and private sectors?	Inclusiveness in some form is important to widen the support for the EPE. However, to engage a large group of people to process may slow down the process and also let more traditional previews prevail (if knowledge of possible futures is weak). Just transitions also require a fair distribution of costs and benefits, while the opinions regarding what is 'fair' is likely to differ.
<i>Accelerating and embedding niche innovations</i>		
5 Upscaling	How does the EPE contribute to upscaling a niche, and which niche(s)? Is there a strategy or purpose to upscale	Upscaling is a very instrumental and often technology-focused way to

	experiments during or after the EPE? What are the benefits and drawbacks of the upscaling approach? What barriers and opportunities are present?	think about embedding, and it may not be well suited for all types of niches and experiments.
6 Replication	How can the EPE enable the replication and learning from experiments/projects/niches? What support structures are in place to advance replication and context specific adjustments for doing the same experiments elsewhere?	Replication can be a very good way to accelerate niches, but it is not always straightforward as context specific adjustments, i.e. 'translation', and learning are required.
7 Circulation	How can the EPE support the flow and circulation of knowledge and ideas, as well as resources, within the EPE? What support is available to enable circulation after the EPE has ended?	Circulation has the advantage of taking into account real world 'messiness' but as it is so fluid it can be difficult to concretely advance.
8 Institutionalisation	Are there processes in place to identify what are the ways in which an experiment/niche alternatives can become more permanent/mainstream? What are the mechanisms planned for institutionalising learning into rules and practices; and policy outputs into formal governance structures? Is the EPE proposing a more experimental actor-network configuration on a permanent basis?	The ideal time for institutionalisation is difficult to set. Too early institutionalisation may lead to ineffective outcome, if the experiment has led to non-desired effects. Further, vested interests may try to institutionalise experiments prematurely for economic/political gains – or prevent institutionalisation if experimentation is used as avoidance strategy.
<i>Opening up regimes and unlocking path dependencies</i>		
9 Systemicity – acknowledging multiple system dimensions & going beyond technological change	How does the EPE focus on change in multiple system elements (technology, infrastructure, industry structure, markets and business models, regulations and policy, practices, policies and norms, culture)? How does it aim to unlock path dependencies? How are tensions identified and addressed?	In transformation, changing the multiple system elements is important. However, it may be difficult for one EPE cover these all, and thus an EPE may, e.g., focus on practices and culture. What is important is to go beyond frame 1-2 technology and infrastructure focus.
10 Identifying tensions in regime rules	How does the EPE stimulate regime actors to identify tensions between various regime dimensions, e.g., between market demand and technologies on offer, or between regulatory requirements and demand? Do they identify anomalies clearly? Do they re-assess the potential of applying regime rules for solving problems?	Regime actors need to decide whether they optimise their current portfolio or depart from it in a more radical way.
11 Unlearning	Do regime actors begin to question their own assumptions, cognitive beliefs and values?	Unlearning often brings huge costs and requires new organisational structures.
12 New forms of alignment with niche actors	Do regime actors build new alignments and networks with niche actors and perhaps also with new actors who favour specific transformations?	New forms of alignment brings questions about a just distribution of costs and benefits.
13 Changing perceptions of landscaper pressures	Do regime actors begin to re-assess the importance and requirements of landscape developments (trends and shocks)? For example do they re-assess how growing inequality and climate change will influence their activities?	Re-assessing landscape developments brings questions about whether to promote and socialise certain views and lobby for them.

4. Conclusions:

It is clear that policymaking culture changes slowly, and there is variation between civil servants regarding how open-minded or risk averse they are vis-à-vis EPEs in general and transformative EPEs in particular. Often, the existing regulatory and institutional structure still

favours traditional RDI funding formats. This links to transformation in two ways: 1) the need to expose tensions and transform innovation policy from within (EPEs addressing the structures, processes and programmes within the innovation departments and agencies) and 2) the need to realign innovation policy with other policy domains and actors to more explicitly contribute to transforming socio-technical systems (EPEs carried out in collaboration with others and seeking connections beyond STI policy mixes)

The work on EPEs in the context of transformative innovation policy is in its early stages, and will benefit from a dialogue within the innovation and transition studies communities as well as from a continued co-creation work with policy makers.

Key words: innovation policy, experiments, transformation

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TRANSFORMATIVE INNOVATION POLICY IN THE NORDIC COUNTRIES: BETWEEN NORMATIVE THEORY AND REALITY

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Aim of the proposal:

Following from the calls for a more problem-oriented innovation policy, several countries have recently designed new STI programs. The literature on transformative innovation policy offers a range of conceptual approaches, but remains scarce on empirical analysis. This paper compares four cases of problem-oriented STI programs in four Nordic countries. Reverting to organization theories of institutional change and coordination, the paper compares the diversity of the programs in relation to their features and their organizational embeddedness in national contexts. The findings show a considerable degree of path dependency in the design of the programs according to the characteristics of national STI policies (the features of the programs), and a series of unresolved issues regarding organizational coordination (the embeddedness of the programs) particularly about the facilitation of scale up and exploitation of new knowledge for transformative outcomes/impact (beyond project deliverables/short-term outputs). These two findings serve for a further development of a normative theory of transformative STI policy that is more interested in organizational dynamics, alongside the current focus on end-goals.

Background:

During the past few years a new normative approach to STI policy has been gaining ground in some countries. The new approach is more mission-oriented than previously, and aims at addressing two interlinked issues, namely, the transformation of specific socio-technical systems, and a set of broad goals towards sustainable social, economic and environmental development. The move towards transformative innovation policy has profound implications for the design and implementation of programs and instruments, the tools and frameworks for conducting evaluations (analyses of impacts and promotion of policy learning in a broader sense), for issues of governance (here including issues of managing diverging and sometimes opposed policy goals), as well as different forms of interaction and collaboration among a wider set of stakeholders and agents of transformative change in the society and economy. However, while this normative approach to STI policy is gaining momentum among policy-makers, think tanks, academics, and other general discussion fora, two important issues remain largely unexplored. Firstly, there is a lack of empirical studies about how far the 'transformative turn' is actually happening, and in particular what specific features characterize the new transformative programs/ policy instruments that some countries are putting in place. This is important in view of determining the way in which some abstract normative principles have been actually translated into the real formulation of policy instruments.

Secondly, there seems to be a lack of attention to some crucial organisational aspects of transformative innovation policy. The normative approach of transformative innovation

policy suggests that science, technology and innovation are key aspects in processes of transformation towards social, economic and environmental sustainable solutions. However, the literature has so far focused mainly on normative issues about goal-formulation and end-goals, disregarding somehow the organisational dimension about how those transformations are going to be put in place. For that reason, an empirical examination of transformative innovation policy programs requires not only an examination of their features, but also about their organisational embeddedness in relation to their policy and socio-technical context.

The current paper aims at addressing both gaps in the literature. In so doing it addresses the following two research questions. Firstly, how is the transformative turn being 'translated' into the design and formulation of concrete STI funding programs (policy instruments), and what characterises those new funding programs? Secondly, how embedded are these funding programs in their organisational context in view that they aim at bringing systemic transformation?

In order to address those two questions we rely on two separate, yet interlinked, literatures. The first one is the literature of the normative approach of transformative innovation policy. This literature shows some variation about the conceptualization of transformative innovation, which is important to review. The review will serve the current paper to identify shortcomings and to develop further a set of specific analytical tools that will allow an examination of the features of the innovation policy programs in question. The second literature refers to the organisational issues in this paper. Here we will use the literature of institutional change to the extent to which there is some degree of path dependency in the new policy programs, or how novel they really are. Likewise, we will use theories of organisational coordination in order to examine the question about organisational embeddedness.

Empirically this paper compares 4 cases of funding programs in the innovation policy of four Nordic countries, Sweden, Denmark, Norway, Finland. These programs are highly relevant, as they have introduced important aspects of the normative approach of transformative innovation policy.

The paper proceeds as follows. Next section reviews the literature of transformative innovation policy in order to bring forward the findings of the few empirical studies currently available, as well as reviewing the variation within that approach regarding some normative aspects (Weber and Rohrer, 2012) (Foray, et al., 2012) (Weber and Truffer, 2017) (Palmberg and Schwaag-Serger, 2017) (Schot and Steinmueller, 2018) (Lundin and Schwaag-Serger, 2018) (Kuhlmann and Rip, 2018) (Borrás and Edquist, 2019) (Robinson and Mazzucato, 2019). Thereafter, this section will consider issues of organisational analysis in terms of two interrelated aspects, one is about the institutional logic of change and path dependency in policy dynamics, and the other one is about organisational embeddedness. The section after that will specify the theoretical framework to be used in the empirical analysis of this paper. More concretely, the paper will identify and conceptualise 6 key concepts of transformative innovation policy programs: their directionality, their epistemic boundary spanning, their cross-sectoral reach, their stakeholder involvement, their time span, and their geographical span according to the analytical criteria defined earlier in the paper. Section 4 will discuss the data and methods used in the analysis, and it will justify the research design in terms of the choice of four Nordic countries, as well as the choice of the specific programs under study. Section 5 will be devoted to the analysis of each of the four programs: the "Grand Solutions" programme (Denmark), the "Flagship programme" (Finland), the "Pilot E" programme (Norway), and the "Challenge-driven innovation" programme from Vinnova (Sweden). Section

6 will summarise, compare and discuss the findings. The final section, will conclude by answering the two research questions, and by suggesting some steps regarding a further development of the normative theory of transformative innovation policy that goes beyond the current focus on end-goals. More specifically, it will develop this theory so that it allows for further empirical analyses about the instrumentation and policy implementation, and most importantly of all, so that it brings forward the organisational dynamics of innovation policy, providing concrete clues about how to study these policy programs' role in transformative change.

In order to address our first research question (about how 'transformative' the funding programs have been designed) we will use a set of analytical criteria to characterise their features. Hence, transformative programs would have the following features:

- a) **DIRECTIONALITY:** refers to contextualising the production of new knowledge and technology into a problem- solving context. Therefore we will examine how directional (mission-oriented, targeted, demand-driven, problem-identification, goal-oriented) are the programs? This refers not only to top-down mission identification, but also bottom-up 'open-ended' problem identification by the applicants and their stakeholders.
- b) **EPISTEMIC BOUNDARY SPANNING:** 'Transformative' and problem-challenge oriented STI policy requires the pooling of different knowledge bases and epistemic communities, in particular, closer collaboration between the 'hard' and social sciences and humanities. It also requires facilitating the convergence of existing/new technologies into new approaches. How far the programs are providing the basis for epistemic boundary spanning? This will be identified by looking at the inter-disciplinarity and multi-disciplinarity of the funding programs.
- c) **CROSS-SECTORAL REACH:** how far are the programs facilitating the collaboration between different industrial sectors, different capabilities with complementary assets?
- d) **STAKEHOLDER INVOLVEMENT:** How far are the programs facilitating the engagement and involvement of diverse stakeholders (university, industry, philanthropies, NGOs, public organizations, regulators, etc) on the supply and on the demand side?
- e) **TIME SPAN:** 'Transformative' change takes time... How are the programs focusing on the medium- to long-term aspects of transformation? How is the short-term interests of some stakeholders (policy-makers, industry) addressed in view of long-term goals of transformation?
- f) **GEOGRAPHICAL SPAN:** Transformation is multi-level: how far are the programs introducing multi-level approaches in terms of diverse agents of change operating at different levels (multinational firms, municipalities, EU, etc) and in terms of the alignment with broader trans-national goals f.ex. UN's SDGs, or EU's smart, sustainable, inclusive growth?

The second research question aims at studying the organizational embeddedness of the programs. Here we look at how far the funding programs envisage coordination in order to facilitate the scale up and the exploitation of the new knowledge in view of achieving transformative outcomes/impact (beyond focusing on just merely project deliverables/short-term outputs). In particular the analysis will focus on three dimensions of organisational embeddedness. The first dimension has to do with the embeddedness of the programs in relation to other innovation policy outputs, meaning the extent to which the programs is designed in a way that individually funded projects are put together thematically in view of creating synergetic efforts. The second dimension has to do with the embeddedness of the

programs in the corresponding socio-technical system, looking specifically at the focus of the programs in terms of their focus on issues of knowledge diffusion and scale-up of solutions. The third dimension of organisational embeddedness of the programs has to do with the governance aspect; in particular we will examine the extent to which the programs are somehow linked to some important organisational aspects related to innovation in the context of the activities of the public sector, like for example policy laboratories, or issues of regulation and policy learning.

Methodology and empirical base:

This paper compares four innovation policy programs, one program in each of four Nordic countries. The reason for choosing the Nordic countries is that they share some important similarities like their size, levels of economic development, levels of quality, high trust societies, innovation leaders and technologically advanced economies and societies. However, they also share some challenges in terms of digital transformation, provision of healthcare in an ageing society, governance, limited productivity growth, etc. those similarities render the choice of those 4 countries a good starting point, as those structural dimensions do not vary too much (somehow remaining constant), which facilitates our analysis.

The programs under analysis are: the “Grand Solutions” program (Denmark), the “Flagship” program (Finland), the “Pilot E” program (Norway), and the “Challenge-driven innovation” program from Vinnova (Sweden). The criteria for selecting those specific programs is that they are all new (approximately or less than five years old), and they are all somehow flagship programs because they are highly visible in political terms and also very significant in terms of possible change of tendency. The programs are not very large in terms of budgetary resources; however they are highly relevant because they are designed in a different way than other programs. All of the four programs are funding research and innovation activities to specific applicants, who submit concrete collaborative projects for funding. For these reasons, the four projects are somehow representative of how each of those four countries have designed specific policy programs following the transformative innovation policy approach. The data used in the analyses is based on a collection of specific documents (annual reports, evaluation reports, and other various official documents), a number of observations in meetings and other gatherings and interactions related to the programs, and a series of interviews with prominent policymakers and civil servants designing and implementing those programs. The data collected has been triangulated by critically examining the degree of consistency of the different sources on each of the cases. Likewise, a final round of validation has been conducted with experts in the innovation policies of the four countries, as well as with national stakeholders that have been directly involved in the use and implementation of each of the programs.

Results:

(These are provisional results)

The findings about the features of the programs show that:

- Mixed forms and degrees of directionality: Some programs are top-down, some bottom-up; and they have as well different levels of directionality.
- Epistemic boundary spanning: Relatively limited in all the 4 programs

- Cross-sectoral reach: Mostly encouraged in the 4 programs, but not conditional to funding
- Stakeholder involvement: still most supply-side of stakeholders involvement.
- Time span: limited in 3 of the 4 programs. Vinnova's program has a longer time span than the others.

- Geographical span: Clear focus on national level in all 4 programs.

Findings about the organisational embeddedness of the programs:

- The embeddedness in other STI solutions is limited: the focus is mainly on individual projects, as mechanisms for transformation; in few cases the program is embedded in a portfolio of other projects or initiatives seeking synergy (the Swedish program)
- The embeddedness in social technical systems is limited: the main focus of the programs is on experimenting and testing, not on scaling up or diffusion; likewise the focus of the programs are mainly on project specific outputs, not on the potential outcomes and their ability to induce systemic change.
- The embeddedness in terms of governance dimension is also limited: the programs have very few links to initiatives of relevance like policy labs, innovative regulation, policy learning, or innovation in the public sector in a wider context.

Sweden's Challenge-driven Innovation Program

- DIRECTIONALITY
 - Strong bottom-up directionality (emphasis on identifying a need and potential impact)
 - Strong link to Agenda 2030
- EPISTEMIC BOUNDARY SPANNING
 - Strong emphasis on multidisciplinary but not specifically linking hard and soft sciences
- CROSS-SECTORAL REACH
 - Strong emphasis on cross-sectoral reach and system approach (what does it take to develop a working solution?)
- STAKEHOLDER INVOLVEMENT
 - Strong focus on demand side through emphasis on needs and problem owners (eg municipalities); Portfolio thinking (program embedded in a larger approach to tackling societal challenges); various linked initiatives (innovation platforms, innovation in public sector, innovation management etc)
- TIME SPAN
 - stage gate approach creates more long-term thinking?
- GEOGRAPHICAL SPAN
 - international perspective is emphasized; strong involvement by municipalities

Conclusions:

Our empirical analysis shows that the four programs have a considerable degree of path dependency as several of their features are still not truly aligned with the core notions of transformative innovation policy approach, according to our conceptual framework. Likewise, we have found that there are a number of unresolved issues regarding the organisational embeddedness of the programs, particularly about the facilitation of skill up and the exportation of new knowledge for transformative outcomes and impact. Most of the programs are still focusing on project deliverables and their outputs, and has not envisaged truly important aspects in the three dimensions of organisational embeddedness that we have identified (embeddedness with other STI solutions, embeddedness in social

technical systems, and embeddedness in governance frameworks).

These limited findings show not only the challenges of designing transformative innovation policy programs in terms of the features that characterise them, and in terms of their organisational embeddedness to provide for truly transformation beyond the strict funding of projects.

From the above it also follows that we need a further development of the normative theory of transformative innovation policy that goes beyond the current focus on end-goals, and is interested in empirical analysis about instrumentation and implementation, and brings forward the organisational dynamics of innovation policy in order to promote truly transformative change.

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E2 GOVERNANCE 2

Thursday 06 June 2019 from 16:30 to 18:00

MARTA ZDRAVKOVIC, Chair

Abstract 6

ROBUST ACTION IN SCIENCE

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This paper introduces the concept of ‘robust action’, as proposed by Padgett and Ansell in their study of Cosimo de Medici, as a suitable framework for revealing whether and how scientists strategize to change scientific disciplines with the goal of advancing in their careers, as well as for disclosing the conditions under which they turn the control over resources into structural changes in scientific communities. When using robust action as a strategy, the goal is to preserve flexibility while achieving short-term objectives that will enable long-term gains. These strategies lead to complex, hard to categorize moves, with the purpose of spanning structural holes and gaining power. Robust action would be therefore a suitable strategy when facing unpredictable and competitive environments like in science. In the paper, we unpack the concept of robust action according to three main dimensions, i.e. legitimacy, multivocality and network brokerage, and we illustrate it with examples derived from the literature on scientists’ strategies and on the development of scientific fields. Our paper therefore contributes to the study of science a) by deepening the robust action concept and its variations according to environmental contingencies, like the characteristics of scientific fields; b) by making a connection between the three dimensions of robust action.

1. Introduction:

The choices of research questions that scientists make in the course of their careers do not only affect scientists themselves, but they also influence the entire scientific community. Those choices made by scientists might be the consequence of strategic game playing in science whose purpose is to obtain scarce resources, which can be turned into advancement in career (Latour and Woolgar, 1979), but also into changes of entire scientific specialties. The choices scientists make shape and guide the future evolution of science (Foster et al., 2015). In order to bring the improvements to science policy, we need to understand better processes undergoing those choices. Nevertheless, tradition is important part of scientific productivity, we have witnessed some major changes in different fields of science. These changes could be consequence of strategies undertaken by individual scientists, while they compete one with another, with the goal of improving their status and obtaining rewards. Another factor that is shaping the scientific community and dynamics in it is resources availability. In the process of obtaining resources, scientists must balance collaboration and collegiality with competition and secrecy, which leads to strategic game-playing (Hackett 2005). When the scientists take specific positions in networks of scientific relations, they might act as catalysts of change. In other words, they can use the powers acquired through the setting to bring changes to communities. However, we know relatively little about (i) whether and how scientists strategize to occupy those positions and (ii) the conditions under which individuals turn the advantages of their specific positions, into structural changes in scientific communities. The

literature dealing with these issues was mainly in sociology (Latour & Woolgar 1979; (Bourdieu, 1975)) and economics (Partha & David 1994), while there are is a lack of studies explicitly conceptualizing such strategies.

We suggest that the concept of 'robust action' (Padgett & Ansell 1993) is suitable for disclosing strategies scientists use to become power brokers with high status and rewards in their respective fields. Consequently, robust action can reveal how scientists can use the control over resources to orchestrate collective action towards the emergence of new cognitive and social structure in science. Scientific community is relatively stable setting, deeply relying on tradition and reproduction of existing work, yet we can encounter a lot of change in it, with numerous new specialties and forms we never encountered before. We suggest that robust action is appropriate tool for discovering the deeper transformational dynamic enabling the emergence of new structures (Padgett and Powell, 2012) in science. New organizational forms emerge from spill overs across different social networks. The aforementioned authors said that actors are "the vehicles through which the life self-organizes" (Padgett and Powell, 2012, p. 3.). Scientists occupying brokerage positions are interacting with different parts of scientific networks, and their moves can contribute to creation of new scientific specialties. Revealing the strategies scientists use for achieving their personal goals might be key to understanding how changes in a science take place. Science is fragmented social setting, and scientists acting as catalysts might use two models to bring changes. Firstly, they need cognitive models to connect two disciplines in which they have established certain legitimacy and high status. Secondly, they need support from their respective institutions, which enables mobilization of resources needed for change.

The concept of robust action has been introduced to indicate "noncommittal actions that keep future lines of action open in strategic contexts where opponents are trying to narrow them" (Padgett & Powell 2012, p.24). When using robust action as a strategy, the goal is to preserve flexibility while achieving short-term objectives that will enable long-term gains (Ferraro et al, 2015). These strategies lead to complex, hard to categorize moves, with the purpose of spanning structural holes (Burt 1992) and gaining power. Robust action would be therefore a suitable strategy when facing unpredictable and competitive environments.

Despite the appeal of the concept, there has been relatively little theoretical development and empirical analysis about robust action. On the one hand, we lack of a precise and operational definition of the concept, which would also identify its core components (e.g. among the "seven principles of robust action" introduced by Eccles, Nohria and Berkley 1992). On the other hand, we know little about variation in robust action and on its outcomes depending on specific environmental contingencies.

Our aim is thus to develop a framework for applying the concept of robust action in science by illustrating the theory with the support of existing literature. We plan to do so by recollecting the data from prior research that deals with cases of scientists' careers and development of institutes, and consequently to systematize the existing approaches and findings according to our framework.

We suggest that studying robust action can contribute both to the study of science in several ways. First, it can shed light on strategies used by scientists when they are acquiring resources in their respective communities and, more specifically, how scientists balance social norms of

science (Merton 1968) and the need for collaboration and collegiality with the ability of accumulating resources to pursue their individual goals (Anderson & al., 2007).

Second, we suggest that robust action allows understanding how individual scientists might bring broader changes in their scientific community. Changes in science are complex and multidimensional processes that involve multiple actors and dimensions, including changes in the cognitive content of scientific field, as well as in the social structure, formal institutions, and in hierarchy (Becher 1989). Robust action might thus help understanding how selected individuals might be able to orchestrate collective action towards the emergence of new cognitive and social structures in science (Anderson & al., 2007).

Third, through the study of its enactment, we aim at further developing the concept of robust action, according to three dimensions we identified - legitimacy, multivocality, and brokerage. Extant research indeed failed to answer some important question pertaining to the conditions under which actors are more likely to engage in robust action and to the behavioural patterns leading to robust action. There is an extensive body of knowledge dealing with brokerage (Burt, 2005). Literature concerning legitimacy and multivocality is poorer ((Suchman, 1995); (Padgett and Ansell, 1993)). Our approach contributes to the existing literature because of its unique way of connecting the three aspects of robust action.

2. Unpacking the concept of robust action:

Padgett and Ansell (1993) studied Medici family and Cosimo de Medici's style of control as an example of robust action. They found that Cosimo's power came from his "multivocal sphinx-like identity" and from structural holes in social networks that existed at the time in Florentine state. Empirical data on marriage, economic, patronage, and friendship networks in Florence were analysed. From the dataset, the authors created marriage and economic blockmodels, which are demonstrated to be excellent predictors of political partisanship. They argued that it was not the social groups that created political parties, but rather the underlying networks induced conjointly parties and social groups. Blockmodeling revealed the social structure of Medici party, that was centralized and star-shaped. The opponent's structure, the oligarchs party was very rich in connections and cohesive.

Besides the analysis of blockmodels, Padgett and Ansell looked at network dynamics and demonstrated that "Cosimo de Medici did not design his centralized party, nor did he intend (until the very end) to take over the state" (p.1287). It was "historic trends in neighbourhood exogamy, political vulnerability among Medicean partisans, and oligarch elite closure," as well as economic ties with new men that created structural preconditions for robust action and, therefore, generated opportunities for Cosimo's action. Occupying such position in complex web of relations in Florence, made foundation for contradictory attributions of their self-interests. "Clear goals of self-interest, we conclude, are not really features of people; they are Florentine (and our) interpretations of varying structures of games" (p. 1308).

More recently, Ferraro et al. (2015) studied the mechanisms that might contribute to the way organizations deal with grand challenges. They found that the "opportunities for changes emerge at the intersection of conflicting fields and logics" (Ferraro & al., 2015, p. 364). According to their work, the concept of robust action can be used to solve the problem of organizational action and field change. In a previous work, Eccles and Nohria (1992) proposed to decompose the concept by adducing "seven principles of robust action" (pp. 41– 44): acting

without certitude; constantly preserving flexibility; being politically savvy; having a keen sense of timing; judging the situation at hand; using rhetoric effectively; and working multiple agendas" (p.371).

Based on these studies, we identified the following three dimensions of robust action, which we will also mobilize to map robust action to science.

Legitimacy is the prerequisite and the outcome of robust action. Legitimacy is "a cognitive process through which an entity becomes embedded in taken-for-granted assumptions" (Suddaby & Greenwood 2005, p. 37). It is about persuading others that actions of an actor are not motivated by self-interest but comply with the broader norms of the field they belong to. The authors suggest that in order to act in legitimate way, actors need to reconcile public and personal interests. This could be done by an effective usage of rhetoric and by being politically savvy.

Multivocality or "the tactical capacity of robust-action brokers to sustain multiple attributions of identity through uttering sphinx-like statements that plausibly can be interpreted in multiple ways" (Padgett & Powell 2012, p. 24). Those identities lead to complex, difficult to categorize lines of actions that span across network holes, acting as bridges connecting otherwise separate social classes. Such actions enable flexibility while working on achieving multiple goals. Multivocality is closely connected to network brokerage, as brokers will have "multiple audiences" each of whom attributes different interests to brokers. Therefore, it is important for brokers to be capable of sustaining those ambiguous identities (Padgett & Powell, 2012). Robust action brokers indeed accomplish vagueness by asserting sphinx-like statements that lead to multiple interpretations by others and to political polarization by segregation of structure and inconsistent attributions of what is communicated (Padgett & Powell, 2012).

Brokerage. For an actor to be able to act in a multivocal way, he or she needs to be in a brokerage position (Burt 1992). An actor is a broker when he or she holds a position that connects otherwise separate parts of network. Being in the brokerage position means acting as a bridge, a connector between different audiences. Different audiences imply different perspectives in interpretations of brokers' action. The positions of these actors are key to creating the contradictory base of support, and consequently being able to control the exchange among separate groups.

The three dimensions of robust action interact one with another. As already said, multivocality is closely connected to brokerage. It also depends on actor's legitimacy, who has to make their actions/ideas appealing to multiple audiences and, at the same time, keep the ownership of those actions/ideas. To achieve that, an actor has to be accepted as a legitimate by her multiple audiences (Soda et al., 2018). On the other hand, if audiences perceive that broker is acting too "multivocally", that actor might lose legitimacy, since "others are too shrewd not to see through behavioural facades down to presumed self-interest motivations" (Padgett and Ansell, 1993, p. 1307). The specific connection among these three dimensions makes robust action strategies very flexible and unpredictable. The key for successful implementation is finding the optimal combination of dimensions, which will result in many possible options for future actions.

3. Applying the robust action concept to science:

The 14th century Florence and modern science have some things in common. Both are highly complex and competitive surroundings, which means that “opponents” and their actions are “unpredictably hostile”. Both are based on formal relations and both have “apparently clear goals” (Padgett & Ansell, 1993, p. 1310), which are in conflict with personal interests of actors. Actors are racing for power and high status. To understand the fluctuations in these surroundings it is necessary to go beyond “the veneer of formal institutions and mutual goals” (Padgett & Ansell, 1993, p.1310). The key for understanding strategies used by actors is social embeddedness that explains distinct, equivocal, and conflicting character of actors.

Science has a number of features that are highly suitable for robust action. It is a highly competitive environment that requires usage of strategies by scientists in order to achieve specific outcomes. Furthermore, the strategies are supposed to lead to complex and difficult to categorize moves. These strategies are supposed to make the prediction of future moves by the side of “opponents” very difficult, and as such, they leave very little place for narrowing the future options. In this respect, robust action emphasizes commitment to short-term actions that bring long-term benefits but remain open to alternative courses of action.

Further, we can represent a scientific community as a network where knowledge and resources are shared and within which scientists are deeply embedded. The connections between actors are shaped by the community itself (Borgatti 2005). In science, each part of community embodies specialized skills and knowledge, and in order to increase the productivity or to obtain different resources, a researcher wants to access different parts of network (Mohnen, 2016). This is precisely what creates the brokerage positions in science, and furthermore what creates the possibility to enact multivocality.

Science is very fragmented social structure. Scientific disciplines function as primary units of internal differentiation in science, based on specialization of scientists (Hadorn, 2004). Although different on micro level, some of specialties have certain things in common, such as cognitive frameworks and social structures. The disciplines represent partially connected worlds, where connection might appear when individual scientists decide to apply concepts from one discipline into another. To do so, those scientists should have established good reputation and credibility in disciplines that partially overlap (Becher, 1989). The change requires more than cognitive models. The scientists acting as catalysts should also have a strong positions in their respective institutes, in order to mobilize resources required for change.

We will therefore analyse the centralization and development of scientific networks, that underlie the changes of status of individual actors, changes in scientific community, and that are used as a pipeline for personal advancement of actors. We suggest that scientists engage in robust action to obtain resources such as citations and promotions, or to improve their own performance. In addition to achieving specific outcomes, scientist also need to use different strategies for legitimacy, given that their actions need to be socially acceptable to their community.

However, the extent to which the scientist engages in acting without certitude or working multiple agendas may vary depending on: (a) characteristics of the scientist, (b) characteristics of the organisation (prestige, age, size, etc.), and (c) characteristics of the domain (extent to which it is emergent or established, narrow or broad, etc.).

First, robust action requires acting in legitimate way (Padgett & Ansell, 1993). This means that actors who are using this strategy should reconcile the commitment to science and the need to be better than others. We want to check how the personal and public interests of scientists are put together for the benefit of the science, and how scientists make their choices by claiming that their behaviour complies with the legitimate norms. Merton (1968) suggested that there are certain processes that affect the allocation of resources and rewards in science. Having that in mind, robust action is a strategy that might be used by scientists in competition for resources. These actions of reconciling personal and public interests are supposed to be made in a legitimate way, which is an antecedent and an outcome of robust action. We should bear in mind that this dimension is about persuading others to believe that one is acting legitimately. This dimension depends on values and expectations of scientist using robust action, but also on values and expectations of the entire domain. The goal for this individual is to maximise the legitimacy in the eyes of others, and that is why the scientist must be aware of how their actions will be interpreted by others. They should also be able to use rhetoric effectively to persuade others.

Second, the capability of an actor to behave in multivocal fashion might depend on his or her personality and patterns of behaviour. The statements of actors should be ambiguous, and thus interpreted differently by different audiences. In science, we suggest that this dimension of robust action largely depends on the characteristics of the domain. Some fields of science that are highly structured leave little space for multivocality, given that they have already established norms that should be respected by all the participants (Becher 1989). On the other hand, environments that are emergent and unstructured have a lot of structural holes, and scientists that are able to span those holes appeal to different audiences and are more able to act multivocally.

Third, the position of scientist in the network of connection may enable or constrain robust action. To induce robust action an actor should be in a brokerage position to bridge structural holes, and he or she must be able to cross the boundaries demarcating different networks, in this case different disciplines that are proximate but weakly connected. On the other hand, if a scientist participates in single network that is highly connected and closed, he or she does not have space for action in multivocal manner. To be able to actively manage network a scientist must be aware of the network structure as well. When an actor is able to define the competition and the performance outcomes, managing the network becomes easier. This will also ease the management of the inevitable tensions that are likely to appear in science, for instance by being adaptive (Hackett 2005). Robust action is a form of strategy that is based on adaptation to a specific situation and it can reveal the strategies that scientists use to cope with tensions.

4. Empirical design and further steps:

Our main level of analysis is the individual within a community who is able to influence others with the purpose of gaining advantage. Since the individual's strategies are determined by his or her position in the network of ties (Padgett & Ansell, 1993), we plan to account for such position to analyse how the individual leverages the network to bring changes to scientific communities.

The further steps of this research will be a) to fully develop the analytical framework by including additional insights from science policy and sociology of science literature and b) to

illustrate and test the framework through the analysis of existing case studies of careers of scientist and development of research institutes presented in the literature (see for example Braam and van den Besselaar, P. A. A 2010, Verbree, Van der Weijden and Van den Besselaar 2012). To this aim, a systematic screening of such cases published in journals in sociology of science and science policy will be undertaken.

The identified cases will be re-analysed by using the categories suggested by our framework; this is expected to lead to theoretical refinement and to the identification of specific avenues for empirical research.

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Abstract 138

RESPONSIVE AND CO-CREATION MODES OF STI POLICY GOVERNANCE FOR COPING WITH DISRUPTIVE CHANGES

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We have witnessed several major change processes in society, economy, and major S&T domains in recent years. While these are complex on their own, they are also interwoven, and thus it is a rather demanding task to make sense of these changes and on that basis devise adequate strategic responses, and then identify and implement effective policy mixes.

STI developments have a key role to play in this context, both as drivers and possible responses to these change processes. While specific policies and strategies are certainly needed to address the change process, it seems that a more ambitious, and hence even more challenging, approach is required to address them appropriately; an approach implying to overhaul the current STI policy governance sub-systems with the aim of making them able to (co-)shape the on-going fundamental S&T, economic, and societal changes. That would require a close co-operation with all the major actors and stakeholders, radically renewed policy-setting and implementation processes, in which experimentation and co-ordination between supply- and demand-side policies play a much more accentuated role, as well as devising relevant policy tools. Even a less ambitious approach, that is, being prepared for these changes and reacting to them in an appropriate way, could be still rather demanding.

Our exploratory paper is aimed at (i) contributing to sense-making of the on-going fundamental change processes, (ii) exploring two types of STI policy-governance approaches to address these changes; and (iii) considering the relevance of forward-looking activities (FLAs) to assist these STI policy governance approaches.

The paper first offers an overview of the on-going fundamental changes at the intersection of STI, societal, and economic processes. These on-going changes give rise to different main types of processes of transformative change in need of appropriate governance: A) fast and disruptive transformations give rise to new, often digital, business models, which supersede existing businesses (e.g. Uber, Airbnb, etc.) and lead to entirely new innovation ecosystems, with often unknown consequences e.g. on labour issues, privacy, safety or ethical dilemmas; and B) slow but equally transformative transitions of existing, often hard-wired, socio-technical systems with strong path-dependences (e.g. in energy supply, mobility); or C) hybrid forms that are challenging both in terms of their scope and their speed of occurrence (smart grids, autonomous driving, etc.).

These different types of transformations give rise to growing concerns about the direction of change and fears about a loss of control, but they are characterised by different levels of scope, speed, and uncertainty, and thus necessitate different strategies and governance approaches.

Thus, in the second part of the paper we distinguish two main ideal types of STI policy governance approaches, intended either to (a) respond to the disruptive transformations in an effective way, characterised by a strong emphasis on flexibility and responsiveness, or (b) create pro-actively new opportunities for (co-)shaping transitions towards socially, economically, and environmentally desirable directions, thus calling for long-term goal orientation and coherent strategies of a broad range of actors. Clearly, there could be a third approach, namely just “wait and see”, that is, being rather passive. It is even quite likely that this approach will be taken in many countries and regions. Yet, as this approach is not really promising and fruitful, we do not consider it in the paper.

Using a simple 2x2 matrix, where we have the types of disruptive changes (fast vs. slow) in the columns and governance approaches in the rows (responsive vs. co-creator) we can identify four combinations. (Table 1)

Table 1: Types of changes and governance approaches

	Fast disruptive changes (A)	Slow disruptive changes (B)
Responsive governance (a)	“Wait and react”: adapt to changes mainly by trying to minimise negative impacts in a broad sense and to exploit new opportunities to a lesser extent, given the pace of changes [Aa]	“Wait and prepare”: more emphasis on being well prepared to exploit the new opportunities evolving, but not even taking major risks, let alone facing or creating uncertainty in a proactive way [Ba]
Pro-active co-creation governance (b)	“Keep pace”: try to co-shape fast changes – largely driven by external factors – to the possible extent [Ab]	“Get ahead” of changes: take the driving seat, take risks, or even create some uncertainty [Bb]

Source: own compilation

In this paper, we illustrate our argument by looking into examples of areas where fast disruptive and slow disruptive change arises, and where we can observe different governance approaches in different context for dealing with these disruptions. In both cases, we look into the field of mobility, broadly defined.

Our first example is the automotive industry. Disruptive technological changes in the early 20th century led to the emergence of a new industry, that is, automotive industry, and revolutionised personal mobility and logistics. Of the competing technological solutions, the combustion engine became the dominant design. In a few decades, this technological change, coupled with many more technological and non-technological innovations gave birth to a new techno-economic paradigm, “the age of oil and mass production”. (Freeman and Perez 1998, Perez 2010)

The major actors were businesses, while state actions were closer to responsive ones: it provided crucial infrastructure and introduced the necessary regulations, which facilitated the diffusion of this technology, but didn’t play any noteworthy role in directing either the technological or the related non-technological changes. The last 2-3 decades of the 20th century were characterised by incremental technological and major organisational innovations, especially the emergence and diffusion of the lean production paradigm and that of the globalising innovation and production networks (Womack *et al.* 1991, Malerba 2002, Malerba (ed.) 2004).

Disruptive technological – and related non-technological – innovations are emerging in the 21st century, which are likely to change mobility again: autonomous vehicles, electric vehicles, as well as new mobility models (car sharing, car ownership vs. use, ...). New players are

introducing new business models. Closely related innovations and other changes are needed for making these technologies safe, and thus promote their diffusion, including new sensor and software technologies, IoT, new physical infrastructure (roads with sensors, reliable, stable access to fast internet “everywhere”), and appropriate regulation (at national and supranational levels), new insurance policies. Major ethical issues (liability, privacy, who should be “saved” by the driving software in a dangerous situation, etc.) also need to be solved. For these reasons the state needs to play a much more active role (NASEM 2018) than in the 20th century changes. Moreover, citizens also need to be involved. In principle both responsive and co-creation governance modes can be applied. The ambition of the Hungarian government, for instance, is “to stay ahead of changes”. A major R&D programme is being implemented, focussing on S&T issues and drawing on strictly expert-based forward-looking activities. A new research centre was set up in 2015 at the Budapest University of Technology and Economics, a test track for autonomous vehicles is being built, to be completed in 2020. An autonomous vehicle cluster, composed of IT and automotive firms, as well as IT service providers, has also been created, with massive government subsidies. This highly ambitious co-creation governance approach will be discussed in more detail in the presentation, contrasted with cases of responsive governance mode, taken from other important automotive producer countries, for instance, Spain and Sweden.

Our second example refers to the introduction of new types of mobility services, which are disruptive because they undermine the very functioning of our current mobility systems and represent a departure from car ownership. They also put into question the established business models of the automotive industry – be it based on autonomous vehicles or not – and thus leads to the emergence of completely different innovation and service ecosystems. This does not mean, however, that established players (e.g. major car manufacturers) could not be part of that new ecosystem and transform their business models fundamentally (as currently done at a comparatively small scale by BMW and Mercedes with their now to be merged car sharing platforms), but there are also new players entering these markets, who may take on strong, possibly even leading, roles. We can observe signals of this emerging development in the engagement of IT companies like Google, and the creation of digital-platform-based service providers like Uber.

The two cases of Finland and Austria serve as examples of responsive (Austria) and co-creation governance (Finland) for dealing with fast and disruptive change in the area of mobility provision. The Finnish example of introducing mobility-as-a-service can be interpreted as an iterative process combining bottom-up initiatives of an entrepreneurial community and top-down framework setting to enable system change. The top-down element required also mutual adjustment of policy initiatives in different domains in order to enable market formation (Kanger and Kivimaa 2018). It thus fits the model of co-creation governance, with using directional FLA. The Austrian case of handling the introduction of Uber and other examples of ride-sharing (such as Compano), on the contrary, must be characterised as responsive (if not restrictive) mode of governance. Entrepreneurial initiative was not complemented by supportive policy action, but rather inhibited by either protecting incumbent stakeholders (i.e. taxi services in cities) or by not adjusting regulations (in particular taxation) that would have reduced uncertainty for ride-sharers (Weber et al. 2014). In this case, there has been no sign of applying FLA methods.

To come to our third argument, for both types of transformative change processes, FLAs can play an important role as an appropriate tool for anticipation, joint visioning and soft co-ordination. In line with the differentiation of governance approaches, the main intentions of FLAs equally need to differ and be geared towards the corresponding governance approach.

The key dimensions of differentiation are (i) the main aim of an FLA: explore what might evolve vs. give direction to changes with the intention to create new opportunities and new ecosystems for these new opportunities; and (ii) the level of participation: expert-based vs. participatory.

To bring together our simple typologies, for responsive governance modes (that is, Aa and Ba combinations) exploratory FLAs seem to be appropriate, while pro-active co-creation governance approaches (that is, Ab and Bb “pairs”) can be supported by what we call directional FLAs. Further, participatory FLAs would increase the chance of shaping the direction of change by involving the major actors. These processes would align their visions as to which direction to take, and thus reduce uncertainty and orchestrate their efforts and pull together their resources to achieve the desired change, in particular, create new opportunities. Yet, policy-makers and other actors opting for this type of FLA need to be aware of a trade-off between the speed of changes and the time needed for conducting a proper, fully-fledged participatory FLA, that is, a foresight process.

When drawing policy implications, the paper emphasises the importance of taking a multi-level perspective. First, national and regional innovation systems, together with their policy governance sub-systems, provide key framework conditions for addressing transformative changes (fora for major actors to communicate, interact, and co-operate; strategy-setting capabilities; competences in using decision-preparatory tools, especially “futures literacy”; regulations; financial and other support; etc.) to the actors at the level of actual innovation ecosystems, where transformative changes manifest themselves most directly and most forcefully, on the one hand, and where it is the most appropriate to attempt co-shaping the transformative changes to create new opportunities or finding appropriate governance responses, on the other. Second, any given country or region is likely to be fairly diverse in terms of having Aa, Ba, Ab, and Bb “pairs” at the level of innovation ecosystems. National and regional policy-makers need to be aware of this diversity and find effective ways to assist in creating appropriate, and therefore diverse, governance approaches for these different innovation ecosystems.

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Keywords: Fast and slow disruptive transformations, Innovation ecosystems, Responsive governance, Co-creation governance, Forward-looking activities (FLAs), Exploratory FLAs, Directional FLAs, Multi-level governance, Diversity

Abstract 140

TOWARDS A GOVERNANCE FRAMEWORK FOR TRANSFORMATIVE STI POLICY FOR SOCIAL INCLUSION AND PEACE IN COLOMBIA

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Aim of the proposal:

Research question: how can STI policy contribute to social inclusion and peace in developing countries like Colombia? The aim of the proposal is to outline a transformative STI policy governance framework for social inclusion and peace, by approaching transformative innovation from the policy and governance studies point of view.

Background:

Modern trends in science, technology and innovation (STI) policy have focused on addressing societal and environmental challenges (Smith, Voß, & Grin, 2010; Kuhlmann & Rip, 2018). For instance, 'transformative change' emerges as a STI policy frame aimed at fostering sociotechnical change in order to prompt sustainability transitions (Schot & Steinmueller, 2018). Recently, this policy approach was proposed in Colombia by the national governmental STI policy agency – Colciencias– and was depicted in 'El Libro Verde 2030'. This policy document defines the transformative approach for Colombian STI policy to address the Sustainable Development Goals, and outlines transformative policy principles, objectives, strategies, financial sources and evaluation orientations. The future implementation of this policy approach in Colombia does not seem clear, however, mostly for political reasons (it was launched during the final months of the last government 2014-2018, and the current administration 2018-2022 is not clear about this frame in its governmental program).

Methodology and empirical base:

Based on the case of Colombia, the concept of transformative STI policy is discussed briefly from a critical perspective. We argue that transformative STI policy must take into account the politics of policy, among other factors, in order to be effectively implemented. The chapter discusses the challenges for transformative STI policy in emerging economies, and addresses a successful case of transformative STI policy in Colombia in order to identify the conditions under which this sort of policies can have an effect in the country.

Results:

The proposed governance framework intends to contribute to a social-inclusion-oriented understanding of STI policy, rather than just focusing on competitiveness, productivity and

economic development (Kuhlman & Ordóñez-Matamoros, 2017). We expect that such governance framework will orient STI policy making in countries such as Colombia.

Conclusions:

A transformative STI policy governance framework for social inclusion and peace is proposed based on the colombian case.

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Thursday 06 June 2019 from 16:30 to 18:00

STEPHANIE DAIMER, Chair

Abstract 104

INVESTIGATING CO-CREATION PRACTICES IN PUBLIC-PROCUREMENT-OF-INNOVATION – A DANISH CASE

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Investigating co-creation practices in Public-Procurement-of-Innovation – A Danish case

The aim of this paper is to investigate co-creation processes related to Innovation related procurement addressing sustainable development goals. Furthermore, we investigate how the public sector actually may support 'green' innovation. The reason for this is that despite EU's recent commitment to Innovation related procurement, there does not seem to be a clear definition of the related terms in practice. Investigating innovation related procurement from a Danish view requires an investigation of seemingly rather related terms that are used differently in Denmark and in the European Union.

Innovation related procurement by the public sector is gaining increasing focus by the European Union, (see for instance European Commission, 2018). The reason for this is that the public can use its purchasing power to create new markets (Edquist, 2018) and become early adopters of new technologies supporting innovative solutions.

Scholars have previously been investigating innovation processes that include both the private and the public sector looking into the role of the current legal frameworks related to procurement, which is often highlighted as a barrier to a wider uptake of Public Private Innovation processes. By exploring the role of institutions (Rolfstam, 2009) they argue that legal frameworks are not the major obstacle for a broader uptake of public procurement of innovation in Europe. They suggest, future studies should focus on exploring how institutional factors "*may affect the success or failure of multi-organisational collaborations in public procurement of innovation*" (Rolfstam, 2012 p109). Thus, until now, not much focus has been on the actual collaborative processes that are practiced in and across institutional settings in Public procurement of innovation projects in order to support or create new innovative solutions.

Public Procurement of innovation, grand challenges and innovation:

Innovation related procurement policies such as Public Procurement of Innovation has been proposed as a policy instrument to tackle grand challenges. Much of its potential arguably lays in its inherent properties to trigger heterogeneous actors in the socio technical system in a facilitative manner. This includes articulation of occurring societal demands leading to development and selection of new technological trajectories (Wesseling & Edquist, 2018). Central to this policy instrument is the notion of 'functional specification' which indeed allows for innovation occur. Functional specification allows public organizations to specify which functions they intend to procure rather than describing technical specifications narrowly to

favour certain firms. Although these initiatives have been initiated to lower favouritism of certain companies, it also can favour innovation (Edquist, 2017).

What is Co-creation – from product to process...

Co-creation is a concept that has gained increasing popularity as an approach that enhances innovation processes and outcomes. The notion of 'co-creation' quite simply means any activity where different actors come together in a joint activity, which leads to an outcome that is beneficial to all participants. Beyond that very general or broad characterization, co-creation can take many forms and be utilized for many different reasons.

Co-creation has long been studied in the private sector, often in relation to 'Design Thinking'. Scholars have argued that co-creation is connected with value-creation and that the core idea for actors engaging in co-creation activities together is related to value-creation. Value-creation is accordingly increased for all involved actors. Others are discussing the consumers' dialogs with firms as a value-creating co-creation process and highlight that *'co-creation is about joint creation of value by the company and the customer. It is not the firm trying to please the customer'* (p:8 Prahalad & Ramaswamy, 2004).

Some strands of management literature have argued that firms may increase their number of innovations on the market by tapping into people's urge to create new products. Firms may collaborate with users to develop products that better fit the markets. Meanwhile the users may purchase the product once it hits the market (von Hippel, de Jong, & Flowers, 2012).

While the concept of co-creation emerged from work in the private sector other researchers have been expanding it to the public sector sphere. This has resulted in discussions of drivers and risks of the adaption of the concept in the public sector. Some examples of the risks are related to costliness and concerning democratic issues. In relation to drivers the authors state that *"co-creation may strengthen social cohesion and build more resilient communities by empowering local actors, enhancing mutual trust, and building additional social capital that enable public and private actors to use their relations to other people to accomplish new things"* (ibid p15) (Torfing et al, 2016).

While some strands of literature do not differentiate between the concepts co-production and co-creation we follow the definition used by Torfing et al, 2016 who distinguishes between the two concepts. This implies that co-production as a term includes all processes in the public sector where citizens contribute to the *"production and delivery of a particular service"* (ibid p 8). This is supposed to be seen in contrast to co-creation, which can be seen as a new trend, encompassing heterogenic actors in the process of creating innovative solutions to common problems (Torfing et al, 2016).

Methodology and empirical case:

Empirically this paper is based on two Danish triple helix cluster organizations that facilitate public procurement of innovation projects; Gate21 (non-profit partner-organization) and CLEAN (non-profit member-organization). Both organizations are intermediaries between research institutions and public-and private sectors in innovation activities such as Innovation related

procurement projects. Thus, these cases represent an excellent opportunity to firstly, understand multi-organisational collaborations in and across institutions in Innovation related procurement cases, which can secondly, enable us to discuss whether insights and tools from the co-creation literature can better support the inter-institutional collaboration (and co-creation) in Public procurement of innovation projects, ultimately leading to more successful PPI projects (i.e. innovative solutions that all stakeholders are satisfied with). Both organizations are working towards a greening of society and are involved in projects that support the development of innovative solutions that can address the sustainable development goals. Specifically they are facilitating and involving a range of heterogeneous actors in various types of projects that have the goal of increasing sustainability (through i.e. waste management, climate change securement of cities etc.). In Denmark the public sector is increasingly trying to support a green transition through various projects and activities focusing on innovative technologies and processes. Some of the activities are, for instance, aiming to address some of the sustainable development goals. Rather than necessarily being focused on 'only' technologies these activities are also social innovations, i.e. changing how problems are solved in a more bottom-up way (Geelen, Reinders, & Keyson, 2013).

The case study includes participant observation during various public procurement of innovation projects' execution as well as qualitative interviews with more than 15 actors that were/are involved in the project activities. Our analysis of (multi-organisational collaborations in and across institutions...) (co-creation practices) takes its outset in literature on 'the co-creation paradigm' whose conceptual repertoire will sensitize us to understanding processes where a range of heterogeneous actors collaborate to find mutually beneficial solutions (Ramaswamy, Pralahad; 2014).

By taking this approach, we will investigate the 'actual co-creative activities' that are playing out in the cases we study and outline how 'institutional factors' presents challenges to these co-creative practices. Lastly, we will outline how co-creation in public procurement of innovation projects may be better supported to improve areas that are related to a greening of society. Thus, we are interested in describing the current situation in Denmark concerning innovation related procurement by the public sector and sustainable transitions, and to investigate how co-creation activities among heterogeneous actor may or may not support a 'greening of society'.

Preliminary insights:

There are different ways to frame the way that co-creation processes can be found in the cases that we analyse for this paper. In the following, we present three ways to focus on the empirical material that are illustrative in terms of addressing our research questions, where the first two are drawn from Gate 21 and the third dimension is from CLEAN.

Firstly, we want to unfold the way that pre-tender market dialogue is enabling co-creation of 'the problem space' and how, on the other hand, the co-creation activities (workshops etc) has to be meticulously documented and made publically available due to strict public tender laws. (og hindrede dette co-creation, gjorde det deltagerne mindre åbne, kreative etc?). Thirdly, we want to illustrate how co-creation is enacted in PPI by drawing on 'the innovation model' that CLEAN is working with, which emphasizes that the role of the mediator is to facilitate radically new actor constellations in project consortia, which raises the innovation hight.

Market dialogue: Co-creation is necessary to define the problem-space

Firstly, co-creation activities were occurring to create new legal contracts between municipalities and companies to support innovation before a tender. Thus, arranging 'market dialogue workshops' is a common activity in PPI projects. Normally, when the municipalities procure, they need to put out a tender. A tender includes a very specific description of the product that the municipality wants to procure. By our informants, we found that they had the opinion that if they were to support innovation they could not just make a tender. Making a tender for them would mean that they already knew the definition of the product they wanted – i.e. there is an inherent contradiction in asking for innovative solutions, but setting out very specific requirements for what the solution should look like. Thus to support innovation they were more interested in collaborating together with companies to work on the 'problem space', i.e. working together with market actors to define the requirements that is going to be set out in the tender in order to develop the ideal solution for their problem.

However, when engaging in development processes before a tender certain rules apply to avoid that the involved companies are disqualified from being included in a possible future tender. Thus, certain standards need to be followed. Therefore, a part of this process was to create a legal contract to ensure that the process does not favor or exclude the involved companies in a future tender. The aim of the contract was to legitimize the project activities in such manners that they could be used again in municipalities after the end of the project. The contracts included very specific legal constraints which had an influence on the co-creation process which is described in the next section.

Demand for documentation in public procurement restricts co-creation

In contrast to co-creation processes in many research projects where the process often does not necessarily need to be well documented, the co-creation activities in Public procurement of innovation projects need to be strictly documented to make sure that the companies are still allowed to enter a possible tender later on. For the companies to be able to join the future tender all information, apart from strict business knowledge belonging to company, needs to be available to other companies. Thus, the creative meetings and discussions need to be monitored carefully and written down. Afterwards the minutes need to be filtered out for delegate information belonging to the businesses. Accordingly, due to the nature of the project: Cleantech Tipp the co-creation processes in the project are restricted according to laws and rules concerning public sector and tenders in DK. Specifically this means that, the co-creation activities (workshops etc) had to be documented and made publically available.

As written above, previously literature on Innovation related procurement by the public sector has shown that the law is not necessary the main hinder towards the application of public procurement of innovation. Rather it has been shown that problems stem from 'other institutional levels' (Rolfstam, 2012). Our empirical material seems to support this line of argumentation and illustrates that indeed the public sector has rather good possibilities for the public to support innovation in Denmark. The legal practices are not hindering the practices.

However, this does not mean that it is legally easy for public authorities to support innovation this way.

CLEANS innovation model: attempt to support risk taking and new collaboration configurations

The national clean tech cluster organization CLEAN has been working with public procurement of innovation for almost 8 years. During this time, the organization has experimented with bringing the American DAPA model to Denmark. CLEAN has facilitated three large public procurement of innovation projects so far: 1) The data marketplace, 2) the reuse of building materials and 3) plastic recycling. CLEAN is currently facilitating the latter project, which focuses on finding new and innovative ways of handling the major issue of plastic recycling (40 municipalities/waste companies have come together to be the 'problem owners').

CLEAN plays an important role as neutral organization that facilitate the project, i.e. they organize matchmaking processes to find the most innovative consortia and support the establishment of consortia that would otherwise not have collaborated. They argue that companies are otherwise risk adverse and that they will not enter into such PPI consortia unless CLEAN provide the right arguments, i.e. find huge new potential markets for them (the public demand). And on the other hand they help and empower the public actors in organizing themselves to better be able to define what it is that they want (i.e. a better solution to plastic recycling) and to represent a bigger market (which can then make demands) for the winning solution.

In the pre-tender material they emphasise that they want the companies to enter into new collaborations/constellations that they would otherwise not be used to. They do not believe that one actor can find a solution to such complex challenges, otherwise they would have been found already.

CLEANS work shows that there is a need for a value chain innovation in Denmark. In other words, co-creation is not just a question of e.g. developing new innovative sensor technology that is better able to sort various plastic types from each other, it is also a question of developing new organisational configurations. In terms of plastic recycling, it could for instance be to organise that municipalities collectively bid the handling of their plastic waste as opposed to today, where each municipality has to handle their own plastic waste and thus have much smaller amounts to offer.

Conclusions and further work:

Innovation policy advisors suggest that: *"It is important to pull demand in different ways, finding and defining joint needs, carrying out early market dialogues, and also considering municipalities and lower sub-national territorial levels, creating buyer groups, etc."* (European Commission, 2018) which encompasses a great deal of collaboration between heterogeneous actors. However, in this case study we have found that co-creation processes, which need to live up to various procedures and practices in the public sector, are rather difficult to work with. The co-creation processes related to 'defining joint needs' among the public actors and private companies when creating new solutions are hampered by a rather heavy documentation burden.

Co-creation and mutual learning exercises are dependent on high levels of openness, trust and sharing which is not present in the current situation for public authorities procuring for innovation in Denmark. The question then remains if there may be constructed a process that both lives up to the public's need for transparency (through documentation) and the co-creation process's need for openness and sharing.

These cases also remind us that public procurement of innovation is highly contextualized in the political landscape. Thus, the actors involved in the innovation procurement activities need to have political support for their projects. Thus, much time in the beginning of the projects is allocated to education and information of politicians on the scope of the project. If an election occurs before the project has been initiated all work can be useless. Thus, Public procurement for innovation projects and processes need to be agile to be able to succeed.

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Abstract 112

HOW TO ENHANCE INNOVATION IN SME SUSTAINING EMPLOYABILITY OF PHD HOLDERS. THE EXPERIENCE OF FINDYOURDOCTOR, AN INNOVATIVE START UP.

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Aim of the proposal:

A PhD graduate's current chance of ultimately attaining a permanent position in public research is a few per cent on average, and may be even slimmer in certain geographical contexts (Auriol et al., 2013; ADI 2016; Fumasoli et al. 2015). Turning to the non academic labor market could be perceived as frustrating if the distinctive characteristics of academic research experience fail to be recognized, integrated, and valued (Galimberti, 2016). This risk is connected to a wider social problem of mature economies: overskilling (Flisi et al., 2014). Alongside the sustained, albeit debatable efforts of institutions and universities across Europe to enhance the employability of PhDs, initiatives involving both the academic and entrepreneurial worlds could make career options in industry more visible, and researchers' professional experiences more accessible. Such an initiative is the FindYourDoctor start-up (FYD), supported by an Italian not-for-profit consortium of private companies and operated by a team of professionals from both academic and business backgrounds. The aim of the project – which is run on a no-profit basis – is to provide a reference point for junior and less-junior PhD holders in all fields and of all nationalities, facilitating their contact with the entrepreneurial world and making their value accessible to broader society. Our presentation will focus on the different actions conceived and performed within the project during the last four years and their outcome (Galimberti & Ratti, 2018).

Background:

One of the FYD actions is based on consultancy: in the course of 2015 and 2016, we had the opportunity to test some of the assumptions underlying our model in collaboration with an Italian association of SMEs, which was interested in developing ways to boost the innovation capability of its member companies. We set out to verify whether the needs of “traditional” SMEs companies and the skills offered by PhDs could be matched in practice, and whether it was possible for the two parties to work together successfully when an “interpreter” was provided. In this case, given that we were operating locally, the translator was a physical person: the FYD innovation manager, whose academic background complemented her colleagues' corporate experience. We set up trials with twelve companies, mediating short-term consultancy services focused on solving highly specific problems. The first three received the service for free (the SMEs association was funding the test) while the other nine were willing to pay for the intervention. Such short-term consultancy arrangements, potentially leading to longer-term collaboration, turned out to be of extreme interest to SMEs and an excellent opportunity to demonstrate that researchers can be a valuable resource when it comes to analyzing and solving real-life, practical problems. Thirty-six young researchers were recruited from all over Italy to take part in the project: they were post-docs or PhD graduates in different branches of physics, engineering, chemistry, materials science, mathematics. Our

“translator” supervised all the meetings with the participating companies and acted as coordinator of the teams that we put together ad hoc to work on the individual projects. At the end of each trial, we asked for feedback from the company and the team of PhDs, obtaining an extremely positive response from both parties. As a result, a permanent cooperation agreement has been established between FYD and the industrial association that facilitated the test phase.

The engagement of PhDs was possible thanks to a website (www.findyourdoc.org), which collates professional profiles of PhDs on the one hand and profiles of companies interested in recruiting researchers on the other. Through the website, Find Your Doctor is in the position to highlight the skills of PhDs across disciplines and territories in response to different market needs: short and long-term consultancy, but also recruitment for high-profile staff positions and more. While creating a bridge to make PhDs reachable by any enterprise seeking for innovation and innovators, we are building a reference point for the graduates in their job search outside the Academic pathways, a place to find support across their professional transition, to find opportunities that are suitable for them, to make a first step towards the market in a protected environment, to establish connections and collaborations

Methodology and empirical base:

Although the basic structure of our website resembles existing job-search portals, with companies and researchers both registering and browsing through each other's profiles and adverts, FYD differs from the standard in many ways. First and foremost, we are directing our efforts towards devising the most effective possible presentation of the PhDs' profiles and customising the search engine used by the companies to browse through them. More specifically, we have devised sets of questions that invite researchers to reflect on their professional experience to date, by getting them to focus on areas that frequently involve transversal skills (see Blomeke et al., 2013) such as creativity and innovation, rigour, managing risk and uncertainty, communication and networking. We have chosen to offer jobseekers a narrative space rather than measuring their competences via online tests (despite the growing popularity of the latter approach). Candidates' responses are fully viewable on their FYD profiles, making for better communication with potential employers. We are analysing these narrative texts with a view to identify categories for mapping researchers' learning experience. This might be viewed as reversing the typical paradigm whereby those seeking employment are asked to describe their professional selves by choosing among a predefined set of categories, whose meaning may be unclear or perceived as not readily applicable to certain kinds of experience. In contrast, because those registering on the FYD website are invited to freely answer open questions, their accounts of their work experience may be organized a posteriori into categories, creating a language that we ourselves will have defined and is therefore unambiguous to us

Results:

We are building this set of categories a-posteriori, following the methods of “constructivist” Grounded Theory (Charmaz, 2006) and working with computer scientists who are currently developing an experimental tool that will use the categories to construct an individualised multidimensional professional profile for each subscriber (Azzini et al., 2018).

Conclusions:

FindYourDoctor is, first and foremost, an attempt to support and promote researchers outside the boundaries of academia, and so to address a critical issue for the contemporary labour market: overskilling (Flisi et al., 2014). The project is also designed to become a research space in which the different learning career paths undertaken by participants will help us to explore professional transitions between academic and other work contexts. In particular, we are interested in unpacking the transferable skills that can facilitate the transition process.

Abstract 13

TAKING GIANTS BY THE HAND: SIMULATING POLICY MIXES TO DRIVE TECHNOLOGICAL TRANSITIONS OF INCUMBENT FIRMS

Van Mossel A., Wesseling J., Van Rijnsoever F.*

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Aim of the proposal:

Countries around the globe have pledged themselves to drastically reduce their emissions of CO₂ (UNFCCC, 2015). Governments can deploy various policy instruments to ignite and accelerate this process (Rayner & Jordan, 2016). While doing so governments do not want to damage the economic competitiveness of firms in industry. Hence, governments need to design a set of innovation policy instruments that balance economic competitiveness with reducing CO₂ emissions. However, the complexity and heterogeneity of (mixes of) policy instruments frustrates empirical measurement and systematic comparative analysis of innovation policy measures (Schmidt & Sewerin, 2017a). A systematic understanding of the factors that influence the effectiveness of innovation policy instruments lacks. This paper contributes to resolving this issue by conceptualizing how innovation policies affect technological development on an organizational level and then systematically investigating their effectiveness and competitiveness using a computational model.

Background:

Policy instruments can affect organizations' technology design process at two distinct intervention levels: the technical level and the service level (Castaldi, Fontana, & Nuvolari, 2009; Saviotti & Metcalfe, 1984), and through three distinct intervention mechanisms based on Vedung (1998): coercing, evaluation-altering and search-facilitating. This leads to a typology of six fundamental policy interventions.

Methodology and empirical base:

We formulate this conceptualization as an NK-model (Kauffman 1993), which allows us to systematically investigate the impact of the six interventions. We score each intervention's impact along two metrics: effectiveness, in relation to the policy goal and firm competitiveness.

Results:

Regarding effectiveness, service-level coercing interventions increase the policy goal the most. After the policy it still has the highest persistent effect across all policies. Technical-level and service-level evaluation-altering interventions are also very effective. The overall competitiveness is increased the most by technical-level evaluation-altering interventions. However, when these interventions are discontinued, the overall competitiveness decreases to the starting competitiveness levels. The only interventions that improve competitiveness after implementation and discontinuation are those that facilitate search. The combinations of interventions that have largest effectiveness mostly lead to a modest improvement in competitiveness when the interventions are discontinued. An exception is the combination of

a service-level coercing intervention and a technical-level search-facilitating intervention. After discontinuation, this combination gives the largest increase in policy goal, and an improvement in competitiveness as well.

Conclusions:

The combination of service-level coercing interventions and technical-level search-facilitating interventions is most effective to guide incumbent firms through transitions.

E6 SUSTAINABLE RESEARCH

Thursday 06 June 2019 from 16:30 to 18:00

BIANCA POTÌ, Chair

Abstract 31

REGULATORY RESPONSES TO ASSISTED REPRODUCTIVE TECHNOLOGY: A COMPARATIVE ANALYSIS OF SPAIN AND ISRAEL

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Key words: Assisted Reproductive Technology (ART), In-Vitro Fertilization (IVF), Regulatory Assessment, Delphi, Egg Donation

Aims and Background:

Assisted Reproductive Technology (ART) involves a range of medical procedures centered on the development of human embryos, including In-Vitro Fertilization (IVF) and prenatal genetic screening (PGS). ART related issues are generating heated social debates, raising the need for updating regulations to avoid harmful effects of innovations, including through responsible research and innovation practices. The regulatory approach adopted by governments faces the challenge of coping with a moving technical frontier and a certain level of uncertainty concerning the risks and benefits of ART. Technological trajectories in ART have been shaping and stimulating the market, often generating more complex ethical dilemmas. For example, the ability to control fertility by cryopreservation and determine its outcome by genetic selection are expanding the motivations to approach IVF, threatening to disrupt natural reproduction (Shulman & Bostrom, 2014; Knoepfler, 2016).

In our work we compare how different institutional and cultural factors affect regulations and priority setting in two countries, Israel and Spain, which offer a fertile ground for comparative analysis, since they are amongst the most active users of ART (ESHRE, 2017; SEF, 2015; Health Ministry of Israel, 2018). We also review their regulatory responses to technological and market developments. This study can be framed within recent calls in the literature highlighting the importance of “regulatory assessment” of medical technologies (Ho et al., 2016; Hofer et al., 2015). It also builds upon the existing literature that has engaged in comparative analyses of ART regulations in the U.S., Canada, the U.K. and other European countries (Nelson, 2006; Brigham et al., 2013; Pennings et al., 2014; Präg & Mills, 2017; Jasanoff & Metzler, 2018). Finally, we take as a reference the work by Ogbogu et al. (2018), which provides a set of useful regulatory recommendations based on a workshop with scientific, clinical, health administration and ethico-legal experts.

We began by developing a conceptual framework to identify the main regulatory dimensions and categorize the potential factors affecting regulatory behaviors. Then, we conducted a comparative review of ART regulations in both countries.

Through a systematic literature review, we identified and classified the main dimensions of ART regulations, including the following:

- The institutional settings, namely the regulatory agency establishing ART regulations. Additionally, the preference of legislation or guidelines.

- The regulatory controls which are the legal framework of ART practice. We have focused on the eligibility criteria for IVF treatment; the market for gametes donation; preimplantation genetic testing; gestational surrogacy; and fertility preservation.
- Public support which includes epidemiological research and prevention; public funding of different treatment; and the management of activity and donor registries.

These dimensions were used to compare ART regulations in Israel and Spain. Additionally, we gathered the factors influencing regulation, dividing them into four main public interests as proposed by Johnson and Petersen (2008):

- Health interest are factors related to patients' safety and well-being; the prevention of infertility; reduction of disabilities and severe genetic conditions; prevention of negative impact on society's gene pool resulted from IVF; avoiding consanguineous marriage and reproductive risk; and securing access to donor's genetic identity and medical history.
- Economic interest are factors associated with a market approach: availability of public resources and procedures to set priorities; reduction of future public health expenditure; gains of efficiency; and promotion of commercial activity.
- Ethical interest can be distinguished as protecting children's open future; secure children's access to parents' identity; conversely supporting the autonomy of parents and donors; securing adequate information and legal framework.
- Socio-political interest includes religion, historical events, cultural traditions and social conventions; Perception of public health system and social responsibility; and the importance of fertility rates.

Methodology:

We applied a Delphi survey combined with in-depth interviews, addressing two groups of experts formed to simulate typical bioethics committees in each country. A Delphi is a qualitative interactive method based upon a quantitative survey with at least two rounds of answers. This process allows experts to reach a consensus or, alternatively, to foresee scenarios which may be used for challenging future uncertainties (Okoli & Pawlowski, 2004; Melander, 2018). Moreover, interviews enrich the analysis with deeper qualitative insights.

We began the Delphi by consulting members' lists of bioethics committees, assisted by an experienced member of the advisory board at the Spanish health ministry, and by the coordinator of the Israeli last bioethics committee, who provided some relevant contacts. We selected experts of multidisciplinary character, who have interest in ethical issues, whose careers were dedicated to ART from medicine, public health, law, ethics, philosophy, theology, sociology, economics or psychology (Bagheri et al., 2016; Gomes de Oliveira et al., 2017).

A set of 27 in-depth semi-structured personal interviews lasting one hour on average were conducted. 18 Israeli and 18 Spanish participated in the survey, which was based on four 10-point scale groups of questions about: a) the impact of different factors on ART regulation; b) experts' satisfaction with the way different aspects of ART provision are regulated; and c) their level of support to different policy measures to prevent infertility.

The survey was delivered in two rounds, for the second, we returned to each participant only regarding those questions for which consensus proxied by standard deviation (SD) was not reached ($SD > 2$) (Landeta et al., 2008). We marked for each expert only those answers which were out of the interquartile range, allowing them to change replies and provide additional

comments regarding their skewed positions (Okoli & Pawlowski, 2004; Landeta & Barrutia, 2011). The statistical analysis was complemented with qualitative insights gathered through the personal interviews and open comments from both Delphi rounds.

The interviews together with the available literature also enabled a regulatory comparison between the two countries, presented in the paper. This comparison assisted both to form the survey and with results' analysis.

The novel methodological approach used in this study, based on a combination of the Delphi method and in-depth personal interviews, may contribute to the broader field of regulatory assessment and foresight (Blind, 2008).

Results:

Regulations in both countries are elaborated by the health ministries. In Israel, the Ministry is occasionally advised by nominated committees, while in Spain legislation is advised by the National Committee of Human Assisted Reproduction (CNRHA).

Eligibility criteria in Spain are less strict, particularly in terms of age limits. It could be partially linked to the fact that private entities provide 80% of IVF cycles and run the gametes banks while being strongly involved in the regulatory process. In Israel, almost all treatments are publicly funded, although more than 50% are provided by private clinics (Kol et al., 2016).

Gametes donations are less restricted in Spain and the market for egg donations is very large (SEF, 2015; ESHRE, 2017). Conversely, in Israel local egg donations are very rare and most arrive from abroad (Birenbaum-Carmeli, 2016). Both countries are relatively open towards the use of PGD which is more generously publicly covered in Israel. PGS is privately funded in both, since only a modest advantage for employing it has been perceived so far.

Surrogacy is illegal in Spain and legal in Israel but privately funded and is significantly restricted. Cross-border surrogacy is practiced in both countries, however raising more polemics in Spain. Also, fertility preservation for medical reasons is more generously funded in Israel, while social fertility preservation is more liberally handled and less restricted in Spain.

Finally, The Spanish activity registry is comprehensive and reliable, following European and American standards. Conversely, Israel lacks a complete registry of activity, and for both countries there seems to be large gaps between the law requirements and actual elaboration of donor registries.

The experts were first asked to rate the optimal level of influence of key factors affecting regulations and to rate their actual impact according to their perception. According to both panels, health interest should have had more impact over ART regulations, current practices of ART in both countries fail to pay enough attention to scientific evidence and global trends of regulations. Consequently, patients are undergoing excessive number of treatments, particularly in an advanced age when prospects are low.

Regarding economic factors, both panels believed that private interests have excessive impact over regulations. Many Spanish experts criticized the excessive involvement of private stakeholders in the regulatory agency CNRHA, and their efforts to eliminate limitations on private clinics and donor banks. Israelis claimed that many doctors in key roles are ignoring evidence that should lead to policy changes, as it's against their own interest. The Spanish believed that budgetary constraints have an excessive impact over regulatory decisions. In

contrast, the Israelis claimed that repeated cycles for women of advanced age are draining public funds.

Under these conditions, both panels are preoccupied with reduced ethical interests, expressed by insufficient protection of vulnerable individuals from exploitation. Moreover, according to the survey, both panels stated that patients should have more autonomy in decision-making.

Regarding socio-political interest, the Israeli panel stressed that national fertility and public values have an excessive impact over regulations, while the Spanish panel would have preferred more impact by these two factors.

The panels were asked to rate their level of satisfaction with outcomes of regulations regarding different categories. Both panels indorsed more strict limits on cycles in private clinics concerning age, number of attempts, and securing proper diagnosis. Moreover, the problem of enforcement was raised, it was claimed Private clinics face no real limits in the application of any of the techniques.

While satisfaction was expressed regarding PGD, few Spanish experts criticized PGS as an instrumentalization of IVF by adding techniques, which are not always necessary and may be introduced merely to increase economic gains.

Spanish experts were unsatisfied with donor-eggs as the common solution to age-related infertility, since reimbursement for donation exceeds the minimum wage and the panel is worry of donors' exploitation. It was stated that in the absence of supervision and restrictions, private egg banks are exercising abnormal profits from donations. Alternatively, Israel experts were in favor of increasing compensation for egg donations to increase the currently very limited supply. Moreover, the panels were satisfied with anonymity of gametes donors, but it was mentioned that lack of access to parents' genetic material and medical history may constitute a discriminatory factor in the future, by reducing one's chance to be treated by precision medicine.

The Spanish panel was unsatisfied with regulations about surrogacy since prohibition doesn't prevent private companies to offer services abroad, what raises inequality in access and difficulties regarding child registrations. Also, both panels were not very satisfied with regulations of social fertility preservation. It was claimed that allowing or funding it would motivate women to use it. The panelists also warned of using this technology mostly at an advanced age, leading to ineffective results.

The Spanish were unsatisfied with clinics' capacity to respond to demand and with eligibility criteria for public services. They were generally in favor of increasing public provision of IVF cycles and favored the inclusion of egg donations and gametes banks in public health insurance. In contrast, Israeli experts were satisfied with public provision, however advocated to reduce the age limit and the number of cycles allowed. Comprehensive public funding of ART provides expectations and *"pressures women to keep trying cycles with their own eggs when prospects are low"*. Both panels were unsatisfied with donors' registries, underlining the gap between law and enforcement. Moreover, Israeli experts expressed strong dissatisfaction with the lack of proper activity registry.

The experts suggested different possible solutions that could be adopted to address increasing infertility and demand for IVF. Their comments emphasized non-medical solutions, such as social support, education and facilitating adoption.

In Spain, the panel advocated to increase social support policies for young parents. Also, both panels highly supported securing proper diagnosis of infertility, distributing more information

regarding causes and success rates of ART, and dedicating more resources to detect environmental factors, prevent and cure. The Spanish panel favored funding fertility preservation, while the Israelis preferred funding more egg donations, considering its low popularity in Israel.

Conclusions:

According to our results, the Spanish public health system has failed to fully respond the increasing demand for IVF, leaving the market to the private sector, while legislation is insufficient and too often not enforced. The current regulatory situation creates unequal access to services and casts heavy burden on patients.

In contrast, Israel has a comprehensive public funding, but cycles for women older than 40 years using own eggs have a-priori low prospects and patients are repeating many cycles (Kol et al., 2016), spending public resources and may face physical, emotional and financial damage. Donor-eggs as a possible solution carries a significant problem since egg (or embryo) donations law is political-religious while Jewish law (in contrast to the civil) prohibits to receive donation from another Jewish woman. As a result, donations are limited and expensive, very unpopular and most donor-eggs arrive from abroad.

When considering the solution of donor-eggs for age-related infertility, it is valuable to learn from the Spanish case. Currently, cycles with donor-eggs among patients older than 40 provided 32% birth rate (in contrast to merely 6.6% for non-donor cycles). However, using gametes from young donors is not always an optimal solution that allows increasing the age of the recipients. In 2013, Spain accounted for 45% of total egg donations in Europe (ESHRE, 2017), and in 2015 at least 27,769 cycles of egg donations were performed in Spain, involved thousands of donors and provided more than 10,000 children (more than 30% of total births) (SEF, 2015). The magnitude of this phenomenon emphasizes health and social risks to egg donors. Moreover, it stresses the importance of central and comprehensive donor-registries, since within few decades, hundreds of thousands of children will have no access to one or both of their parents' genetic database, medical history and civil identity and may face large disadvantage considering the growing weight of genomics and precision medicine.

Another upcoming solution is fertility preservation, more strongly supported by the Spanish panel. However, regulations on this field should be revised, particularly regarding age limits, since preserving eggs after the age of 35 is less effective.

Prevention of infertility by epidemiological studies is of utmost important and may be enabled by more comprehensive data collection and transparency. In order to serve such purpose, registries of clinical diagnosis should be added in Spain, i.e. the reasons for referral to IVF. Conversely, Israel, in practice, has no activity registry, although since 2015 initiatives were taken to form a more comprehensive report. There is an urgent need to embrace this initiative.

Three broader conclusions emerge from our study: First, in both countries, ART is often wrongfully perceived as a solution to age-related infertility. Our findings raise the need to observe current socio-economic factors which influence infertility and consider additional solutions. Particularly the Spanish case may set an example for how financial reasons and reduced public policy lead to social vulnerability, which stands behind parenthood postponement and results in an increasing demand for ART. Additionally, public campaigns through media, health and educational systems, and distribution of accurate information regarding age-related and environmental factors of infertility and regarding ART, could be adopted.

Second, excessive number of IVF cycles, as well as treatment additives such as PGS, are sometimes “pushed” by the system even though their benefit to treatment is unclear.

Third, an appropriate regulatory approach at this stage would be to set a (non-governmental) statutory central regulatory agency, devoid of commercial interest. Such an agency could facilitate regulatory decisions and set up the required donors’ registries, the importance of which will only increase in years to come. While such an agency would be novel in Israel, to comply fully with this approach it would also be necessary to reform the Spanish CNRHA.

In sum, our regulatory assessment study combining insights from Israel and Spain draws attention to a number of controversial issues that would need to be addressed by regulators in the future. Given the expected technological progress in ART and its deep implications for humankind, further research and policy debates are necessary in order to engage in a more systematic regulatory foresight that may better guide government responses.

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Abstract 38

EVALUATION FRAMEWORK AND METHODS FOR CONVERGENCE RESEARCH: CASE ON GM CORNS RESEARCH AND INNOVATION IN CHINA

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Keywords: evaluation framework and methods, convergence research, societal grand challenges, genetically modified corns, China

1. Background and objectives:

Nowadays people are still facing many societal grand challenges such as food crisis, energy shortage, environment pollution, and climate change, et al., whose solutions rely heavily on responsible research and innovation. As is known to all, traditional R&DI activities and related policies are mainly disciplines oriented, instead of problem -solving oriented. For example, large national research funding agencies allocate funds mainly based on disciplines such as physics, mathematics, and biology, and comparative analysis on national innovation capabilities are traditionally focused on specific disciplines such as the annually published “Nature Index” (Spring Nature, 2018). In this context, the rise of convergence research paradigm has been paid much attention to, and even be regarded as the third revolution in science and innovation (MIT, 2011). Convergence research as a new research norm, integrates knowledge, tools, and thinking patterns from diverse areas such as life and health sciences, physical, mathematical, and computational sciences, engineering disciplines, and beyond to address grand and complicated scientific and societal challenges that exist at the interfaces of multiple fields (NRC, 2014). Consequently, new ways of organizing, investing, and evaluating are required to foster the development of convergence research, which provide promising power to address societal grand challenges above. So the purpose of this proposal is to develop appropriate evaluation framework and methods for convergence research, which would be valuable to compare national capabilities in solving societal grand problems.

In order to develop appropriate evaluation framework and methods for convergence research, in the past two years a research group in Chinese Academy of Sciences has conducted an evaluation study to construct a novel evaluation framework which reflects the following four features of convergence research: problem-solving orientation, multi-disciplinary integration, knowledge diffusion and coherence along innovation value chain, and involvement of diverse stakeholders like government, academy, industry and public. Besides, this group also implemented this new framework in the case of GM corns, through which specific evaluation methods were developed to support the framework. The reason of selecting GM corns as the case is because, in China the shortage of corns in industrial use is seriously effecting the development of related industries. Every year China imports large amount of GM corns to fill the gap of corns in industrial usage. Technologically developing and commercially planting GM

corns is obviously one of the societal grand challenges in China, and its solution requires the approach of convergence research because traditional research is lack of problem-solving orientation.

In this article, the new evaluation framework for convergence research are developed and evaluation methods supporting this framework are studied on the case of GM corns in China. This research is closely related with the new evaluation methods and instruments for responsible research and innovation, and therefore this article would fit TRACK4: RRI and the responsiveness of science and technology developments, institutions and policies.

2. Theoretical framework and methodology:

2.1 Evaluation framework

In order to evaluate the effect of convergence research in addressing societal grand challenges, the key element is to analyze the knowledge transition along innovation value chain, i.e. whether the knowledge from basic research support applied research, whether the technology from applied research lead to experimental demonstration, and whether the results of experimental demonstration lead to marketed products or solutions and finally solved the aimed problems. In another word, evaluating the coherence of different kinds of R&DI activities across innovation value chain, oriented by specific grand societal challenges (such as the theme of GM corns below) is the principle line here because convergence research is born to solving problems instead of solely producing knowledge or technology.

Besides this principle line, there should also be two complementary but also important elements in this framework. The first one is to evaluate whether different disciplines are effectively integrated in solving the aimed societal grand problems, and the second one is to evaluate whether diverse stakeholders are effectively involved in the process of problem solving. These two elements could be synchronously evaluated with the principle line, because the output data for the principle line could also be analyzed from these two perspectives. For example, when we collect output data and analyze the knowledge diffusion from papers (the major output of basic research) to patents (the major output of applied research), we could do that from the level of disciplines or institutes, which will illustrate the integration among different disciplines and also the major stakeholders involved.

Based on above philosophy, an evaluation framework for convergence research is constructed, which is composed of one principle line and two supplementary lines as stated above. This evaluation framework reflects the distinctive features of convergence research, and accordingly requires development of new evaluation methods to implement it.

2.2 Evaluation method

First and foremost, the methods for the principle line (evaluting coherence of different kinds of R&DI activities across innovation value chain) in above framework should break the boundaries of different R&DI activities, and then connect the output data of all kinds of R&DI activities and form a lined-up data chain covering from basic research, applied research, demonstration research to marketed production. Previously research on two branches of knowledge diffusion provide important basis. The first one is research on science-technology

transition using non-patent-references approach (Narin et al., 1995, 1997), and has become a hot topic since the latest decades (Meyer, 2000, 2006; Gao et al., 2012; van Raan, 2017; Sudhindra et al., 2017). Another one is research on technology-industry transition, which is based on the reflection between patents categories and industry categories (Comanor and Scherer, 1969; Kortum and Putnam, 1997; Lybbert and Zola, 2014; Tian C and Zhao YJ, 2017). These two branches are separated in traditional paradigm, however convergence research is deemed to bridge discovery and innovation intentionally (Sharp, 2014), and pushes the knowledge transition along the whole innovation value chain, oriented by specific societal grand problems.

Therefore, we firstly adjusted the two branches of knowledge diffusion research with the orientation of problem solving, and then combined the two adjusted branches of research to develop a specific method of collecting data for the evaluation of the principle line. In more details, the first step is to select several keywords standing for specific problems in aimed societal grand challenges, which could be done by consulting with bibliometric experts and scientist in related areas. The second step is to retrieve all patents data with the selected keywords from all technology categories in patents databases such as Thomson Innovation, which form the outputs of applied researches (core patents). The third step is to collect all papers cited by core patents from databases such as Web of Science (cited papers), and also all patents cited by core patents from databases such as Thomson Innovation (cited patents). The fourth step is collect all patents citing core patents from databases such as Thomson Innovation (citing patents), and commercialized production or market data based on core patents from public database, such as FDA Orange Book for medicine research, or ISAAA and USDA information about GM varieties and planting areas (market data). Through above four steps, inter-related output data of basic research, applied research, demonstration research and marketed production are gathered and lined up.

There are mainly three perspectives in analyzing above lined-up data. Firstly, all types of output data along the principle line are analyzed on the level of nations, so that we could compare different nations in terms whether different kinds of R&DI activities in each country are converging to address specific societal grand challenges. Secondly, core patents, cited papers and cited patents data are analyzed on the level of disciplines with Sankey tools, so that we could look into the integration of different disciplines from basic research to applied research, and also from applied research to broader industrial use. Thirdly, the major contributors (universities, research institutes, enterprises, et al.) in above two perspectives of analysis are identified, and then used to compare the involvement of diverse stakeholders in each countries.

3. Empirical analysis and result:

3.1 Data collection

As stated in background, technologically developing and commercially planting GM corns is one of the societal grand challenges faced by China, and its solution requires the approach of convergence research. So we implemented above evaluation framework and methods in the

case of GM corn to compare China and related countries in terms of capability of convergence research to solve this societal grand problems.

There are mainly four kinds of research activities along GM corn innovation value chain: basic research producing knowledge about GM plants, technology development producing GM corn related patents, government approval of GM corn varieties, and GM corn commercialized planting. Firstly, we selected several keywords working with some bibliometric experts and scientist in the area of GM plants. Then, we used these keywords as clues to collect the lined-up data of GM corn through the steps stated above.

In total, there were 4596 GM corn related patents from 2006 to 2015 retrieved with selected keywords from TI databases (core patents). Papers and patents cited by these core patents were then retrieved from Web of Science (980 cited WOS papers, books and websites papers were excluded) and Thomson Innovation (5670 cited patents) respectively. Also, patents citing these core patents were retrieved from Thomson Innovation (9334 citing patents). Data of governmental approval of GM corn varieties (events) and commercialization planting were retrieved from GM approval database publicly provided by International Service for the Acquisition of Agri-biotech Applications (ISAAA), and US Department of Agriculture website.

3.2 Analysis and results

Core patents, cited papers and cited patents data of GM corns were analyzed on the level of disciplines, which depicts the converging of features of GM corn related research. On the one hand, diverse areas of basic researches (botany, genetics, biochemistry and molecular biology, interdisciplinary, biotechnology and applied microbiology) and diverse areas of applied researches (GM plants, botany, plant growth regulators, stress tolerance and insect resistance) together supported the patent development of GM corns, which also reflects the knowledge diffusion from basic research to technological development. On the other hand, from the perspective of technology follow-up diffusion and industrial application, the patents of GM corns are mainly applied in pharmaceutical manufacturing, agriculture, chemical raw materials and chemical products manufacturing industries, among which the manufacturing industry has the largest distribution. Its main technology sources include genetically modified plants, vectors, plasmids and so on. It mainly involves the production of medical protein materials, lysine and other related genetic engineering methods.

Analysis on the level of countries and organizations showed that, USA has obvious advantage in comprehensive capacities in cohering different types of research activities in GM corn to solve crop crisis problems. Compared with USA, China has somewhat competitiveness in the basic research of GM corns, but it shows obviously shortage in using basic research to support patents of GM corns, and develop GM varieties, which explains a lot why China is behind not only USA but also some developing countries in commercialized planting of GM corns. Details results are as below.

(1) From basic research to applied research

China shows a certain competitiveness in producing papers and patents in GM corns, but only 3.2% of cited papers and only 6.8% of cited patents came from China, which shows weak capability of China in providing basic knowledge and tools for development of GM corns technologies. Beside, the absence of Chinese institutes or universities or enterprises in top 10 organizations listed by either cited papers or cited patents also illustrates the low coherence capabilities from basic research to applied research in GM corns in China.

Compared with China, USA research institutes, universities and enterprises proved strong capability in supporting basic knowledge, theories, tools and methods in GM corn technology development. In details, the largest percentage (48.3%) of papers and patents (81.7%) cited by global GM corn patents came from USA. Percentage of cited papers or cited patents from other countries are all less than 10%. Among the top 10 global organizations provided reference papers for these patents, there are seven USA organizations spreading from universities, research institutes and enterprises. And especially two USA enterprises (Dupont and Monsanto) provided half the cited patents around the world.

Countries	Cited papers	Global percentage	Organizations	Cited papers	Global percentage
USA	473	48.3	University of California, USA	50	5.1
UK	97	9.9	Department of Agriculture, USA	46	4.7
Japan	62	6.3	Monsanto, USA	32	3.3
Germany	49	5.0	Dupont, USA	32	3.3
France	36	3.7	John Innes Centre, UK	28	2.9
China	31	3.2	INRA, France	23	2.3
Swiss	30	3.1	University of North Carolina, USA	20	2.0
Canada	30	3.1	Max Planck Institute, Germany	20	2.0
Australia	29	3.0	Iowa State University, USA	20	2.0
Netherland	24	2.4	Cornell University, USA	20	2.0

Table 1: Top 10 countries and top 10 organizations in producing papers cited by GM corn patents

Countries	Cited patents	Global percentage	Organizations	Cited patents	Global percentage
USA	2890	81.7	Dupont, USA	818	23.1
Germany	290	8.2	Monsanto, USA	933	26.4
China	240	6.8	Syngenta, Swiss	83	2.3
Japan	174	4.9	Dow AgroSciences, USA	92	2.6
Canada	170	4.8	Mendel Biotechnology, USA	42	1.2
Swiss	147	4.2	Bayer, Germany	157	4.4
France	133	3.8	BASF, Germany	33	0.9
Belgium	116	3.3	Japan Tobacco, Japan	32	0.9
UK	88	2.5	Ceres, USA	30	0.8
Netherland	69	2.0	Hexima, Australia	23	0.7

Table 2: Top 10 countries and top 10 organizations in producing patents cited by GM corn patents

(2) From applied research to research demonstration

In order to commercialize GM corns technology, the premise is to develop new varieties based on related patented technologies, especially to obtain safety certificates through intermediate experiments. Data analysis shows that there is a big gap between the capabilities of developing new varieties of GM corns in China and that of other countries.

As of 2016, 149 GM corn transformation events have been approved for commercial production, among which USA has the largest percentage (62%), followed by Switzerland (32%). Institutionally, six large transnational corporations from six countries, such as Syngenta, Monsanto, Dupont, Dow's Benefiting Agriculture, Bayer and Basf, have almost monopolized (more than 96% in total) the commercial research and development of GM corns. China also approved the safety certificate of orygin-transphytase corn by Origin Agritech Company in 2009, but this is the only transformation event in China. Nowadays, in addition to that company, there are four other enterprises in China which have entered the application stage of safety certificate for GM insect-resistant corns, but none of these companies have their GM corns varieties commercially planted.

(3) From research demonstration to marketed production

Globally, the large-scale commercial cultivation of GM corns began in 1996, and since then the cultivation of GM corns has maintained a relatively rapid growth, but China lags behind the United States and some developing countries in this respect.

United States is the earliest country and also has the largest country of GM corns planting area in the world, with 90% of its domestic corns is GM corns. Transgenic corns traits grown in the United States include HT (herbicide tolerance), Bt (insect resistance) corns and their superposition (Stacked). Among them, Bt corns and HT corns have been growing in the United States since they were introduced. Over the past 10 years, the proportion of GM corns grown in developing countries in the world has been increasing year by year. At present, GM corns has been commercialized in eight developing countries, such as Brazil and South Africa, and the planting area has increased rapidly.

The research and development of genetically modified corns in China began in the late 1980s. With the strong support of the Chinese government, a number of functional genes with independent intellectual property rights have been cloned, which laid a solid foundation for industrialization. The first safety certificate for production and application of genetically modified corns with phytase was approved and issued in 2009. However, due to the anti-GM people, public distrust and even the government's choice, the research and development of phytase gene Corns in China is still in the stage of variety approval, and has not been really applied in production.

4. Conclusions:

From the perspective of evaluating research capabilities in solving societal grand problems, a new evaluation framework and methods for convergence research covering from basic research, technology development, product development and market development has been constructed based on the new paradigm of convergence. Based on data availability and the background of serious shortage of corns in industrial usage in China, the case of GM corns has been chosen to implement the new evaluation framework and methods. The empirical analysis of GM corns verifies the feasibility of the new framework and methods, and draws important results on Chinese capabilities in solving the problem of corns shortage from the perspective of convergence, which also illustrates the value of this new evaluation framework and methods.

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BRIDGING ORGANIZATIONS IN RESPONSIBLE RESEARCH AND INNOVATION SYSTEMS: BRIDGES OVER LESS TROUBLED AND MORE RESPONSIBLE WATERS?

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Aim of the proposal:

Responsible research and innovation (RRI) has become a proto-paradigm in innovation studies and policy literature (Ribeiro, Smith, and Millar, 2017; Stilgoe, Owen, and Macnaghten, 2013) but we still know very little about how this framework could be applied in broader innovation systems. Wickson and Forsberg (2015:1176) argue that “the perspectives on innovation offered so far in RRI need to better take into account innovation systems in all their complexities”. Here we posit that gaining insight into ‘bridging organizations’ (BOs) in systems, could increase our understanding of how ISs might become more responsible.

The concept of Innovation System (IS) replaced the previous linear innovation models which deem that the main role of public policy was to fund basic scientific research). In contrast to this paradigm, the IS perspective focusses on the heterogeneity of the actors involved in innovation processes and the importance of their relationships in specific geographic, institutional, and technological contexts (Schot and Steinmueller, 2016). IS research stresses, for example, the relevance of knowledge transfer via university–industry relationships (D’Este and Patel, 2007) through formal or informal interactions and relationships which often require bi-directional transfer of knowledge and skills. Based on the crucial importance of the relationships among actors in ISs, several studies have highlighted the role of BOs (Sapsead, Grantham and De Filippi, 2007), also known as ‘intermediaries’ (Howells, 2006), ‘boundary organizations’ (Guston, 1999), or ‘brokers’ (Sapsead et al., 2007). BOs perform various activities (see Howells, 2006, for a review), but the most commonly described one is the “establishment and maintenance of interactions among various actors of the system” with the objective of fostering knowledge transfer (Carlsson and Stankiewicz, 1991:16).

We argue that ‘responsible’ BOs are crucial for the development of more responsible ISs. At the policy level, the European Commission and some countries, including Norway, the Netherlands, and the United Kingdom have acknowledged the utility of RRI approaches. In these contexts, public agencies—who are among the most important IS stakeholders—are adopting RRIS to conceive, design, and implement new innovation policies. However, according to Owen and Hartley (2017), to allow RRI initiatives to deal with governance issues, they must function at the systemic level, rather than being embedded into certain policies at only some institutions. We believe BOs are a natural target for systemic innovation policies informed by RRI perspectives. This paper is a theoretical proposal of normative considerations for BOs under the perspective of RRI.

Background: BRIDGING ORGANIZATIONS

Knowledge transfer is the most noteworthy among the many relationships that BOs facilitate between the actors in ISs. Knowledge can be transferred between actors in the system by three kinds of organization: (1) university-based technological transfer offices (TTOs) which

promote relationships between the academic community and private industries (Padgett and Powell, 2012); (2) public organizations such as government agencies which are often sectoral and focus on developing specific industry sectors (López-Estornell, Barberá; Más, García-Reche, 2014) by establishing and maintaining relationships among companies at the same or different levels in the supply chain (Cole and Barberá, 2013); (3) private (often non-profit) organizations that receive public funding and also work to cultivate cohesion in different industrial sectors (Sapsead et al., 2007).

Within innovation studies, TTOs are the most analyzed type of BO; one of its most important (and studied) functions is to transfer knowledge via patents and form bridges between universities and industry by managing the patenting and licensing processes. For example, the Stanford University TTO brokered the transfer of technology from the Cohen–Boyer patent—which describes the process of gene transplantation from one living organism to another—to the biotechnology industry in the 1970s (Feldman, Colaianni and Liu, 2007 and 2005; Feldman and Yoon, 2011). By the end of 2001, they had accrued US\$255 million in licensing revenues on behalf of Stanford and the University of California by managing these patents. This case is considered the gold standard for university technology licensing because of their pragmatic decisions and flexibility, which allowed them to adapt their licensing strategies as circumstances changed (Feldman et al., 2007:1797). Indeed, Feldman et al. praise “the creativity and adaptability of [Stanford’s TTO] in setting up their licensing program and the myriad of decisions that guided the ultimate outcome” (2005:12) and describe this strategy as “brilliant because they made more money than they possibly could any other way” (Feldman et al., 2005: 32).

In all this work, the relationships among actors help to improve the economic efficiency of technological knowledge transfer and TTOs play a role in establishing and mediating these economic relationships. In these cases, the knowledge is mostly explicit, technological, and formalized as patents, but BOs also facilitate the transfer of other kinds of knowledge, such as the case of tacit knowledge. For example, Sapsead et al. (2007) discuss the case of a non-profit BO in the electronic games industry in the United Kingdom which received regional-government funding. This BO fostered the transfer of tacit knowledge by organizing ‘clinic’ events to introduce entrepreneurs to industry experts and measured their success in terms of their subsequent development of entrepreneurial companies. In this setting the place (i.e. the clinics) was one of the most important factors in encouraging useful interactions—and efficient knowledge transfer flows—between relevant actors in the IS.

Although a lot of research in this field has a strong regional focus (López-Estornell, Barberá-Tomás, García-Reche and Más-Verdú, 2014; Ahedo, 2006; Grandadam, Cohendet and Simon, 2013), there are also some international examples. In the European animation industry IS, Cole and Barberá (2013) explored how BOs nurture new connections and interactions among relevant actors (producers, animators, entrepreneurs, and regulators) by facilitating: (1) explicit knowledge transfer (e.g. in the form of ‘codebook recipes’ for innovation practices); and (2) tacit knowledge transfer via interactions among ‘field configuring events’ (e.g. fairs and meetings) which help to structure the IS (Garud, 2008); in fact, the latter appeared to more efficiently foster the emergence of a new European animation industry IS.

However, despite the contribution of research by BOs, in our view, focusing exclusively on the role that tacit or explicit knowledge transfer plays in producing economic benefits impoverishes the debate about the nature of the relationships these BOs should foster. We argue that analyzing certain aspects of RRI can illustrate the relationships involved in ISs and in this sense, BOs can leverage ideas including governance, deliberation, and discursive and collective responsibility to promote more responsible RRIss.

Methodology and empirical base:

This paper is a theoretical proposal of normative considerations for BOs under the perspective of RRI.

Results:

RESPONSIBLE INNOVATION SYSTEMS? INSIGHTS FROM THE LITERATURE ON RESPONSIBLE RESEARCH AND INNOVATION

This section is now under construction. In the final version of this paper presented in the conference we will build on existing research on RRI to identify some essential RRIS traits, including motivation for broader community involvement, consideration of alternatives beyond the current conception of 'innovation', a focus on collective responsibility, and inclusion of non-technical and participatory visions of a shared future among other essential traits. We argue that a systemic perspective based in RRI perspective should include these elements, which could guide the role of BOs by trying to offer complementary ideas to aid constructive dialogue. See Figure 1 for a list of essential traits of a responsible research and innovation system

Conclusions:

BRIDGING RESPONSIBLE RESEARCH AND INNOVATION SYSTEMS: RELATIONSHIPS BETWEEN DIFFERENT ACTORS AND NORMATIVE CONSIDERATIONS FOR BRIDGING ORGANIZATIONS

The privileged position of BOs as intermediaries, brokers or 'bridges' between actors makes them a good target for promoting RRIS within policy and theoretical frameworks. Building on the essential traits of RRIS that we will develop in the final version of this paper, we could understand how BOs could help ISs to become more responsible.

DELIBERATIVE PROCESSES SHOULD INCLUDE A BROADER SELECTION OF OPPOSING OPINIONS, CRITICAL VIEWS, AND AN UNDERLYING UNDERSTANDING OF THE DEFINITION OF 'PROBLEMS'

A transformative and responsible shift to systemic approaches must include actors like public or civil society (which are usually excluded) and must commit to achieving meaningful inclusion. For example, in the polemic area of synthetic biology in the United Kingdom, Marris observed that social movements ('lay people' in terms of scientific knowledge) were absent from engagement processes, social scientists were sometimes presented as 'public' participants in these arenas, and social scientists favorable towards genetically-modified organisms (GMOs) were selected (Marris, 2015). Furthermore, patient groups with an interest in drug development were presented as neutral non-governmental organizations and the public was perceived as irrationally fearful of these GMOs, even though some qualitative studies concluded that, rather than fear, issues with transparency and accountability were the underlying reasons they rejected GMOs. Thus, immaterial public engagement and a naïve or self-interested understanding of 'the public' can harm governance systems. Equally, diversity must influence institutional logics and the ideas they support. Different actors have different perceptions of the main debates and of how these should be framed. In areas such as gender equality with a longer trajectory even before it was included under the umbrella of RRI, scholars have already demanded reflection and honesty in the understanding of gender issues—which may differ according to each stakeholder (Bacchi, 2005)—considering gender

policies as 'clusters' of views on gender problems (Verloo, 2007).

ACKNOWLEDGE POWER, INTEREST RELATIONSHIPS, AND DIFFERENCES IN INCENTIVES FOR TRANSPARENCY AND PARTICIPATION IN THE CONSTRUCTION OF SYSTEM INSTITUTIONAL LOGICS

Corporations are hugely important in current ISs and so it is vital to understand their roles and whether they should participate as citizens rather than specific economic actors in system governance. The experience of corporate social responsibility (CSR) self-regulation could constitute an example of companies' roles as citizens. However, stakeholder accountability and democratic control remains a problem in companies (Crane, Matten, and Moon, 2004) and indeed, increasing corporate power in democratic systems has resulted in the emergence of CSR research. The moral legitimacy of companies should lie in deliberation processes beyond corporate lobbying but is currently based on the perception that they play an a-political role and in the "widely accepted rhetoric assuming that all members of society benefit from capitalist production" (Palazzo and Scherer, 2006:71). Nonetheless, deliberation and communication with other actors is not easy in innovation environments, especially where companies acquire their competitive advantages from information asymmetry, and their returns on investment are not shared with every stakeholder. The promotion of mutual responsiveness must consider that economic incentives such as further profit, as well as power relationships, could drive corporate participation in research and innovation governance even if these do not explicitly match the incentives of other actors such as civil organizations (Blok and Lemmens, 2015).

CAREFULLY ASSIGN WEIGHT TO THE VALUES OF DIFFERENT ACTORS AND TO BELIEF IN THE TRANSFORMATIVE CAPACITY OF CONVERSATION AND DIALOGUE BEYOND ACTIONS ALONE

When different stakeholders are participating, there may be conflicts related to 'dissensual communication' (i.e., based on differences in identity or values) rather than in interests (Rowley and Moldoveanu, 2003; in Palazzo and Scherer, 2006). In this context, conversations (rather than actions) are more likely to lead to common identities that can drive collaboration (Hardy, Lawrence, and Grant, 2005).

CONSIDER KNOWLEDGE CO-PRODUCTION, INCLUDING ETHICAL KNOWLEDGE, AND EMOTIONAL DIMENSIONS IN THE FRAMEWORK OF GENERAL RESPONSIBILITIES

Actors are usually included in a way that avoids dividing and specifying their roles and responsibilities, however this could hinder the achievement of mutual responsiveness between them (Von Schomberg, 2014; Blok and Lemmens, 2015). Valuable experience was garnered from the ELSI program regarding the division of labor between research-focused life scientists and engineers versus the social scientists responsible for ethical reflections, group care, and affective dimensions (Balmer et al., 2015). These are key issues in interdisciplinary collaborations but are still based on separated role responsibilities. The ELSI program detected some problematic criticisms directed at social scientists (e.g., perceptions that they parasitize interdisciplinary research group funds) which may relate to the perceived unimportance of these issues by non-social sciences researchers. In this sense, interdisciplinary performance has identified the need for 'reflexivity inducer' or 'knowledge co-producer' roles. Nonetheless, we must still overcome attitudes of resistance and the failure to acknowledge the expertise

of social sciences or humanities researchers in these contexts. Collaborative reflexivity and risk-taking, shifting and experimenting with different roles, and dealing with power relationships and their affective dimensions, may help to soften possible conflicts in such daily collaborations (Balmer et al., 2015). Good practices and case studies are still scarce in RRI because of the field's newness; nonetheless, some experiences have succeeded in constructing visions of responsibility. These include the Dutch Rathenau Institute (Van Est, 2010 in Von Schomberg, 2014) and the SPICE project interdisciplinary panel that worked in geoengineering using a 'state-gate' strategy (Macnaghten and Owen, 2011).

UNDERSTAND RESPONSIBLE RESEARCH AND INNOVATION FACILITATION AS A CORE ISSUE WITH A RECOGNIZED POLITICAL DIMENSION IN THE ACTIVITIES OF BRIDGING ORGANIZATIONS

In its widest sense, RRI could help deal with the tendency towards pre-conceived ideas, democratic deficits, and de-politicization. Actors embrace both general and role-based responsibilities, and so politics can allow RRI to be used as a tool for participating in science and innovation governance. Universities have shown that RRI perspectives can facilitate this process, although this can only happen when dialogue is conducted through interdisciplinary and mutual learning, integrating RRI as a pillar rather than considering it an external activity (Hartley et al., 2017).

FOCUS ON PEOPLE WHEN ANALYZING BRIDGING ORGANIZATIONS' PERFORMANCES, ASSESSMENTS, AND RESEARCH

Some studies have suggested that, compared with entrepreneurship research, gender perspectives are absent in innovation studies. This may be related to the way that innovation studies focus on processes, outcomes, or organizational typologies while entrepreneurship studies tend to focus on people. When individuals are hidden in studies, diversity and other socio-personal considerations are also easily hidden (Agnete Alsos, Ljunggren, and Hytti, 2013).

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E7 UNIVERSITY AND INDUSTRY

Thursday 06 June 2019 from 16:30 to 18:00

ANTOINE SCHOEN, Chair

Abstract 132

MANAGING SOCIETAL COOPERATION IN UNIVERSITIES: A SYSTEMATIC REVIEW OF THE EVIDENCE

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Aim of the proposal:

The aim of the paper is to synthesize scholarly knowledge on the management of societal cooperation in universities for the creation and utilization of academic knowledge. The findings from a systematic literature review are used to structure and accumulate the state of current knowledge in research addressing how universities manage societal cooperation to strengthen and expand their teaching and research, as well as to highlight opportunities for further research in this area.

Background:

Universities are currently facing growing expectations from policy makers and the general public to assume broader societal responsibility. This expectation adheres from the increased importance of knowledge production for economic and social development, and from the call on universities to address contemporary challenges in society as the very foundation for its existence (Schmitz et al., 2017). The increased responsibility for addressing societal challenges has demanded a recasting of university tasks and greater responsibility for embedding academic knowledge in social and economic networks that expand traditional higher education missions (Caryannis & Campbell, 2012). Among others, this development has resulted in multiple and diverse efforts within and across universities aimed at building up structures and capabilities to enable the management of societal cooperation for this purpose.

The incorporation of societal cooperation alongside traditional research and teaching tasks is posing important strategic and managerial challenges for universities. The societal interface of university tasks is wide-ranging, heterogeneous, and complex (Caryannis & Campbell, 2006; Jonsson et al., 2015). It includes variable interactions between several spheres of society, ranging from commercialisation and coproduction of research-based knowledge, to student placements, and alignment of educational programs (Jacobsson & Perez Vico, 2010). Overall, this requires universities to build and develop structures and capabilities that not only enable them to undertake new and increasingly complex responsibilities as change agents in society, but which at the same time complements and strengthens their traditional key activities such as scholarly teaching and research.

In this study we approach the societal cooperation of universities from a systemic perspective (e.g., Freeman 1987; Lundvall 1992; Edquist, 1995) where innovation is seen as resulting from continuous interactions and knowledge exchange between organizations. Due to the tacit nature of knowledge, universities often innovate through interactions with private firms and public organizations (Caryannis & Campbell, 2012). Building and developing such interactions across heterogeneous scientific and technological disciplines is a key challenge for universities

with ambitions to meet the growing pressure to contribute to the social and economic development of their localities. In this respect, universities need to make higher education more effective by expanding their outreach activities while at the same time avoiding or managing conflicts and sustaining commitments for societal cooperation.

Universities face great pressures to develop structures and capabilities that enable them to successfully manage societal cooperation in a way that can both strengthen and expand their higher education missions. However, to date there is scarce research which systematically address this issue. We can identify at least three reasons that underlie this unfortunate situation. First, the scholarly interest in the societal cooperation of universities has chiefly focused on either 'macro' (i.e. policy and national systems) or 'micro' (i.e. individuals) levels of analysis, while the attention given to how societal cooperation is administered at the meso/organizational level has been lukewarm (e.g., Perkmann et al., 2013; Jonsson et al. 2015). Second, the stream of literature that has focused on university-industry interactions has shown a limited interest in how universities partner together with diverse stakeholders in mutually complementary and reinforcing research, education, and innovation activities (Carayannis et al., 2018). Rather, the primary interest has been on how universities and academic staff engage in activities aimed at pushing out inventions to be commercialized via patenting, licensing and spin-offs (Clarysse et al., 2005; Bramwell and Wolfe 2008; Geiger and Sá 2008). Third, the research that target and focus how universities build and maintain partnerships to raise the joint innovative performance by combining resources and processes of interactive learning appears scattered across a relatively wide range of scholarly journals. In this respect, the available bulk of scholarly knowledge that provide research-based evidence of how universities target and focus societal cooperation to meet sustainable development goals remains limited.

In all, the current fragmentation that seems to characterise the field calls for a need to systematically review and accumulate the knowledge that is available, as to build a more comprehensive base for further scholarly inquiries. To meet this challenge, we present in this paper a systematic review of the literature on the management of societal cooperation in universities. The research question guiding our study is framed as follows: what is the state-of-the-art in research on how universities manage societal cooperation for the creation and utilization of academic knowledge, and what do the available evidence inform about how to generate favourable organisational conditions for this purpose?

Societal cooperation is defined as situations when universities partner together with non-academic actors to solve problems in society or the economy in an enabling sense, thus making all actors more able to do something together. Non-academic actors include industry, the public sector and other types of organisation (e.g. NGOs), as well as the public at large. Academic knowledge is defined as the justifiable understanding of a subject that is the result of the application of academic methods. This is largely in line with Popper's (1962) understanding of scientific knowledge but expands the definition by also including the educational realm. As we seek to develop the understanding of the formation and implementation of structures and capabilities that are administered at the organizational level this is our deliberate focus throughout the paper.

Methodology and empirical base:

Methodologically, we employ a systematic literature review in order to take stock of the current knowledge base on the management of societal cooperation in universities. Our review methodology follows the principles of Denyer & Tranfield (2008; see also Gough et al. 2012), where the various steps undertaken in the process are made explicit to enhance the validity, rigour and generalizability of our findings.

Following available guidelines, our systematic literature review was initiated by setting the research objective and defining the conceptual boundaries of the review. In this step we also developed a coding scheme to enable systematic collection of relevant data in line with the review objective. We used specific inclusion criteria to build a comprehensive database of articles addressing the management of societal cooperation in universities. We first established a time horizon for our review starting in 2005. To enhance quality control of search results we set our search parameters to focus on peer-reviewed academic journal articles. In addition, we only included articles in English. To develop a baseline for our search we then identified a series of keywords matching our area of interest, that were subsequently developed into Boolean search terms. We relied on ABI Inform ISI Web of Science (WoS), and ERIC to match our demands for coverage and article access, and entered the search terms. All multiple entries were deleted. This resulted in 9 123 unique hits, 3 107 in ABI Inform, 6016 in Web of Science, and 5 982 in ERIC.

Thereafter, we started to narrow down the baseline search by carefully examining all titles and abstracts with respect to our review objectives. First of all, we carefully searched for research that explicitly addressed when universities engage in societal cooperation by partnering together with non-academic actors. This resulted in a narrower sample of 421 hits. Moreover, as we were particularly interested in studies addressing organisational conditions that enable universities to engage in societal cooperation, we removed all articles that did not fulfil this criterion. For example, we excluded studies that did not focus attention on organisational levels of analysis (i.e., whole universities, departments, and research units). We then made a manual search of the bibliographies of the remaining articles to search for other relevant studies that could be included in our review. We also conducted an independent literature search on Google Scholar to compare with the search results obtained above.

Results:

The systematic search methodology resulted in a final database of 136 academic articles. All articles were downloaded to enable full reading and analysis. The articles will be reviewed and coded in accordance with the coding scheme before being subject to content analysis. The coding is in process; however, the following tentative findings can be highlighted:

- The findings corroborate the general notion that research on the management of societal cooperation in universities shows a largely fragmented character. Overall, we find the 136 articles to be scattered across 98 different academic journals. The outlet that has published most articles addressing the topic is Journal of Higher Education Outreach and Engagement (n = 11), followed by Journal of Technology Transfer (n = 6), Industry and Higher Education (n = 5), and Journal of Museum Education (n = 5). However, these outlets are still only counting for about 20 percent of the articles.

- When it comes to empirical contexts, most empirical research is conducted in the US, however, several articles also address societal cooperation in developing countries. Thematically, there are several studies that address societal cooperation for vocational training, in particular in public schools. Some recent studies also encompass societal cooperation in relation to smart and sustainable cities.

- The exchange of ideas across institutional boundaries is an important condition of interactive learning in societal cooperation, where the pluralism of knowledge forms serves important purposes to further understanding, collaboration and action.

- Among the major challenges that universities face when engaging in societal cooperation with non-academic partners are: 1) the intermittent character of most partnerships, with needs of investing time and resources for creating trust, commitment and mutual benefit when working together with non-academic actors, 2) ill-developed performance measurement systems, where outcomes often appear unclear and even untraceable within existing performance measurement frameworks.

Conclusions:

In this paper we review scholarly knowledge on how universities manage societal cooperation for the creation and utilization of academic knowledge, and more specifically, we seek to accumulate what the available evidence about how to generate favorable organizational conditions for this purpose. By doing this, our study addresses an important research gap regarding how universities can engage in complex and variable interactions between several spheres of society by combining and switching between a pluralism of knowledge forms (Caryannis & Campbell, 2010).

Abstract 44

WHEN AVERAGE JOE MET THE INEXPERIENCED GIANT - THE CONSEQUENCES FOR A YOUNG UNIVERSITY OF A PARTNERSHIP WITH A WORLD-RENOVED COMPANY

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Aim of the proposal:

This paper aims to contribute to the understanding of how collaborative relationships with new actors develop over time, including the potential consequences for engaged academic actors at various levels. This is done through conducting an in-depth case study of a new partnership between a young Swedish University and an internationally renowned company. The study explores how the university-wide collaborative effort unfolds over time by focusing on the consequences for the university both on operational and management level.

Background:

Contemporary universities face large expectations to intensify their commitment to meet societal challenges. In line with this development, the view of how universities should collaborate with society has broadened from a mere instrumental relation between industry and university in spurring economic growth to a multifaceted interplay encompassing a broad set of actors to induce systemic societal transitions (D'Este et al., 2018; Larédo and Mustar, 2004). This broadening obliges endeavouring on collaborative efforts with new actors outside of academia, many of which have limited experience of working with universities. Clearly, this broadening will have varying consequences for universities on different levels. On the level of individual teachers and researchers, it may enrich scholarly work (Perez Vico, 2014; Faulkner and Senker, 1995), present simultaneous opportunities and constraints to the development of research directions, and require time and efforts to identify common interests and build up a mutual understanding and trust (Perkmann and Walsh 2009; Tartari and Breschi 2012). On the organizational level, it may attract funding and strengthen the visibility of a university as a whole while at the same time requiring the ability to manage an increasing set of stakeholders with implications for resource dependencies, confidentiality and appropriation of knowledge (Pinheiro et al., 2015; Broström et al., 2019). The variety of ways in which these consequences unfold on different levels may create internal tension such as when university management see significant benefits and set up collaborative arrangements that put pressure on faculty to engage even in the perceived absence of individual level benefits (Perez Vico et al., 2017). Thus, in order to better understand the conditions for undertaking and organizing for collaborative efforts with new actors at a university it is crucial to capture and explain how consequences from new collaborative efforts unfold for actors operating at different organisational levels.

A large and informative body of research studying the extent and modes of collaboration, antecedents or motivating factors, and outcomes associated with collaboration has accompanied the broadening of collaborative efforts of universities (Perkmann et al., 2013; Bozeman and Boardman, 2014). However, these studies have primarily focused on

consequences within the private sector and from established collaborative efforts. Moreover, those studies that have paid attention to the consequences for academia have used quantitative measurements which provides limited explanatory insights into wider and less tangible consequences (Larsen, 2011; Perez Vico and Hallonsten, 2017). Indeed, our understanding of how collaborative relationships with new actors develop over time, including the potential consequences for engaged academic actors at various levels, is limited (Thune and Gulbrandsen, 2014).

This paper aims to address this insufficiency by exploring how a university-wide collaborative partnership between a university and a new partner unfolds over time by focusing on the consequences for the university both on operational and management level. For this purpose, an in-depth case study of a new partnership between a young Swedish University and an internationally renowned company has been conducted.

Methodology and empirical base:

The analytical framework applied in this study is an elaboration of a conceptual tool for analysing how diverse types of outcomes unfold from collaborative academic work, presented by Perez Vico and Hallonsten (2017). This conceptual tool draws on traditions in organisation theory and innovation studies and captures the consequences of collaborative efforts between academics and actors outside of academia. These outcomes are conceptualised in terms of the dynamics of a variety of resources defined as the tangible and intangible assets that academics require in order to pursue their core activities. The analysis in this study is structured around three categories – material resources, social resources and knowledge resources. Material resources involve tangible assets such as financial funds, physical infrastructure and access to data, research objects, real life test environments and manpower. Social resources refer to the informal inter-human aspects of relationships which comprises assets related to the development and maintenance of networks and social appreciation. Knowledge resources concern the stock of scientific, technological and other type of knowledge that often is intangible in its nature, embodied in individuals and mobilize through learning. This analytical framework paves the way for a more fine-grained understanding of the consequences of a collaborative partnership with a new partner for a university by tracing diverse resource dynamics stemming from the collaboration. This includes deciphering tensions that arise due to disparities in resource dynamics on operational and management level at a university.

The current case study builds on rich data from multiple sources, but central for the analysis were 27 in-depth face-to-face semi-structured interviews conducted in 2017. In addition, meeting notes, e-mail correspondence, media coverage, formal and strategic documents (e.g. agreements and declarations), yearly activity plans, internal evaluations, documentations from workshops, informal memos,

marketing material and media coverage also made part of the data. A three-hour long interpretation workshop with six individuals of central importance to the partnership was organized after a preliminary analysis of the data had been conducted. This workshop aimed at clarifying, confirming or revising interpretations and seeking supplementary clarifications. The case concerns the partnership between a rather young Swedish University, referred hereafter as 'Beta University', and a Swedish-founded company with global operations, referred to as company 'Alpha'. Beta university is a Swedish public university with six faculties, 2000 employees (including 250 PhD students) and approximately 15 000 full-year students. The University is characterized by its strong regional embeddedness, responsiveness and

flexibility towards its context and a larger focus on education than research. The university's performance with respect to conventional research and education outputs is average compared to other Swedish higher education institutions. Alpha is a world-renowned company originating from the same region as Beta University. Alpha operates over 400 stores in approximately 50 countries worldwide, and has operations all around the globe. The company is a world-leader in its industry and its brand is globally well-renown. Alpha is perceived to be a resourceful yet cost-aware actor and even though the company has experience from working with student recruitments and placements, commissioned thesis work and commissioned research, it has relatively limited experience of collaborative research, particularly in the region where the collaborative effort with Beta University takes place. Indeed, Alpha has a relatively limited research capacity given its international position and size.

The case provides a unique opportunity to study the development of a university-wide collaborative effort with a new partner where few external factors (such as requirements from third-party funding) conditioned the developments. Indeed, the lion share of studies of university-industry partnerships include government supported activities where efforts evolve under predicated requirements (Perkmann and Walsh 2007). Thus, the case can be seen as an independent evolution of the resource dynamics of a university-industry partnership from start.

Results:

The evolution of the partnership

The partnership between Beta and Alpha was initiated in 2009 following a significant donation from the founder of Alpha to Beta University. The aim was 'to become an internationally recognized and connected initiative' between the two actors through interdisciplinary research and teaching by linking thematic areas of relevance to Alpha. A co-operation council was created with three persons from each organization. The endowment was written more as an agreement on a partnership than as a donation, and included a description of the council and expectations from Alpha. The lion share of the donation was used for traditional research positions (PhD students, postdoc) centred around an interdisciplinary professorship including economics, technology and design. The contract was set up hastily and both sides were rather unprepared but enthusiastic. Top management at both organisations sensed that they had shared ambitions, although the agenda was rather unclear at first. Alpha perceived the donation to be a low-risk opportunity since the funds came from a foundation and not from the company budget.

Soon after the set-up, the founder handed over the responsibility to Alpha managers which were somewhat puzzled as to what to make out of it and unexperienced with these type of collaborative efforts with universities. At the same time, Beta University was quite start struck by Alpha - the endowment was a significant contribution and working with a world-class company was expected to open up great opportunities. Around 2011, the professorship was installed and the appointed professor who had an economics profile started to build up a research group. The funds were also used for some positions in the technical sciences, but these two groups were built up separately. Early on, Alpha management expressed a will to link the collaboration closer to their business operations and, based on experiences as procurers of research, they started to expect instrumental results. Large expectations were put on the professorship and soon differences in perceptions, expectations on outcomes and working methods between the professor and several of the council members became clear.

These differences created tensions between the university management and faculty, as well as between Alpha and Beta University. When few instrumental results from research materialized, Alpha management shifted its attention from research to education and Beta University answered by developing a multidisciplinary master's program that started in the autumn of 2014 and responded to the personnel needs of Alpha.

By 2014, Alpha managers perceived a lack of overview of the collaboration and a programme management was installed. A clearer vision was developed and linked to the operational level through plans and reports, and a number of workshops were conducted to find new areas for exploration. As a consequence, the researchers connected to the professorship felt a fear of losing exclusivity and freedom which spurred tensions between management and researchers at Beta University. By 2017, a review and renewal of the collaborative agreement was carried out and the collaboration entered a new phase. In all, over 100 persons from both organisations have been engaged in the partnership. The relationship has been characterised by concerns that are well-recognised in research on university- industry collaboration related to diverse time scales, confidentiality and appropriation and differences in focus on problematising versus problem solving (reference to these studies here?). These concerns are particularly prominent in this case, as Alpha is rather inexperienced in conducting research and working with a university in a partnership. In addition, there are signs of a lack of trust in the relationship, which is largely based on imbalance in the relationship between the comparatively small and anonymous Beta University and the world-renowned Alpha.

Consequences for faculty and university management:

The consequences from the collaboration for Beta University varied between different actors on different levels. On the operational level, a significant material resource has been the endowment that chiefly enabled the build-up of a group of researchers in economics that, at its largest in 2015, consisted of the professor, three doctoral students and two post docs. In addition, the economics group has gained unique access to research objects and data. For the technology group, the endowment has enabled the recruitment of two doctoral students, a few researchers have received seed money and an adjunct professor from Alpha has provided additional manpower. As regard knowledge resources, both research groups have acquired inspiration for new ideas, which according to the researchers created many interesting research results. The researchers describe a deep collaboration that includes joint problem formulation and co-creation with relevant connection to Alpha's activities. Yet, joint knowledge development has been a challenge for the economics group since there have been no links to Alpha employees with relevant research capacity. Besides, the group has deliberately distanced itself from Alpha because collaboration with a large company is not entirely unproblematic in the research tradition where the group operates. This indicated negative social resource consequences from the collaboration. The technology group has not faced the same challenge, rather they experience positive social resource consequences since the collaboration has created increased mutual understanding of each other's conditions and interpersonal trust. For them, the collaboration is seen as a natural element given the group's focus on applied technical research and strong tradition of industrial cooperation, and it has created spill-over effects in the form of contributions to critical mass, self-confidence and visibility.

Although the masters programme is generally described as successful, teachers engaged in the master's programme have experienced significant negative material resource consequences since collaboration with Alpha has been challenging and time consuming. The

development of the programme has created enthusiasm and inspiration among some in the teacher group, indicating positive knowledge and social resource consequences. The clearest positive consequence is the increased relevance in education. Beta university teachers and Alpha employees have jointly developed new forms of educational collaboration, such as cross-disciplinary project work and thematic teaching modules where university teachers and staff from Alpha jointly discuss practical and theoretical perspectives. Still, teachers also experienced a lack of trust and transparency from both Alpha and Beta university management, as well as legitimacy issues related to the strong presence of Alpha in student activities (i.e. negative social resource consequences). Still, teachers and researchers perceive increased knowledge resources in terms of strengthened knowledge in how to organize and conduct interdisciplinary work, and collaborate with a large international company.

The most pronounced consequences on a university-wide level has been the material resources mobilised through the donation and the efforts related to the development of the master's programme. The shift in views on the collaboration from an endowment to a partnership spurred the question if Alpha's donation should be matched financially by Beta University. Although university management rejected this suggestion, the university has made available support functions and the development and conduct of the master's programme has demanded significant financial resources and personnel engagement also on management level. Yet, university management perceive significant social resource benefits. The master's programme is perceived to have a strong signalling value that attracts students and gives the university legitimacy. Management has gained significant experience of collaborating with a strong yet academically rather inexperienced actor (knowledge resources) which has created self-assurance and external legitimacy (social resources). Indeed, the commitment to the collaboration from a well-recognised and resourceful actor such as Alpha is seen as a significant acknowledgement of the university as a valuable partner.

The differences in consequences between faculty and management level at Beta University have given rise to two noticeable areas of tensions. First, while the group in economics have experienced great material benefits from the collaboration, university management perceive that these benefits have not had spill-over effects outside of the funded researcher group and that expected interdisciplinary and joint research outputs have failed to materialised. This tension has resulted in that large expectations has been put on the professorship, yet the format of the collaboration, i.e. as an endowment funding traditional academic positions, has poorly suited the expectations of Alpha and Beta University management. Second, while management perceive significant social resource benefits, the experience on faculty level is more ambiguous and is related to diverse disciplinary traditions which give rise to tensions and identity conflicts. While some faculty perceive strengthened legitimacy, visibility and relevance from collaborating with Alpha, others see issues related to threatened objectivity and dependency. As a consequence, university management are assertive related to the collaboration and have sometimes difficulties understanding faculty opposition.

Conclusions:

The study illustrates the many ways in which consequences from a partnership unfold at various levels in a university. Overall, significant material and social resources materialise, yet negative consequences unfold related to the imbalance in the relationship and challenges related to Alpha's limited experience of working with academia which chiefly affect faculty level. Notably, the differences in consequences for faculty and management level at Beta University have created areas of tensions within the university.

Some tentative implications can be drawn from this preliminary analysis. First, the case illustrates the importance of holding a coherent understanding that includes conditions and benefits on all levels and areas within a university when orchestrating a university-wide partnership. Second, it implies that engaging in collaborative work with a new and rather unexperienced actor will demand significant time and effort, beyond what is usually expected from a conventional university-industry partnership. Third and consequently, significant resource investments will be a prerequisite for universities who wish to intensify commitments to meet societal challenges and engage with new actors. These resources are particularly needed on faculty level since teachers and researchers bear a significant part of the costs required to establish new collaborations.

F1 TRANSFORMATIVE INNOVATION POLICY 3

Friday 07 June 2019 from 09:00 to 11:00

BARBARA RIBEIRO, Chair

Abstract 81

MISSION (IM)POSSIBLE? MOBILIZING INNOVATION – AND POLICIES SUPPORTING IT – IN THE ENERGY TRANSITION

Fagerberg J.*

University of Oslo; UNU-MERIT ~ Oslo ~ Norway

Aim of the proposal:

Research has shown that energy transitions easily may take several decades if not more to unfold. However, it has also been suggested that change may occur faster when advantages for end-users are sufficiently large and/or there are proactive policies in place. This paper aims at providing new insights on these matters through a discussion of three specific cases, all from Europe, in which change has been very quick indeed: Wind energy in Denmark, the German Energiewende and electrical cars in Norway. The focus is particularly on the actors that took part, how policy schemes supporting these developments were shaped and what their impacts were. It is concluded that by embracing the opportunities offered by the renewable energy revolution and actively involving users (and attracting new ones) it is possible for policy-makers to encourage (green) innovation, create new jobs and significantly speed up the transition.

Background:

The high income that we in the Western world enjoy is not only based on knowledge but also on energy provided in the form of fossil fuels (Fouquet 2016). However, the continuing burning of fossil fuels leads to increasing amounts of greenhouse gases in the atmosphere, steady increases in the global temperature, and potentially very negative environmental and economic consequences in the years ahead (Stern 2015). To avoid this outcome, emission of greenhouse gases through burning of fossil fuels need to be reduced to almost zero before the end of this century, a goal that almost all nations now have agreed to. This is a very demanding goal indeed. To reach it, extensive changes in technology, economic structure, governance, and ways of life will be required. Moreover, while fundamental changes of this nature historically have taken a long time to unfold (Wilson 2012, Smil 2016), the transition has to be well underway quite soon if very serious damage is to be avoided (Laestadius 2015).

Is there way out of this dilemma? The sun is an abundant source of energy. In fact, only a tiny share of the sunshine that reaches earth during a year would be sufficient to cater for all human needs. The sun is the ultimate source of hydroelectric energy (rain), bio-energy (photosynthesis), wave energy, wind energy and solar energy. Hydroelectric energy is clean and relatively inexpensive, but the prospects for massively scaling up production of it globally are bleak. Bio-energy, while promising, may suffer from some of the same limitations since the photosynthesis is a relatively inefficient way to convert sunshine to other, usable forms of energy; it demands a lot of water (which is a scarce resource); and it competes with producing food (which also is in limited supply) to a growing global population (Seba 2014). Wave energy has not really caught on but wind and solar have, particularly during the last few decades.

Can renewable energy from wind and solar, complemented with other renewable sources, be sufficient to cater for humanity's needs? In fact, for both wind and solar the costs of producing electricity has diminished year by year (i.e. productivity has increased) as output has

expanded. As a result cost-levels for renewables now are substantially lower than those of e.g., nuclear energy plants (Seba 2014), and - in many if not most locations world-wide - on par with or below plants producing electricity by burning fossil fuels (Goodall 2016). This pattern, i.e., rapidly falling costs, potentially almost unlimited availability and very broad applicability, is as several observers (Mathews 2013, 2014; Stern 2015) have pointed out reminiscent of previous technological (industrial) revolutions, and may, if continuing on the same track, have very far-reaching implications (Pearson and Foxon 2012).

The possibility of a renewable energy revolution is indeed good news for humanity. However, changes in the energy-sector, although very important, are not enough. Energy-using sectors, such as industry, transport and housing, also have to change their ways. Moreover, a crucial question is if the required changes can happen in time, so that the most damaging effects of climate change may be avoided. Research has as mentioned shown that energy transitions easily may take several decades if not more to unfold. However, it has also been suggested that change may occur faster when advantages for end-users are sufficiently large (Grubler 2012, Pearson and Foxon 2012) and/or there are proactive policies in place (Sovacool 2016). Since time is short if serious damage is to be avoided, it is of considerable interest to find out more about how to speed up the transition to sustainability in energy producing and energy using sectors.

Methodology and empirical base:

The aim of this paper is to provide new insights on these matters through a discussion of three specific cases, all from Europe, in which change has been very quick indeed. In fact, in the Danish case the share of renewables doubled between 2005 and 2015, from 25 % to 51 % of domestic electricity consumption. In relative terms the German performance was even more impressive: the share of renewables nearly tripled, from 11 % to 31 %, during this period. However, as pointed out above, it is not sufficient to be able to produce electricity in a more environmentally friendly way, other sectors of the economy, such as transport, also have to switch from relying on polluting fossil fuels to using renewable energy. An interesting example is provided by Norway, in which the share of battery-driven electric cars increased from 1 % to 18% in just four years. In later sections of this paper we are going to examine these transitions processes in more detail with particular emphasis on the actors that took part and the evolution of policy schemes supporting these developments. As a prelude to this discussion the next section briefly considers what the existing literature about the role of innovation and policies supporting it has to tell us.

Results:

In the three cases under scrutiny here things changed quite rapidly. In fact, if continuing at the same speed, the transition would in all three cases be complete by mid-century at the very latest. Since such fast change is what the world needs to avoid irreparable damage from climate change, it is of considerable interest to understand what made this possible.

First it is worth noting that none of these cases conform to the classic, mission-oriented model pioneered in the US of big science & advanced engineering interacting to produce path-breaking innovations as basis for subsequent commercialization. In fact, when our story begins, both wind turbines and battery-driven cars had been around for a hundred years or so. Even solar cells, invented by Bell Labs in the 1950s, had been available for almost half a century when they finally became targeted for development by German politicians through

the Energiewende. The reason why wind, solar and electro-mobility did not attract more attention before was the very simple that to most observers at the time other technologies appeared more cost-effective and promising.

What changed in the 1970s and 1980s was not a sudden breakthrough in wind, solar or electric cars but that the rosy perceptions of what fossil fuels and nuclear could be expected to deliver started to crack. An important event was the OPEC oil embargo in 1973-4, leading to increased concerns all over the Western world about energy security and, hence, more public money to research on alternatives to fossil fuels. Although most of this actually went to nuclear, it also led to increased R&D on wind, solar and electro-mobility, and hence a larger knowledgebase on these technologies. However, as is apparent in all three cases, these more environmentally friendly technologies also caught the attention of the broader public, i.e., the potential users, and this was to become a matter of major importance for what happened subsequently. Particularly for solar and wind this interest became much strengthened by the increasing popular resistance towards nuclear energy, fueled by events such as the Three Mile Island nuclear accident in the United States in 1979, the Chernobyl disaster in the then Soviet Union in 1986, and, closer to our own time, the Fukushima-disaster in Japan in 2011.

In all three countries, the (initial) driving force was not policy makers at the national level, but popular movements (or networks) composed of concerned citizens, environmental lobbies, technology enthusiasts and small entrepreneurs, united by a common interest for improving the conditions for developing and spreading the technology in question, although the motivation for doing so may have varied. For wind and solar grid connection on economically acceptable terms became the central objective, while for electric cars tax exemptions and access to charging stations got most attention. The general thrust of these demands was to support deployment, by making the technology at least as attractive as the more established, less environmentally friendly, alternatives. A typical pattern was that such demands were first expressed at the local and/or regional level and, after having been accepted there, raised at the national level too.

Getting acceptance for such deployment friendly schemes at the national level was not always an easy ride though. The resistance to the suggested policy changes came from two sources in particular. One was fueled by established economic interests that, perhaps rightly, considered the new policy as threatening to them; this was especially the case in Germany. Another source of resistance, more ideological in nature, came from economists and parts of the political establishment, who looked upon such deployment friendly schemes as excessive intervention in the working of markets. The German FDP party's criticism of Energiewende is illustrative in this regard. However, similar views were also widespread on the political right in Denmark, and for this reason support to further deployment of renewable energy in Denmark actually paused for a number of years in the 2000s. In Norway too, such ideologically charged criticisms of the current policies towards electric cars have been aired, but have so far failed to influence public policy towards electrical cars significantly.

In both Denmark and Germany these policies were accompanied by a rapidly growing industry (and jobs) supplying capitals goods for producing renewable energy, increasing the legitimacy of the policy both among policy makers and the broader public. However, although industrial policy concerns probably played a role in Norway too at an early stage, a similar effect, e.g., a thriving electric car industry, did not materialize there, without - it seems - hurting popular support for the policy. This may perhaps be explained by the buoyant economic conditions in

Norway at the time (fueled by incomes from the oil and gas sector). In fact, policy makers did little to support the emerging industry when it ran into trouble after a few years. Arguably, lacking knowledge about car production, a solid financial backing and a sufficiently large (and growing) domestic market, the emerging industry faced an uphill struggle from day one. Nevertheless, it is possible that some of these constraints might have been addressed through innovation policy, for example by using public procurement policy to address the demand constraint, perhaps the most damaging (blocking) factor during these years. In fact, both in Denmark and Germany policy-makers had been quite clever in stimulating demand (through public demonstration programs for example) at similarly critical moments of their emerging industries' development.

One of the most striking features of modern societies is as pointed out above that users are highly knowledgeable and resourceful, and that their active involvement is essential for successful innovation (von Hippel 2005). It is probably a safe bet that without such active involvement of users, in interaction with attentive policy makers at various levels, the three transition stories discussed above would have looked very different and the speed of transition - and the technological progress it made possible - been much slower.

Conclusions:

A central lesson for policy makers is that by embracing the opportunities offered by the renewable energy revolution and actively involving users (and attracting new ones) it is possible to encourage (green) innovation, create new jobs and significantly speed up the transition (which arguably is a must).

Abstract 88

DISEASE BURDEN, RESEARCH EFFORTS AND SCIENTIFIC VISIBILITY: EXPLORING INSTITUTIONAL FACTORS THAN DIVERT RESEARCH ATTENTION FROM GLOBAL HEALTH NEEDS

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Abstract:

Research priorities and the distribution of the burden of diseases have been shown to be misaligned at both the global and national level. This study aims to document the existence of this misalignment and to explore some potential causes of the relative lack of attention to some diseases. To do this, we first examine the proportion of publications that are published on diseases compared to their proportional disease burden. Specifically, diseases that predominantly impact low income countries (such as Chagas disease or African Trypanosomiasis) receive systematically less research attention in terms of citations than those that predominantly impact high income countries. Next, we explore the distribution of citations that papers receive depending on the disease that they investigate. These results suggest the need to develop strategies to better address disease burden when research is seen as an important part of health solutions. In particular, they may point to the potential inadequacy of using citation-based evaluation methods when evaluating and rewarding health research. Finally, we discuss how more locally responsive, participatory and systematic methods of priority setting could improve research supply in order to meet health needs.

1. Introduction: factors influencing health research agenda setting

In the context of health research, priority setting has systematically excluded the needs of those in low- and middle- income nations and has instead focused primarily on diseases that predominantly impact those within high-income countries (Global Forum for Health Research, 1999; Sarewitz & Pielke, 2007; Ràfols & Yegros, 2018). This finding reflects the broader observation of a pervasive misalignment between priority setting in research and societal needs in a diversity of contexts (Ciarli & Ràfols, 2018; Sarewitz & Pielke, 2007). In investigating this misalignment, Ciarli and Ràfols (2018) describe many socio-political factors that likely contribute to the setting of research agendas. These include the observation that problem framings are likely set by the scientific community (and not a diversity of relevant actors), the presence of pervasive legacies of global inequality in the position of power and legitimacy to determine funding agendas, and also widespread path dependencies resulting in the legacy of decision making determining potential future trajectories of research. The agenda setting of global health research is not an impervious to these influences.

The global health research agenda is undoubtedly influenced by a diversity of factors, and within the current analysis, we adopt the conceptual framework described by Ciarli and Ràfols (2018) which highlights that research outputs and agendas are the outcomes of interactions among a diversity of actors with a diversity of value commitments.

A prominent factor that has been described previously is market demand: roughly 60% of all global health research is privately sponsored (Røttingen et al., 2013). Prior research has indicated that the majority of market demand for health research is found within chronic conditions predominantly affecting individuals in high-income countries, resulting in privately funded research being systematically biased towards investigating these diseases (Aaron & Siegel, 2007; Schillinger et al., 2016; Sismondo & Chloubova, 2016). Furthermore, Evans and colleagues (2014) found that the global market for treatment was a far better predictor for health research than disease burden (as measured by Disability-Adjusted Life Years (DALYs), and even found some negative relationships between disease DALYs and research attention. In addition to market demand, research evaluation systems, publication pressures, and norms and incentives in research institutions and communities are likely additional factors influencing the setting of health research agendas. Many current research evaluation systems value scientific visibility, which is often proxied through either the prestige of the journals that the authors publish in, or the number of citations their publications receive (de Rijcke et al., 2015). As recent investigations have discussed, these forms of evaluation may be harmful when used without care (Hicks et al., 2015), and in some cases, may incentivize researchers in low- and middle-income countries to conduct research that is relevant in high-income countries rather than local national needs (Vessuri, Guédon, & Cetto, 2014). For example, Raitzer and Norton (2009) highlight that in the context of agricultural research, there exist pressures within the scientific community to publish on 'trendy' or prestige-laden topics, since these will likely contribute positively to researchers' career developments.

It is almost certainly the case that these factors are similarly present in the context of global health research. Due to the relevance of health research to the needs of humanity as a whole, it is important to consider how the aforementioned factors may be systematically biasing global health research in ways that selectively benefit certain populations over others. The scale of global spending on health research highlights the immense impact that these misalignments have. Consider that an estimated \$240 billion were spent on health R&D in 2009 (purchasing power parity-adjusted) (Røttingen et al., 2013). The ways in which this money is spent have major consequences on the long-term well-being of populations, hence the need to think carefully about how and for whom research agendas are being set.

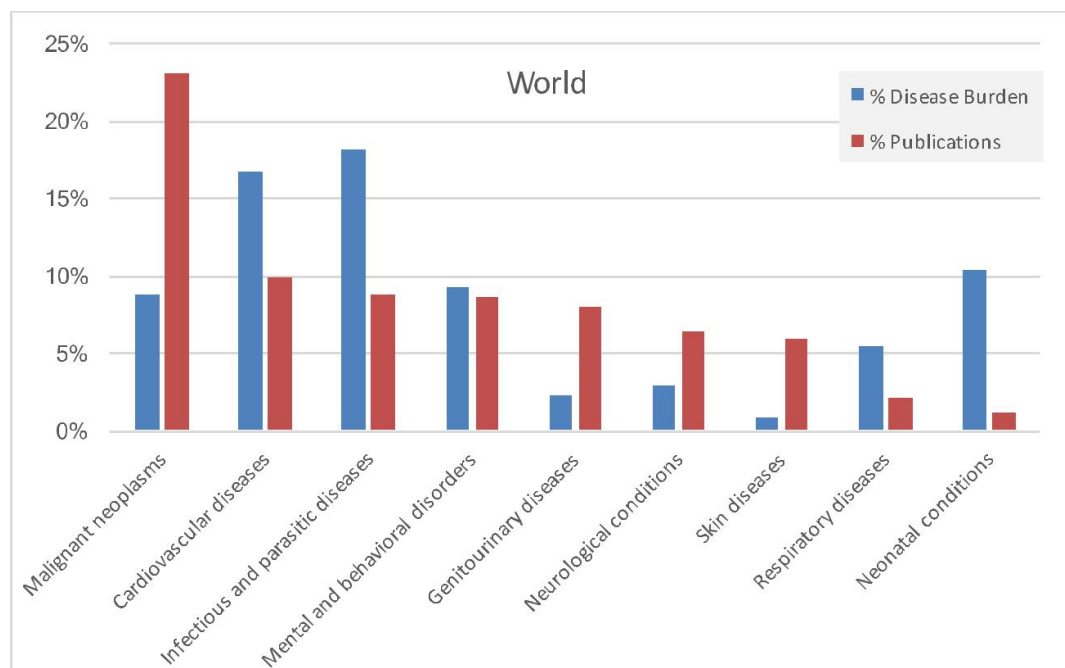
The misalignment of disease burden and global health research attention has been well-documented in the past. The discussion on the 10/90 gap of biomedical research, which highlights that "only about 10 percent of the global biomedical research budget is allocated to diseases accounting for about 90 percent of the worlds' health problems", was first introduced in a report twenty years ago (Sarewitz & Pielke, 2007; Global Forum for Health Research, 1999). While this estimate may be out of date, and its accuracy disputed (discussion described in Vidyasagar, 2006), the general observation still contains relevance and is reflected in our findings below. Despite broad recognition of the scale of this misalignment, the issue has remained pervasive and widespread. Evidently, if the ultimate aim of health research is to improve global health, a shift in research priorities is required. At this stage, it is important to investigate the potential driving factors that contribute to this misalignment.

In this paper we first build on and expand the results by Ràfols and Yegros (2018) on disease burden vs. number of publications; and second, we explore publication visibility in terms of the citations and the journals that publications are published in.

2. Previous studies on disease burden vs. publication counts:

To investigate the degree to which there exists a misalignment between disease burden and publication output, we build on Ràfols and Yegros (2018). Publications are assigned to diseases by using PubMed and Web of Science data. Subsequently, the distributions of these publications are compared to the disease burden DALYs estimates provided by the World Health Organization (WHO) for the year 2012. Ràfols and Yegros (2018) examined this misalignment both globally and nationally in the context of Spain's (as an example of a high income country) disease burden and research output. Below, we will focus on the findings of this investigation at the global level. This prior research uncovered dramatic misalignments between disease burden and research output at the global level. Consider, for example, that in 2012, malignant neoplasms (cancer) contributed to under 10% of total global health burden (as measured by DALYs) while during the period of 2009-2013, over 22% of global disease publications investigated malignant neoplasms (Figure 1). In contrast, while infectious and parasitic diseases contributed to nearly 20% of global disease burden, they received less than 10% of research attention as measured by the proportion of publications.

Figure 1. Percentage of disease burden in Disability Life Years (DALYs) vs. Percentage of Publications for disease groups, globally. Taken from: Ràfols & Yegros (2017, p.5).

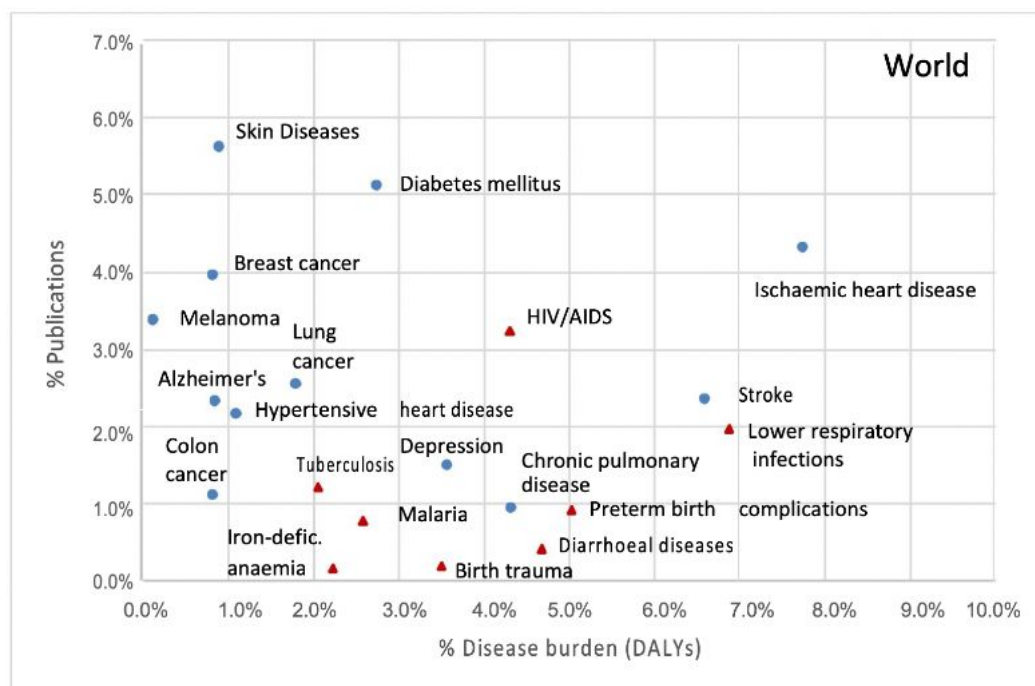


Looking at this misalignment at the level of individual diseases often reveals even more dramatic disparities, as shown in Figure 2. This analysis classified the diseases into two different categories depending on the geographical distribution of their disease burden.

Following Røttingen et al (2013), diseases were considered Type 1 if they were globally present, Type 2 if they were between 3-35 times more prevalent in low- and middle- income countries, or Type 3 if they were greater than 35 times more prevalent in low- and middle-income countries (prevalence was measured by DALYs per 100,000 individuals). This analysis found striking differences across disease types. For example, while skin diseases, breast cancer, and diabetes mellitus each contributed to less than 3% of total global disease burden, these diseases each received a much higher proportion of publications throughout the

analysed time period. In contrast, birth trauma, diarrhoeal diseases, Iron-deficient anaemia, and other diseases that predominantly impact low- and middle-income countries receive a considerably lower proportion of publications than their proportional global disease burden. Indeed, there is not a single instance among highly prevalent diseases in which a disease that was classified as type 2 or type 3 received a higher proportion of publications than its proportional disease burden.

Figure 2. Percentage of Disease Burden in Disability-Adjusted Years (DALYs) vs Percentage of Publications for specific diseases globally. Taken from Ràfols & Yegros (2017, p. 8). Blue dots indicate type 1 diseases (globally present), red triangles show type 2 and type 3 diseases (diseases that disproportionately influence low- and middle-income countries).



3. Exploring research visibility (citation impact) across diseases and countries:

It is within this context of investigating the potential influences on how health research agendas are set that this study takes place. Further to previous studies that have sought to investigate the relationship between global and national disease burden and relative research output (as measured by publication output), this paper is novel in that it also seeks to investigate the relationship between *research visibility* (as measured through citation scores and journal impact factors) and disease burden. We hypothesize that publications investigating diseases that are disproportionately prevalent within low-income countries may be less likely to receive citations. Furthermore, we hypothesize that this effect is more pronounced for publications that are produced by low-income countries. As a result, publications that are the most relevant for low-income countries (as measured by disease burden) are likely to receive relatively less attention (as proxied by citations and lower journal impact factor scores) than publications that focus on diseases that are more relevant for high-income countries. Therefore, we hypothesize that there is either a negative or non-existent relationship between citation impact measures and national disease burden for publications originating from low-income countries. This relationship, or lack thereof, indicates the

potential inadequacy of using citation-based evaluation methods when evaluating and rewarding health research.

The credibility cycle model of knowledge production described by Latour and Woolgar (1986) highlights that the rewards that academics receive (for example, via citations) contribute to their perceived credibility, which in turn influences their capacity and likelihood to further invest in similar research efforts. If there exists a systematic tendency for publications relevant for the health of low- and middle-income populations to receive less citations, this will likely result in a self-perpetuating cycle of reduced credibility (and thus reduced research investment) for work conducted on those diseases.

4. Expected results and future work:

With this study, we will improve upon previous work that has sought to investigate the relationship between disease burden and research output. This will include analyses at a diversity of levels of aggregation, from the global to the national. Furthermore, we will disentangle effects as they exist at the level of the different disease types that we identified, and at the level of individual diseases. These analyses will benefit from recent work we have conducted to update the correspondence table between medical descriptors in bibliographic databases and the International Classification of Diseases (ICD10) to more accurately link WHO data on diseases burden and publications.

In addition to building on prior work, we will conduct analyses of the relationship between disease burden and research visibility as proxied by both citation score and journal impact factor. The study of this relationship represents a highly novel contribution to the field. This analysis will also be conducted at several levels of aggregation, including fine grained looks at the effects within individual diseases and countries. We aim to investigate the effects of several factors that may influence this relationship, in particular the effects of international collaboration and funding, which are known to effect visibility (Confraria et al., 2017).

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Abstract 99

THE ROLE OF ACTORS FROM ESTABLISHED SECTORS IN NEW INDUSTRY FORMATION: HOW TO DEVELOP AN OFFSHORE WIND INDUSTRY IN PETROLEUM DEPENDENT NORWAY

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1. Introduction:

Recent debates on the future of innovation policy include questions of how transformative change of existing socio-technical systems can be fostered. Addressing global challenges, such as sustainable development goals, is not only about fostering novel solutions, but also requires pervasive transformation of socio-technical systems, including destabilization of established industries. In a recent discussion paper, Schot and Steinmueller (2018) suggest that this will not be possible without the participation of a broad set of types of actors. Who are these actors, and how can they be included? We depart from this question, focusing on the suggestions by Fagerberg (2018) and Giuliani (2018), that large, established firms must play a central role, for different reasons.

First, if established firms are part of the problem, they should also be part of the solution (Giuliani 2018, p. 1580). Schot and Steinmueller (2018) also point out that radical socio-technical change requires not only the development of new sustainable technologies, but also destabilization of established industries. A key challenge is then how established industries can be incentivised to do less of what they do today, because destabilizing established and profitable industries is incredibly difficult (Geels 2014). How might a transformative innovation policy be developed through participation by established firms, whom may have little interest in radical policy change?

Second, public incentives are not sufficient to scale up new industries at a fast enough pace. Some established firms will also need to invest in new industries (Schot & Steinmueller 2018). Established firms represent assets that can be vital for building up new industries that fit with a low-carbon future (Fagerberg 2018). Recent contributions, informed by empirical studies, show that actors from established sectors can redeploy their resources towards new industries. These studies however also show persistent challenges with scaling up redeployment (e.g. Mäkitie et al. 2018). There is a risk that building new industries through a reliance of assets redeployed from other, profitable industries, will not be sufficient if not a substantial number of firms take 'the full step' into new industries. The challenge is to sufficiently mobilise the assets that established firms represent (Geels 2018).

Fagerberg suggests that one of the most effective policy instruments to address the two challenges outlined above is to influence firms' expectations about the future, that is, setting direction (with reference to Mazzucato 2017). To succeed in setting a direction (and not become vulnerable to changes in government), policy makers must engage in a broad, open and transparent dialogue with stakeholders at different levels of society (Fagerberg 2018), and to this we add that large firms and trade unions (those affected) are important. Yet, redirecting firms away from currently profitable industries, such as fossil fuels, depends on what type of opportunities that exist outside of their core business area.

Thus, we see that there is a mutual dependency between developing new industrial opportunities and for introducing transformative innovation policy that leads to destabilisation of existing industries.

If developing transformative innovation policies requires the participation of actors from established sectors, a first step should be to gain knowledge about their role in new industry development. Our research question therefore is: what are the consequences of engagement of actors from established sectors in new industry formation.

2. Theory and analytical framework:

The paper constructs an analytical framework based on two central frameworks in the field of sustainability transitions that deal explicitly with emergence and growth of novel technologies and industries; strategic niche management (SNM) and technological innovation systems (TIS). Based on the key tenets of these perspectives we focus on the following analytical dimensions: *Actors*: Actors play central roles in building up new technologies and industries as they experiment and exploit new opportunities presented (Bergek et al. 2015). While SNM focuses on dedicated actors defined as new entrants, with little overlap to established sectors, TIS makes no assumptions of actors' nature and origins. The latter suggests that the actor composition of a new industry is an empirical matter. Irrespective of actor type, e.g. Grubler (2012) highlights that the existence of niche markets that can offer opportunities for experimentation and scaling up is important for speeding up transitions. However, historical research shows that successful scale-ups have required such experimentation and learning over several decades. Thus, firms must be given the opportunity to experiment persistently over a prolonged period, first scaling up at the unit level and later at the industry level, building up critical mass (Grubler 2012).

Institutions: The entry of actors into novel industries is by definition uncertain and risk filled, which highlights the important role of government policy to strengthen experimentation and search into novel areas for firms (Bergek et al. 2015). The rationale for SNM mirrors the insights provided by Grubler (2012) in that new technologies and new industries require protection over time from market selection mechanisms. Kemp, Schot, and Hoogma (1998) point to the importance of raising expectations and to couple societal problems to certain technologies (as solutions). This can be achieved through the formulation of long-term goals (Rip & Kemp 1998).

The TIS literature complements the SNM literature in some areas. For instance, legitimization and alliance building is considered an important functionality for building up a new technology (Bergek, Jacobsson, & Sanden 2008). Moreover, articulation of expectations and visions matters because it can steer investments towards certain technologies. Finally, the TIS framework highlight the importance of supporting institutions such as regulations and policy. For policy, the role of governments and the broader political context matters (Bergek et al. 2015). Governments and ministries shape the conditions under which niches may develop, whilst at the same time niche actors may attempt to shape the political context.

In addition to persistence and continuity, niche protection policies must also be seen in relation to policies that may incentivize behaviour that competes with investments in new renewables. An example could be that policies to stimulate renewable niche development often sit alongside subsidies of fossil fuels. An assessment of niche protection must therefore also consider the broader policy mix, which has received much attention in recent years (e.g. Edmondson, Kern, & Rogge 2018).

Networks: Rip and Kemp (1998) suggest that the creation of alliances and networks is very important in protected niches. This means that policies should not only protect firms from

market selection mechanisms, but they should also stimulate coalition building and networking activities. One reason for this is that strong coalitions will be better positioned to push for further policy support or may even challenge incumbent industries such as fossil fuel (see for instance Lauber & Jacobsson 2016), which might be necessary for scaling up at the industry level. According to Kemp et al. (1998), *“actors with vested interests in other technologies will generally not be interested in stimulating a new, competing technology. They may participate in the developments for defensive reasons but will show no real initiative”* (p. 191). They therefore argue that to expand the niche, new actors must be enrolled and existing actors should be changed.

Based on the discussion above, we are particularly interested in exploring the following aspects. First, dedicated actors that are willing and able to positively engage with industry development over time is necessary. Second, shared visions and expectations matters for industry formation. This includes visions about the role of government and which types of policies are required to grow the niche.

Finally, alliances and networks dedicated to the new niche is important for building legitimacy and influencing decision-makers.

3. Methods and data:

The paper makes use of a single case study of Norwegian firms and the interaction between oil and gas and offshore wind industries. We use three types of data. First, the study draws on an online survey of 100 Norwegian firms engaged in offshore wind, which was executed in 2018. The survey mapped a variety of topics including motivations, drivers and barriers for entering offshore wind, innovation, relatedness between core business area and offshore wind, policy needs and efforts to influence policy. In addition, the survey captured investment levels in offshore wind, position in supply chain as well as information about core business area.

In addition to the survey, interviews with representatives from 24 firms and 7 industry organisations were carried out in 2018 and 2019. The interviews were semi-structured and explored in particular firm strategies in terms of market access, network participation, knowledge demands and innovation activities, as well as policy needs and policy engagement. Finally, this paper also draws on numerous previous studies of the Norwegian offshore wind industry and the oil and gas industry.

4. Results:

4.1. Dedicated actors

According to (Kemp et al. 1998) successful niche development requires dedicated actors over time. The results show that despite a high number of Norwegian firms engaged in offshore wind, the vast majority might not be considered dedicated. Figure 1 shows that most of the Norwegian offshore wind firms are small-medium sized firms. More importantly, less than half of firms that do deliver products or services to offshore wind attribute more than 10 per cent of total turnover from offshore wind. Only 13 per cent of the firms in the survey consider offshore wind as their core business.

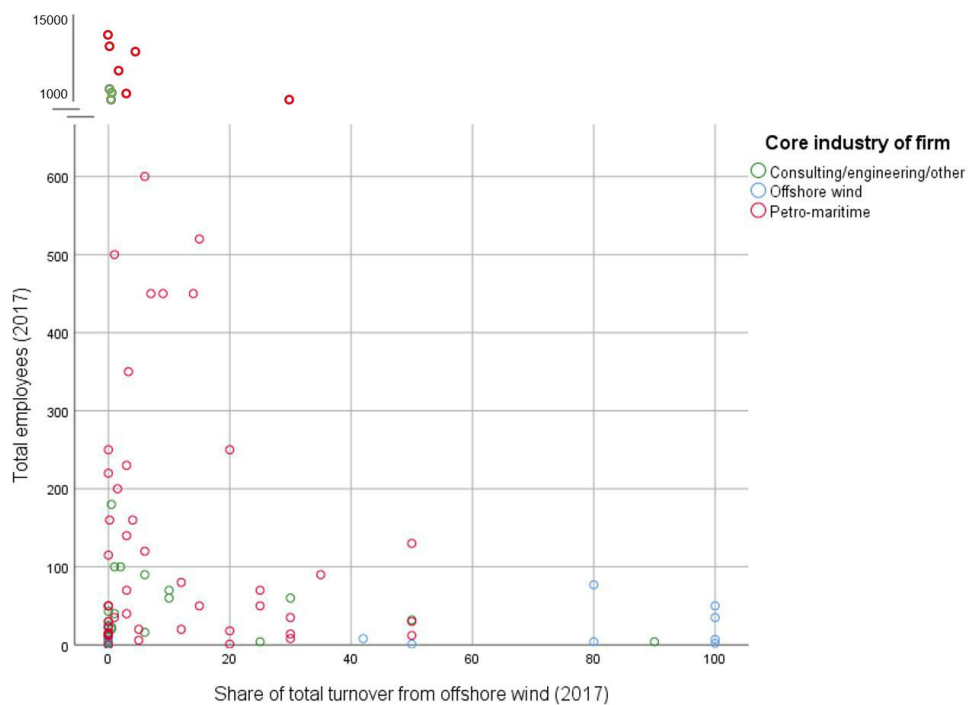


Figure 1 Norwegian firms active in offshore wind. Share of total turnover from offshore wind and total firm size (full-time equivalents). Based on 2018 survey.

There are many reasons for this lack of dedicated firms, such as a lack of a home market and weak incentives to build up more renewable energy capacity in Norway (Normann & Hanson 2017). However, developments in the oil & gas markets is perhaps the strongest influence on firm dedication. Mäkitie et al. (2019) show that periodic decline in oil price and reduced investment levels in Norwegian oil and gas has been a major motivation for diversification to offshore wind. Similarly, increased activity in Norwegian oil and gas has reduced levels of engagement in offshore wind. Thus, the sustained profitability and long-term prospect for activity in Norwegian oil and gas (which are still optimistic on behalf of the oil and gas industry) has not been compatible with the build-up of a large group of dedicated offshore wind firms in Norway.

4.2. Articulation of shared visions and expectations

An important element of building up niches is the articulation of government policy (Kemp et al. 1998, p. 190). Such articulation should stipulate which changes in institutions and legislations that are necessary for upscaling of a technology or an industry. The data suggests that such a shared vision has been lacking. Groups of actors have on several occasions articulated a demand for domestic demonstration facilities supported by public policy. However, several of these proposals have been hampered by a lack of coordination between different offshore wind advocates and competing proposals.

More recent data suggests that there are different views amongst offshore wind firms as to what the government should do to support a Norwegian offshore wind industry. Moreover, the data shows that the majority of firms do not attempt to influence policy-makers or public authorities on policy or the broader political context. The survey data also indicate that dedicated offshore wind firms more often attempt to influence policy-makers, and amongst

the diversified firms (i.e. mostly oil and gas-related firms), those firms that have a higher share of turnover from offshore wind more often make efforts to influence policy-makers.

Finally, the broader political context in Norway is shaped by the large oil and gas industry as well as the hydropower sector. The Ministry of Petroleum and Energy, which is the responsible ministry for offshore wind, has dedicated limited attention towards offshore wind. Due to the vast hydropower resources in Norway, offshore wind represent first and foremost an opportunity for industry development rather than new energy production. However, offshore wind has fallen outside the domain of the Ministry of Trade, Industry and Fisheries. The Norwegian innovation system which has been built up around hydropower and oil and gas represents a barrier for dedicated support from the state.

4.3. Network building

As shown in Figure 1, the majority of the Norwegian firms engaged in offshore wind have their core business in the petro-maritime industry. Around 60 per cent deliver primarily to the petro-maritime sector. An implication of this is that the vast majority of Norwegian offshore wind firms are members of business organisations whose purpose is to work for good conditions for oil and gas and maritime sectors. Some of the firms are members of the Norwegian Wind Energy Association (NORWEA). However, this organisation's primary goal is to lobby for wind energy activity in Norway and does not engage in activity that might help Norwegian firms that target international markets. Considering that there is no domestic market and nearly all Norwegian firms operate in international markets, NORWEA does not have many offshore wind firms as members. In sum, we find that there is a lack of coalition and network building that in part is because most of the firms see offshore wind as a small part of their business and that the organisations that represent these firms prioritise other industry areas.

5. Discussion and conclusions:

Our findings can be summed up under three headings in our analytical framework. First, many Norwegian firms are engaged in offshore wind, most of which have a background from oil and gas. However, most firms are not dedicated. The strong overlap with oil and gas is an important reason for this. Second, there is a lack of collective effort to articulate shared visions. We explain this through observation of different needs and views, many firms that are not very dedicated, and a weak alignment with the broader political context. Third, we see a lack of coalition and network building.

We offer some suggestions for how these challenges to niche-building could be addressed. First, more focus should be put towards efforts to strengthen the diversification activities in already diversified firms. Some of these efforts should in particular target large firms. Second, there is a need to strengthen networks or coalitions that work specifically with offshore wind over time. Finally, the findings do suggest that there is a need to somehow disentangle the close relationship between oil and gas and offshore wind. This brings up politically contentious issues related to the removal of subsidies or policies which incentivise investments in petroleum exploration. Such policy changes must first and foremost be debated in the political arena. Our point here is simply to argue that such policies should be seen not only in the context of phase-out, but also in the context of using destabilizing measures to foster diversification and stimulating growth in new niches.

Finally, we return to a question brought up in the introduction: How to mobilise assets from established firms? Even though transformative innovation policies will require inclusiveness

and broad participation to ensure legitimacy, the creation of a vision and an expectation for future growth in a new industry can be set by politicians.

It is possible for a government to articulate clear goals accompanied with policies to support a new industry. This might in turn strengthen niche-building, capacity to influence policy, and may even create better opportunities for including established firms in the development of transformative policies that are actually transformative, and not just defensive.

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Abstract 110

THE IMPACT OF SCIENTIFIC AND TECHNOLOGICAL TRANSFORMATION ON CLINICAL KNOWLEDGE USERS IN THE AREA OF RARE DISEASES

Woolley R.*

INGENIO (CSIC-UPV) ~ Valencia ~ Spain

Aim of the proposal:

To describe and discuss the impact of the diffusion of next generation sequencing (NGS) technology on practices and organisation in the context of seeking diagnoses for rare diseases (RD).

Background:

From private hobby to systems of distributed collective expertise

The field of rare disease (RD) medicine is undergoing a transformation in the way it is organized and managed. Historically, rare conditions (and very rare conditions in particular) were conceived largely as a kind of private hobby of those clinicians and researchers who, usually by chance, became involved in processes of diagnosis, treatment and care of patients with rare conditions. This meant the isolation of RD patients was matched by the disconnected pockets of medical experience that were not connected in a systematic way. Individual medical practitioner's experience and case-knowledge was not being aggregated in the interests of building shared forms of information that could underpin the construction of professional communities.

The organization of rare disease medicine has now shifted to a model of distributed collective expertise. Recognition of the knowledge problem underlying rare disease challenges has led to an emphasis on finding ways to compile cases, codify indications and diffuse knowledge. This emphasis has focused on mobilizing scarce expertise on rare diseases to address problems of diagnosis, treatment and care for RD patients in diverse social contexts. Measures including establishing registries, constructing bio-bank repositories and professionalizing patient support groups are differentiated elements of collective efforts to ensure expertise is institutionalized and can be mobilized effectively.

The guiding research question of this paper concerns the impact of next generation sequencing (NGS) technologies on the system of clinical and related practices involved in the search for a RD diagnosis. When a new patient is referred to a rare disease centre of expertise (CoE), the initial patient circuit often includes meeting a range of relevant specialists and a series of genetic tests are requested by the clinician managing the case. The results of these tests will form part of a diagnosis or potentially eliminate a suspected rare condition from further consideration. The key research questions asked participants to describe both how the system of practices in which genetic testing is embedded had changed due to NGS, and how these changes had impacted on their professional activities and roles.

Institutionalizing systems of fragmented knowledge

Efforts to institutionalize forms of collective expertise for RD can be understood from two analytical perspectives. First, at the level of practice, clinicians and other professionals are engaged in ongoing processes to build routines, develop capabilities and modes of organizing

their work. This work aims to institutionalize behavior and action into reproducible collective activities. In a context in which there is a high level of uncertainty and irregular inflows of new cases, these efforts to some extent reflect efforts to harness 'systems of fragmented knowledge' (Bruni et al. 2007). The systems of fragmented knowledge perspective is useful as it focuses on the performative challenge of processes that bring together patients, technologies and organisations in the context of addressing a complex socio-technical challenge that may not be amenable to the institutionalization of sets of routines and/or organisational arrangements.

In this paper the concept of a system of fragmented knowledge is extended to also capture the process of bringing together hitherto disparate or disconnected 'fragments' of relevant knowledge, the value of which can be increased through the process of systemization – that is, the integration of these elements into a socio-technical assemblage that integrates them to achieve specific goals. Consolidating the performance of such emergent socio-technical systems into a sequence of reliable and predictable activities in RD, however, constitutes a performative challenge that currently remains quite distinct from the efficiency-focused contexts of highly standardized high-throughput processes associated with common diseases. The emergence of human genome sequencing has profoundly disrupted the trajectory of biological science (Hilgartner 2017), increasingly merging biology with information science in a data-driven bioinformatic regime (Leonelli 2016). The commodification of NGS technologies and their diffusion has had similarly profound repercussions on clinical practice. In the context of RD, the diffusion of NGS testing disrupted arrangements that had been painstakingly put in place over many years with the promise to both drive up diagnosis rates and to reduce the time-to-diagnosis for RD patients and their families. The introduction of NGS, particularly in its initial phase, can thus be studied from the perspective of its impact on existing sets of practices and organisational arrangements in the area of RD that were both hard won and, at least in institutional terms, still in their infancy.

Methodology and empirical base:

Primary data described in this paper were generated as part of a single work package within a European Joint Action (EJA) run under the auspices of the former European Union Committee of Experts on Rare Diseases (EUCERD) in 2014-15. The work package investigated a range of issues related to CoEs and the institutionalizing and sharing of good practices within a Quality of Care (QoC) framework. Data collection relied on three qualitative strategies, a three month ethnographic case study in a single CoE, a semi-structured interview series with CoEs and linked stakeholders such as Patient Organisations, and a Workshop that included three Roundtable discussions of relevant issues among CoE Directors and EJA partners.

The subset of data used for this paper were drawn from interviews (n=41) with CoE Directors, clinicians and laboratory managers conducted in fifteen CoEs in eleven Member States (MS). The theme of genetic testing was triangulated wherever possible in the interview series, by asking about the topic from professionals in different roles within each CoE. Each interview with CoE professionals contained a base of common questions about genomics and rare disease. In addition, specific questions were asked of CoE Directors regarding technical change and CoE strategy, of clinicians regarding testing requirements and interpretations of results, and of laboratory managers regarding changes in testing and the production of interpretations of results. A small number of follow-up interviews were recently completed in the context of the OSIRIS project on the impact of science.

Results:

The analysis shows that the integration of NGS technologies in clinical settings for RD in Europe created a number of important challenges for professionals in the field. A first group of results related to the take up of NGS testing procedures by clinicians. First, a major emerging issue related to the fracturing of the population of clinicians with regard to their degree of competence in relation to new testing processes and requirements.

Older generations of clinicians typically had difficulties conceptualising exactly what tests they could request in seeking to make a new diagnosis. These clinicians are usually those with the greatest volume and depth of accumulated natural history knowledge.

Second, and closely related, clinicians had great difficulty in interpreting the results of NGS testing procedures in many cases. This stemmed principally from the different presentation of data compared to the familiar assay testing of the past. Third, laboratory researchers and technicians reported complications in writing interpretations based on the type of data generated by NGS testing. Differences in the type of data being generated also frames the character of indications that might be suggested somewhat different, leading to negotiations between clinicians and testers regarding how test results should best be described.

A second set of results relates to the reconfiguration of organisational routines provoked by the institutionalising of NGS testing procedures. These reconfigurations include the formation of horizontal alliances, accessing formal institutional resources, and the expansion of existing networks to include organisations with specific forms of translational expertise. Both sets of results involve changes in practices and organisational arrangements that are mutually co-constitutive of a variety of systems of fragmented knowledge. It appears that, in all likelihood, these various arrangements will only endure for as long as it takes to transition to a regime of broadly distributed competences and routines around NGS testing processes in specific RD contexts. Nevertheless, in some rare disease contexts, notably those involving ultra-rare conditions, it remains to be seen whether even comprehensive knowledge of the human genome and the increasing ubiquity and effectiveness of NGS methodologies will allow patients and families to move beyond the uncertainty and ephemerality of systems of fragmented knowledge.

Conclusions:

The results are discussed from the perspective of developing both the knowledge base and policy intelligence on the impact of science. What the results show is that the introduction of what can be considered in the context of healthcare as almost the equivalent of a new general purpose technology cannot be expected to have immediate benefits or even a homogeneous impact in different clinical settings. Rather, an array of complementary organisational routines and competences also need to be performed in the process of institutionalising localised arrangements that can first use and subsequently begin to the exploit the potential of a new technology. In this process, a variety professional identities and roles may be transformed and the relations between them reconfigured. From a policy perspective, it seems important to understand the apparent implication that investments in disruptive technologies will likely only start to realise their benefits after patiently passing through (a succession of) transition phases that experiment with the distribution and routinization of practices and with different possible modes of organising. Seeking to implement a transformation by driving strongly at an imagined consolidated end-state (Jasanoff and Kim 2015) may thus circumvent or constrain unnecessarily a crucial period of policy experimentation and learning.

F2 GRAND CHALLENGES

Friday 07 June 2019 from 09:00 to 11:00

STEFAN KUHLMANN, Chair

Abstract 21

ANALYSIS OF KOREA'S LIVING LAB CASES AS A R&D INNOVATION MODEL AND THE CHALLENGES: FOCUSING ON SOCIAL PROBLEM-SOLVING R&D PROJECTS

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Aim of the proposal:

The purpose of this study is to investigate the living lab activities in the social problem-solving R&D projects conducted in Korea and to derive its achievements and tasks. Through this case study, we will examine how Korean R&D is proceeding to C&D (Connect and Development) in the course of transforming from R&D-oriented technology supply policy to consumer-oriented problem-solving innovation policy and its difficulties and limitations.

Background:

Korea has pursued science and technology innovation activities focusing on economic growth and industrial development. For the rapid growth, Korea has taken a strategy to develop capable subjects and areas that can grow fast first. As a result, the growth of innovation centered on large corporations, high-tech industries, and metropolitan areas was achieved. It is deepening the gap between large enterprises and SMEs, advanced sectors and traditional sectors, metropolitan areas and rural areas.

In recent years, inclusive innovation has been emphasized in Korea to reduce social disparities and strengthen social integration. To this end, it is emphasized that the paradigm shift from research and development(R&D)-oriented technology supply policy to consumer-oriented problem-solving innovation policy. There is an attempt to integrate the subjects, fields, and areas that have been excluded in the conventional process of science and technology innovation. The emergence of new R&D categories in 2010, such as 'Social Problem-Solving R&D Project' and 'National Life Research' reflects the situation of Korea. Taking some time for self-examination of science and technology activities and asking questions such as "what is science and technology for?". This is a new endeavor of the scientific and technological field which sees the science and technology from the viewpoint of the people, not from the familiar and conventional way. These projects are quite different from existing science and technology activities. The goal is to improve the quality of life of the people by solving social challenges. The people and the experts at the scene work together to define and solve the problem. Those new research themes are aiming at R&SD (Research and Solution Development), which is not just a paper presentation or a patent application, but also utilizing R&D results to the problem-solving phase.

In particular, those projects introduced living-lab method as a propulsion system and tried to promote open innovation activities in which end users and researchers jointly develop, demonstrate and evaluate products in real life space. Living lab is an infrastructure that enables professionals and end users to continuously improve their products, services, and demonstrations with interactions.

Methodology and empirical base:

This study analyzed the representative cases in which living lab activities are prominent among the social problem-solving R&D projects in Korea.

This case study has examined how end users and demanders participate in R&D planning and demonstration phase, and what kind of attempts are being made to be R&SD (Research & Solution Development) and C&D (Connect and Development).

Results:

Through this study, we have identified the contents of the living lab activities of the social problem-solving R&D projects and present policy issues.

Conclusions:

The characteristics derived from the analysis are as follows: 1) Living Lab is being introduced as a methodology for user and demand-oriented research innovation in Korea's R&D projects. 2) In Korea's innovation policy, the efforts to strengthen and institutionalize the social responsibility of science and technology are being embodied. 3) Discussions on the improvement of laws and systems such as the establishment of a certification system to promote problem-solving by using technologies are being integrated. 4) New policy experiments to overcome the limitations of Korean innovation system such as top-down approaches to policy decisions, R&D planning which is focused on technology providers' convenience, and industrial innovation stressed on economic growth are being conducted through this project.

Abstract 54

INSTRUMENT-MIXES AND THEIR EVOLUTION: EVIDENCE FROM A SPANISH REGIONAL GOVERNMENT'S R&D POLICY (2006-2018)

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1. Introduction:

Over the last years, there has been a growing interest in R&D instruments mixes. However, there is not a body of knowledge sufficiently developed to fully understand the way policy instruments are selected and constructed by policy-makers, how they evolve over time, how they interact to each other in the context of an instrument mix, and how diverse social actors' behaviors influence decision-making processes and policy goals.

This article aims at deepening the understanding of the factors conditioning the design and evolution of R&D instrument mixes. It examines the case of the Spanish region of Galicia's instrument mix for promoting R&D activities in their universities. The article analyses how the selection of instruments and their design are influenced by different factors, including: involved actors (policy makers, scientists, University authorities...), the policies implemented at other levels of government, as well as policy makers' past decisions.

The case of study is particularly relevant for advancing knowledge in these issues due to several reasons. Firstly, it uses a longitudinal analysis by examining the twelve years evolution of this instrument mix (2006-2018). Secondly, Spain is a highly decentralized country where powers relating to higher education have been transferred to the regional governments. Therefore, regions manage large public budgets in that area, and may design major policy instruments oriented to diverse target groups. And thirdly, Galicia has three public universities, which makes possible to observe the influence of universities' "actorhood" on the achievement of policy goals. In this regard, universities are complex organizations. They carry out multiple missions (teaching, research and knowledge transfer) and show a significant diversity in terms of their internal organization and their members' preferences.

Following this brief introduction, section 2 depicts the theoretical framework guiding the analysis. Section 3 describes the methodology used. Section 4 discusses the preliminary results. And, finally, section 5 draws some conclusions.

2. Theoretical framework:

Even when the knowledge on instrument-mixes design and evolution is limited, there are some literature streams which are useful in order to guide this analysis on the design and evolution of an instrument-mix. This section is organized in three blocks: (2.1) explanatory models of instrument choice, (2.2) types of policy instruments at the disposal of public deciders, and (2.3) interactions among policy instruments over time.

2.1. Explanatory models of instrument choice

The classical approach to instrument choice assumes that public deciders are rational actors with well-defined preferences and clear policy goals. Beyond this perspective, other two contributions must be highlighted. Lindblom (1959) coined the term "incrementalism". According to his view, policy makers try to implement policies that produce incremental progresses. Even when those improvements are not completely satisfactory, they reduce the

risk of producing unintended consequences. On its side, Cohen, March and Olsen refer the existence of a metaphoric “garbage can” of decision-making, relating: an opportunity to make a choice, a series of available solutions, and a set of actors interacting in a complex way (1972: 16).

Capano and Lippi (2017) integrate the previous frameworks introducing the dimensions of “instrumentality” and “legitimacy”. The first of them has to do with policy-makers’ capacity to choose rationally the most adequate instruments in terms of achieving policy goals. The second one is related to the necessity of choosing alternatives that are accepted by the actors involved in the process. The analysis presented in this article bases on these two dimensions.

2.2. Types of instruments at the disposal of public deciders

Instrument choice is enormously influenced by the types of instruments at the disposal of public deciders and policy-makers in a given moment. In this sense, policy instruments may be defined as: “the generic term to encompass the myriad of techniques at the disposal of governments to implement their public policy objectives” (Howlett, 1991). There have been remarkable efforts to describe and categorize both public policies and, more specifically, policy instruments. Indeed, there is a range of classifications and taxonomies of policy instruments (i.e. Howlett, 2000; Schneider and Ingram, 1990; Vedung, 1998). For the purpose of this analysis, the classification used is the one proposed by Christopher Hood in *The Tools of Government* (1983) (revisited in Hood & Margetts, 2007). Hood makes a distinction between policy instruments aimed at collecting information and those oriented to behavioral change. Then, he creates a taxonomy based on the “social resources” managed by governments. His scheme, known as NATO, includes four types of instruments: “nodality” (information), “authority” (regulatory), “treasure” (financial) and “organization” (institutional).

2.3. Interactions among policy instruments and actors

Flanagan, Uyarra and Laranja (2011) emphasize the dynamic nature of instrument mixes. Following those authors, policy instruments evolve over time and interact among them within a multi-actor and multilevel-government context. Interactions between instruments and actors have serious implications in all the stages, from instruments’ design to their outcomes. According to Pierson (2000) classical political science studies do not take into account the variables time and sequence. From a path dependence perspective, he suggests that decisions taken in key moments may determine the sequence of future results in an almost irreversible way. Levi (1997) defends the same idea by arguing that the consequences of changing initial decisions are usually costly.

On its side, Rayner and Howlett (2009) assert that efforts for implementing coherent policy strategies are conditioned by policies previously in place. These authors find in the literature a set of processes affecting the reform of instrument mixes, including: conversion, displacement, drift, exhaustion and layering.

3. Methodology:

In order to develop this research a qualitative approach was chosen. The methodology used included a documentary analysis of a range of materials from diverse sources. Additionally, seven focus groups with scientists and twelve interviews with policy-makers and other involved actors (University authorities and directors of research centers) were carried out. The

interviews and focus groups were useful for obtaining large volumes of information not available from secondary sources.

The fieldwork was carried out in three stages. The first of them took place from the 7th to the 15th of November 2017. The second stage was on the 26th of January 2018. Finally, the third stage was held on the 10th of April 2018.

Because of their experience and knowledge, the participants provide us with insights on themes such as: the evolution of the instrument mix, how the set of policy instruments currently in place interact to each other, how and to what extent the normative framework as well as policies implemented at other levels of government influence the selection and design of the instruments, and how the behavior of different university actors with diverse preferences affect policy decisions, among others.

4. Results:

This section depicts four of the main findings from this research. They are related to: (4.1) the tendency to select and design “treasure” instruments in contexts where target groups enjoy high degrees of autonomy and policy deciders have a large amount of funds to invest; (4.2) the effects of institutional determinants on the design of policy instruments; (4.3) as previous evidence suggests, a strong path dependence as well as a positive feedback between instruments regarding the decisions of adopting and designing new programs; associated with the stability of policy-makers; and (4.4) the consequences of authority sharing on the outcomes of the instrument-mix.

4.1. Instrument choice: preferences for treasure instruments

Spanish universities depend largely on the governments (national and regional) in terms of: funding, opening permanent positions, being allowed to offer new academic programs, among others. However, they remain highly autonomous in their management, funding allocation, hiring decisions, etc. (Cruz-Castro & Sanz-Menéndez, 2015). On its side, academic freedom is at the core of teaching and research activities. Being universities and academics the major target groups of R&D policy, policy-makers tend to choose and construct “treasure instruments” (Hood, 1983). Treasure instruments incentivize rather than impose behavioral change; which is a feasible strategy in such an environment of autonomy. It is likely that autonomous target groups react negatively to policy decisions that are perceived as an imposition. On the other hand, universities and researchers are willing to obtain additional funding. As a result, treasure instruments meet both “legitimacy” (being accepted by actors) and “instrumentality” (being effective in their policy goals) (Capano and Lippi, 2017).

4.2. External institutional constraints of instrument design

It is generally assumed that public deciders make their choices based on their own preferences. However, this research shows that it may be the case in which external institutional constraints influence the design of a policy instrument. Such kind of situation creates potential tensions/conflicts and impacts on the design itself, the policy goals as well as the functioning of the instruments.

In the context of the multi-level governance, the government of Galicia implemented a program for the creation and consolidation of research centers. This program has been designed by regional policy-makers. However, it is mainly funded (80%) by the European Regional Development Fund (ERDF). As a result, the rationale underlying the European

program influences critical aspects of the regional instrument such as: timing of the initiative, eligibility of the expenditure, target groups, and even the existence of the program itself.

4.3. Evolution of instrument-mixes

By analyzing the implementation of new instruments (2006-2018) it has been observed the existence of strong path-dependence patterns as well as a layering process. Regarding the latter, the number of instruments in place in 2018 was significantly higher than in 2006. On its side, path-dependence affects the preferred target groups, as well as the formulation, design and implementation of new instruments. Additionally, a range of positive interactions between instruments have been found out.

4.4 Authority sharing

The interactions between instruments may lead to unintended consequences. Among other findings, this research shows how providing group leaders with large amounts of money may undermine the authority of research institutes directors.

5. Conclusions:

The results highlight the necessity of changing the focus from the analysis of specific instruments to instrument-mixes as well as their consequences in the university environment over time. It is also important to better understand the interaction between instruments and the institutional effects of instrument-mixes; specifically, their role changing the R&D environment and giving (removing) power to (from) some actors.

Finally, our analysis shows how the diverse external constraints to policy-making challenge the idea of planned and coherent instrument mixes in the university R&D system.

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F3 RRI

Friday 07 June 2019 from 09:00 to 11:00

UGO FINARDI, Chair

Abstract 41

ORGANISING FOR TRANSITIONS IN THE RESEARCH SYSTEM; UNDERSTANDING THE BARRIERS TO RRI

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Key words: RRI, barriers, research organisations

Responsible Research and Innovation (RRI) is sometimes described as an approach to research and innovation where societal actors work together during the whole research and innovation process in order to better align both the process and its outcomes, with the values, needs and expectations of European society.¹ Research funders, such as the European Commission, have devised programmes for encouraging the spread of RRI practices in research and innovation organisations. However, there are cultural, structural and environmental barriers to embedding RRI in the research and innovation systems. This article explores barriers in the research system.

1. Introduction:

Responsible Research and Innovation (RRI) is envisioned as a ‘concept of movement,’ transforming research organisations, funding agencies, and STI policies to help foster responsible and sustainable conduct in research and innovation. However, the uptake of RRI in organisations enters a field of barriers and drivers, determining the practices possible, and framing the conditions for mobilisation for RRI. Hence, the adoption process is crucial to the creation of new values in research and innovation as *lived practices* that are sustained in the organisation over time. In the H2020 RRI-Practice project,² we researched national and organisational barriers, drivers and good practices of RRI, from a perspective of organisational institutionalism. We investigated the conditions for uptake of RRI in 23 organisations across 12 countries in Europe and beyond and worked with the organisations to promote RRI.³ When working with RRI in the organisations the fact that RRI is not only a policy approach, but an umbrella concept, bringing together different elements of organisational conduct, became a methodological and practical issue to be tackled. The European Commission often portrays RRI as five keys or thematic elements (public engagement, open access, gender, ethics and science education)⁴. In the academic literature, RRI is often described by the AIRR dimensions (‘Anticipation,’ ‘Inclusion,’ ‘Reflection,’ and ‘Responsiveness’) (Stilgoe et al. 2013). In other words, RRI is a complex construct (the RES-Agora project called this *RRI-in-the-making*).⁵ In the RRI-Practice study, we approached RRI both in the shape of an overall, integrative philosophy about the transformed relation between science and society, as the

¹ <https://ec.europa.eu/research/swafs/index.cfm?pg=about> [accessed August 2017]

² Responsible Research and Innovation in Practice (RRI-Practice), funded by the European Commission Horizon 2020 Science-with-and-for-Society programme (grant no 709 637). www.rri-practice.eu.

³ The national case studies are all available here: <https://www.rri-practice.eu/knowledge-repository/publications-and-deliverables/>

⁴ <https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation>

process dimensions (inspired by AIRR⁶), as the EC keys, and through related concepts used in the countries and organisations studied. While each of these elements of RRI has their specific drivers, barriers, and good practices, common drivers and barriers exists across the elements of RRI. In this short paper, we focus on the *barriers identified in the project* across the five keys and four process dimensions.

2. Methodology in the study of barriers to RRI in organisations:

Our analysis here builds on the 12 national case studies in the project, which include all together 23 organisational reviews. For all countries, researchers conducted document reviews for the national context and in the participating organisations. Such document reviews included relevant laws and other national and organisational policy documents. Additionally, expert interviews, focus group interviews, workshops and feedback sessions with organisational outlooks for the furtherance of RRI were conducted. For more details on the protocol, see Forsberg et al. 2018. In the empirical study we took as a point of departure Scott's (1981) three paradigms for the study of organisations and organizing – rational, natural, and open systems – for an analysis of the organisations' RRI work, but renamed them as 'structural issues,' 'cultural issues,' and 'interchange dynamics.' By using a simple framework of three overall categories, we obtained an easily applicable structure to an otherwise complex study.

We coded all national reports with respect to mentions of organisational drivers, barriers, good practices, indicators, conceptual quarrels or other markers of perceived relevance of RRI; institutional conditions for RRI described in reports; recommendations made to organisations; and agreed points of improvement from the organisational outlooks, using qualitative research software. We coded each driver and barrier with respect to the relevant element in the RRI construct (keys and process dimensions), as well as with respect to the relevant dimension in Scott's framework. The result is a matrix, where each driver or barrier is coded with respect to relevant aspects of the RRI concept, and with respect to Scott's dimensions. This strategy has allowed us to gauge if some keys and process dimensions have predominantly structural, cultural or interchange related driver or barriers. Additionally, it has allowed us to compare the barriers with respect to Scott's dimensions for each element of the RRI construct. We have also condensed the codes into second order concepts, allowing us to compare barriers at a higher level, as well as across barriers for the individual keys and process dimensions.

3. Barriers to RRI in organisations:

Organisational barriers are those that hinder or work against the uptake of RRI in organisations, and make organisational members reject or doubt the relevance of RRI. The national reports each discuss many barriers to RRI under the heading of each element of the RRI concept, i.e. the five keys and the four process dimensions.

⁶https://www.researchgate.net/profile/Ralf_Lindner/publication/301560030_Lessons_from_RRI_in_the_Making_ResAGorA_Policy_Note_1/links/5719f75a08ae986b8b7ba821/Lessons-from-RRI-in-the-Making-Res-AGorA-Policy-Note-1.pdf

⁵ We adopted the approach to process dimensions used in the RRI-Tools project: Diverse & inclusive, Anticipative & Reflective, Open & Transparent, and Responsive & Adaptive to change.

However, our concern here is the barriers across keys and process dimensions, grouped as structural, cultural and interchange in accordance with the theoretical framework used.

We think of structural elements as comprised mainly of goals, objectives, authority structures, roles, mandates, responsibilities, monitoring and assessment systems, decision-making structures, reward systems, standards, procedures, codes of conducts, guidelines, workload, availability of resources, etc. Similarly, we think of cultural elements as comprised mainly of conceptions of organisational or professional values and identities, agency of change agents, management practices, taken for granted assumptions, prizes and other artefacts, etc. Last, interchange elements are understood as political expectations, guidelines or other policy documents, country or stakeholder culture, collaborations with other entities, public opinion, reputational matters, funding schemes, external benchmarks, etc.

There are overlaps between the categories structural, cultural and interchange. At times it is unclear if a structural barrier has succeeded in sedimenting as a cultural one, or a cultural barrier is (also) expressed in the form of a structural one (or several). Likewise, the interchange dimension, covering everything that transcends the borders of the organisation, can be a structural or cultural barrier in the environment of the organisation.

Below, we provide an overview of barriers to RRI keys and process dimensions that cut across several of the aspects or elements of RRI.

2.1 Structural barriers to RRI

Structural barriers to the adoption and successful use of RRI in organisations are plentiful judging from the country reports. Whether structural barriers are more prominent or just easier to identify, structural barriers are the dominant reason given in discussions of what hinders the uptake of RRI in organisations. This is the case for both funding providing and research conducting organisations. Prominent structural barriers across RRI keys and process dimensions are variations over the broader theme of:

- Lack of resources (money, time, people, training, expertise)
- Lack of incentives
- Lack of strategies, policies, frameworks, systems, and formal structures supporting practices pertaining to the aspect or element of RRI

While all of these are important, lack of resources occupy centre stage in the concerns of national report authors. The combination of lack of resources and lack of incentives seems particularly potent as a barrier. For instance, in the case of large-scale universities, perceived pressures for high profile publications, lack of resources, and lack of (other) incentives (than publishing) seems to severely cripple attempts to engage staff in ethical reflection, public engagement, science education, as well as all the process dimensions. Additionally, a very prominent theme is that of fragmentation, which has two overall dimensions and several subcategories for each, most dominantly the one related to the characteristics of the surveyed organisations.

- Fragmentation of organisations and the experience of bureaucracy
- Fragmentation of the RRI concept

Fragmentation of organisations has dimensions such as the lack of dedicated organisational units dealing with RRI or aspects of RRI; the use of non-standardized guidelines and procedures for aspects and elements of RRI within the same overall organisation (most prominent in the case of ethics); disparate programs with lack of co-ordination (also within one key); and unclear mandates. RRI aspects that are concerned with the interface of the

organisation and/or requires formal procedures of compliance (e.g. open access or ethics) are often troubled by bureaucracy. Paradoxically, this barrier could also be seen as a driver, because it allows for dedicated change agents in various units of the organisation, to pursue an RRI agenda. Furthermore, it potentially provides change agents with a vantage point (e.g. department chair, expert role, professorship or the like) from which to speak and influence the organisation.

The structural organisational fragmentation seems further fuelled by fragmentation issues related to the RRI concept. There are no centralized RRI-offices in organisations, but there are (often) offices dealing with gender issues, outreach, ethics, etc. This fact makes RRI less visible in the organisations, and curbs coordination of initiatives running across such units.

Finally, a barrier related to the RRI concept, cutting across keys and process dimensions, is that any use of the concept has a long-term perspective, and consequently results are difficult to trace and document. This is particularly noteworthy, as research on diffusion maintain that lack of clear results – or the ability to track these – are connected to poor diffusion of innovations (Rogers, 2003).

2.2 Cultural barriers to RRI

Barriers pertaining to cultural aspects represent the second largest group of barriers in our theoretical framework. The cultural barriers often seem to work in unison with structural ones. The most prominent barriers across keys and process dimensions are:

- Lack of knowledge and awareness
- RRI seen as an add-on, rather than central to the activity of the organisation (research or funding)
- Classic academic values of autonomy and merit curbs aspects of RRI
- Ingrained ideas on what innovation is curbs aspects of RRI
- Perceived lack of concept clarity

The first group of barriers (lack of knowledge and awareness) requires little further discussion, but is likely to affect the perceived relevance of RRI. In short, the message of what RRI is, and what could be obtained with the concept, is unclear in most of the researched organisations, apart from amongst a limited group of dedicated stakeholders or groups of people close to EU matters or funding regimes. A related difficulty is the existence of many different concepts that are perceived as denoting more or less the same thing as RRI does. However, many concepts drawing attention to the same phenomenon also helps guide attention to that phenomenon, and should aid the development of organisational practices that support what Randles (2016) calls 'de facto rri,' rather than the use of the RRI label for those activities. In sum, many concepts pointing to the same types of practices suggest institutional pressures to adopt models of management that accommodates ideas and techniques theorized as core to these concepts (cf. Guillén, 1994).

Although the add-on theme appears more dominant than the themes on classic academic values, and values related to innovation, we discuss the latter two first, since they logically contribute to the add-on theme. Judging from the reports, ideas and values related to academia and innovation respectively curb elements of RRI. First, the academic enterprise is about discovering new knowledge, where being on the frontier of the new is paramount. Therefore, the research process is considered best done if it is unbound by external agencies or stakeholders (such as ethics boards or governments), which may curb scientific freedom to pursue truth and progress. In some countries, most pronounced where academic freedom may be less of a given, there is fear that RRI may give governmental bodies a pathway to

influence science and possibly science outcomes. Similarly, innovation is about progress (Rogers, 2003), and a number of respondents hold that it should therefore not be curbed, as innovators contribute to economic development. If one curbs the creativity and engagement of the individual, one hinders progress and economic development.

As the two narratives suggest, one way of seeing RRI in its different aspects and elements is that RRI is not central to the pursuit of the research activity, nor to the innovation process. Someone else (e.g. governmental bodies) should concern themselves with such matters described by RRI, and consequently RRI is an add-on (or 'luxury'), and in some cases seen as a bureaucratic burden.

Apart from the above mentioned dominant barriers, other barriers stand out as important across keys and process dimensions.

- De-coupling effects
- Other concepts (e.g. scientific excellence) seen as more important
- Low buy-in from the 'older generation'
- Lack of managerial support

The three strong barriers discussed above seem to lead to de-coupling effects under some circumstances. For instance, de-coupling occurs when compliance with ethics frameworks becomes a matter of ticking the box or ethical reflection in reality is outsourced to some ethics commission or other external unit. Some reports explicitly mention a concern with organisational image as both a driver and a barrier. Such concerns may lead to superficial treatment of RRI aspects internally (to the extent that constitutes non-adoption), while broadcasting the use of the very same element externally (Meyer & Rowan, 1977).

Finally, many reports mention a lack of managerial support, little buy-in from older generations of researchers, and a heavy focus on other concepts (scientific excellence is mentioned) deemed more important.

2.3 Interchange related barriers for RRI

In the group of interchange related barriers, the role of funding organisations, their requirements, standards, systems as well as national policies and expectations – or lack thereof – figure prominently. Across RRI keys and process dimensions, we find the following interchange barriers pronounced in the national reports:

- Lack of policies and clear mandates
- Lack of clarity in various ways
- Lack of perceived interest and pressure from the public and political field (including translation issues)
- Organisations not held accountable
- Privacy and commercial interests
- Other concepts dominate the public discourse (e.g. accountability or sustainability)

Lack of policies and clear mandates, supporting RRI, is widespread according to the report and pertains to both funding organisations and research conducting organisations. In some cases, disparate frameworks used by funding organisations (or across the same funding organisation) seem to alienate the researchers applying for funds and fuels a lack of clarity on what the key

or process dimension means. In other cases, national legislations or other policy documents are at odds with each other, or mandates are unclear. Judging from the reports, it appears that national legislation and policies generally are rather fragmented, and often fail to address broader systemic issues in the science and in the innovation system. Across keys and types of organisations, it seems that organisations often are not held accountable by national authorities with regard to RRI elements.

A group of barriers relate to perceived lack of interest and pressure from the environments of the organisations. Many reports mention that the wider public are perceived as uninterested in science education, many of the process dimensions, and even ethics and gender. In other cases, there is a lack of perceived pressures in terms of policies, or funding schemes do not take elements of the RRI construct into account. Likewise, national legislation in some cases changes rapidly, complicating compliance, and leading to confusion, or is not in place at all. Lack of incentives also figure prominently across keys and types of organisations. In the interchange dimensions too, a lack of integration seems dominant. For instance, collaborations in the science system usually doesn't include the RRI keys or process dimensions.

Finally, privacy and commercial interests curb development of several keys and process dimensions. For instance, such interests at times create issues in relation to the open access key, as well as the process dimension Openness and Transparency.

3. Concluding remarks:

In this extended abstract we have only been able to briefly comment on the barriers to RRI in research funding and conducting organisations. Although we are still to conduct further analyses of the barriers, it can already be noted that many of the barriers appear to be quite similar across types of organisations (research conducting and funding) and across the world (i.e. the European and non-European countries and organisations included in the project). Moreover, an analysis of drivers for RRI will help us explain how the barriers were overcome in the good practice examples identified in the project. However, the barriers analysis seems to indicate that simply funding organisational RRI pilots will have limited effect when national policies do not request or incentivise infrastructures for RRI in the research system.

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Abstract 61

WHAT REALLY MATTERS - GENDER COMPETENCE AND THE PRACTICE AND PERCEPTIONS OF RRI

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1. Background and Aim:

For many years, the EU's Directorate-General for Research has supported the objective of bringing research and society closer together with the help of its central financial instrument, the Framework Programmes (FPs). The science-and-society pillar within the FPs changed terminologically but also conceptually over the years - from "science *and* society - SaS" in the 6th Framework Programme (2002-2007) to "science *in* society - SiS" in the 7th Framework Programme (2007-2013) to the current "science *with and for* society - SWAFS" in Horizon 2020 (2014-2020). During the 7th Framework Programme, the new concept of RRI (Responsible Research and Innovation) entered the scene and plays an important role in H2020. In operational terms, the European Commission divides the umbrella term RRI in six 'key areas': gender equality (GE), science literacy and science education (SLSE), public engagement (PE), open access (OA), ethics (E) and governance (GOV).

Until now, little is known about the practice and perceptions of RRI among researchers in Europe. This lack was addressed by two large-scale surveys that were launched in the course of the EU funded MoRRI project (Monitoring the evolution and benefits of RRI, Contract number RTD-B6-PP-00964-2013, Duration 09/2013-03/2018). In the surveys, researchers were asked about their views on the relevance, benefits, barriers and hindrances of RRI within their daily research activities. Based on the survey data we were able to investigate whether and to what extent institutional frameworks support the implementation of RRI activities

Aim of this paper is to investigate whether the EU funding context makes a difference regarding attitudes and activities towards RRI and how institutional frameworks support the implementation of RRI activities within research organizations.

2. Methodology and empirical base:

In order to analyse the activities and attitudes towards Responsible Research and Innovation (RRI), two online surveys were conducted: In a first step, we surveyed researchers listed on the EC CORDA database, which was delivered by the Commission Services to the study team. This dataset contained contact details of researchers funded by the Horizon 2020 framework programme (including the European Research Council and Marie Skłodowska-Curie Actions). Before launching the first survey among these EU-funded researchers, the data were cleaned by the Fraunhofer ISI study team (deleting duplications, etc.). In a second step, Fraunhofer ISI generated a control group based on selected main characteristics of the EU researchers' group: country of work, gender and scientific discipline. But unlike the first group, this group of researchers had not received any EU research funding within the last five years. This was controlled by matching the EU database with the list of control group addresses but also by integrating a control variable at the beginning of the questionnaire (see below). We used the Scopus Author IDs to compile the control group. The control group approach aimed to analyse whether the EU funding context exerts an influence on the perceptions and concrete activities of researchers through its promotion of RRI.

The first survey - among the EU funded researchers - was launched on 17 November 2016 and reminders were sent in late November and then mid-December 2016. In total, 22,947 persons were contacted by e-mail, but 673 could not be reached. Of the remaining 22,274 persons, 3,117 responded actively to the survey request, a response rate of 14%. In total, 2,755 participants completed the survey (completion rate: 12.4%). The average process time for the survey was 15:57 minutes.

The second survey – among the control group – was launched on 14 March 2017. 25,968 identified researchers were contacted by e-mail. 8,245 persons could not be reached due to absence, retirement or an invalid/outdated e-mail address, resulting in a net sample of 17,723 persons. 1,264 researchers responded to the survey request, constituting a gross response rate of 7.1%. Of these, 945 participants answered at least half the questions in the survey, a net response rate of 5.3%. In total, 723 participants completed the survey (completion rate: 4.1%). The average process time of the respondents was 14:30 minutes.

As mentioned above, a filter question was positioned at the beginning of the control group survey in order to ensure that participants have not received any financial research support from the EU over the past five years. 417 respondents indicated that they had either received funding from the EU Framework Programme (FP7 or H2020), ERC Grants, EUREKA, COST or other EU research programmes. Consequently, this group was excluded from further analysis, leading to an adjusted de facto control group of 528 participants that factually had not received any EU funding.

The following table summarises the main characteristics of the respondents whereas we distinguish between the EU funded survey group and the control group. It can be seen from this table that the EU funded group and the control group differ with regards to several dimensions, primarily the type of institution but also the scientific discipline and the scientific age. This should be taken into account when interpreting the results,

Table 1: Socio-demographic background of the respondents

<i>Criterion</i>	<i>EU Funded Researchers</i>	<i>Control Group</i>
Gender		
Male	68.5%	75.2%
Female	31.5%	24.8%
Institutional Background		
Higher Education Institutions (HEIs)	46%	71.9%
Research Performing Organisations (RPOs)	15.3%	8.8%
Companies	26%	6.3%
Civil Society Organisations (CSOs)	5.9%	3.5%
Public Authorities	3.3%	2.0%
Scientific Disciplines		
Natural Sciences	34.4%	33.0%
Engineering Sciences	29.4%	18.0%
Social Sciences / Economics	11.4%	11.8%
Humanities	6.7%	9.5%

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Medicine	6.3%	13.8%
Structural Sciences (Mathematics, Informatics)	5.6%	8.3%
Research experience (Years after Masters degree)		
Less than 5 years	14.2%	10.1%
Between 6 and 10 years	25.5%	19.6%
Between 11 and 20 years	33.8%	30.7%
More than 20 years	26.6%	39.5%

3. Results:

Our data also provides strong support for the assumption that institutional incentives change mindsets and behaviours: researchers who receive EU funding are far better informed about the RRI concept than those without such funding. Furthermore, there is a marked difference with regard to gender equality: whereas around three quarters of the EU-funded respondents indicate that they support female colleagues, only 60 % (without a GEP) or 67 % (with a GEP) of the control group report such behaviour. In addition, consideration of gender aspects in research design is much lower for the control group than for the EU-funded researchers. The reason for these differences might be that twice as many EU-funded respondents indicate that gender equality is a requirement of their research funders. There are also large differences for public engagement: EU-funded researchers far more frequently indicate an activity like involving citizens in discussing the consequences of research, communicating and disseminating results or engaging with industry. They also indicate more frequently that this activity can be attributed to the requirements of research funders. The differences between the two survey groups regarding open access are not as distinct; the only remarkable difference here relates to the implementation of data management plans, which again is required by the European Commission.

In summary, our use of multivariate statistics (Control variables were country, scientific age, scientific discipline, organisational background, target group of research, type of research and gender) identified the following activities with the largest, statistically significant differences between the EU-funded and control groups:

- two out of seven science education activities (appearances on TV/radio; science cafés, science festivals, researcher's nights;
- three out of five gender equality activities (I encourage gender-balanced teams in my work environment; I actively support female colleagues within my teams; I consider gender aspects in my research design);
- one out of five ethical activities (I submit my projects to ethical reviews); seven out of eight public engagement activities (involvement of citizens in determining what research should be performed; discussing the consequences of research/its application (including technology); communicating and disseminating the results of the project; commercialisation/exploitation of results; I actively consider how my research and

innovation results will be perceived; I work with people who specialise in holding dialogues with citizens and civil society; I engage with industry in my research);

- one out of six open access activities (implementation of research data management plans).

This leads us to the conclusion that public engagement, gender equality and science education are strongly shaped by the EU framework and its incentives.

The control group is also less likely than EU-funded researchers to indicate concrete benefits of RRI. This is in line with the former's degree of familiarity with and reduced practice of RRI: even if over half of the control group indicate an observed or expected benefit in most cases, the share of control group respondents who do not expect any benefits is substantially higher than for their EU-funded counterparts. This holds true for all four benefit categories, i.e. scientific, economic, democratic and social benefits, with the largest differences seen for scientific and economic benefits.

Finally, even if the overall distribution of observed barriers is more or less the same in terms of yes/no responses, concrete barriers are mentioned much more frequently by the control group than by the EU-funded researchers. Task overload plays a particularly decisive role for the researchers in the control group.

Our data also show that female and male researchers differ with regard to the concrete practice of the RRI keys. Particularly obvious differences emerge for concrete gender equality activities, where female researchers mention a respective behaviour more frequently than male scientists.

This first impression based on a descriptive analysis is also supported by our multivariate analyses (see also Bühner & Iferd, 2017), which show that female respondents indicate much more frequently than men that they support female colleagues and consider gender aspects in their research. The differences between the use of gender-sensitive language by women and men are not statistically significant. However, we do find important differences regarding research experience: respondents with longer research experience (11+ years) are more inclined to support female colleagues and promote gender-balanced teams than less experienced respondents. Finally, scientific discipline also influences the responses insofar as researchers from the medical, social sciences and humanities fields mention that they deal with gender issues in research projects or consider gender aspects in their research designs much more frequently than those from the structural sciences. The use of gender-sensitive language in publications is most common in the humanities and social sciences. Finally, researchers from the field of medicine most frequently indicate that they encourage gender-balanced teams.

With regard to the four remaining RRI keys, men and women differ in their engagement in public engagement and science education, while no differences can be found for open access and ethics (Bühner & Berghäuser, 2017; Bühner & Iferd, 2017)

To investigate the differences by different degrees of gender competence, we constructed a new variable in which we indicate whether the respondents mention at least two of the aforementioned gender equality activities. We understand gender competence as a basic competence that all researchers should have, and which comprises a basic understanding of gender equality goals and gendered aspects in science and research. Gender competence has to be distinguished from gender expertise. The latter requires sound theoretical knowledge of gender theories and/or experiences with the implementation of gender mainstreaming in research and innovation in addition to gender competence.

The results show that for science education activities, gender-competent respondents more frequently mention the respective activity and the differences are much stronger than

between female and male scientists. Thus, the explanatory factor is not gender but rather gender competence. A similar picture emerges for public engagement activities. Again, the differences between gender-sensitive and less gender-sensitive researchers are larger than between female and male researchers. Finally, while we could not find any significant differences between male and female researchers with regard to ethics, the new perspective does deliver such differences

4. Conclusions:

The analysis shows that the institutional environment positively influences the degree of RRI activities and the general attitudes towards more responsible research and innovation: researchers working in an institutional environment that systematically supports the practice of RRI are more active in RRI practices than researchers who do not rely on such structures. For the gender equality dimension, this means that institutions with a gender equality plan (GEP) in place are more inclined to support female researchers than institutions without such institutional incentives. Furthermore, researchers with experiences in EU-funded projects are more likely to be engaged in RRI activities. Even if female researchers have a stronger inclination to engage with society than their male counterparts, gender competence proves to be the relevant distinguishing criterion. Gender competent researchers are more often involved in other RRI activities.

These results underline the importance of future activities to strengthen the gender dimension in science and research and point to the potential leverage effects of the gender dimension for other RRI keys. The survey results also provide evidence that research and innovation practices can change if commitment is required. This is the case, for instance, if an institution commits itself to gender equality when releasing a GEP or when a funding institution requires gender equality activities in the research it funds. However, experiences show that such self-commitment has to be supported by external initiatives like the research-oriented gender equality standards formulated by the German Research Foundation (DFG) or the performance contracts concluded between Austrian universities and the Federal Ministry for Education, Science and Research. Such instruments link the funding of a research performing organisation to the development and implementation of gender equality policies (Wroblewski & Striedinger, 2018; DFG, 2017).

Although gender equality policies are widely implemented in Europe, they are still far from becoming a matter of course. Hence, a continuation of existing effective policies is needed to support gender equality. A further development of gender equality policies should also address the potential leverage effect for the other RRI dimensions, e.g. by explicitly combining the goals of different RRI keys. Contrariwise, gender competence should be included in the development of measures and policies addressing the other RRI keys, since gender-competent researchers seem to be more open to adopting innovative practices in research and innovation.

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INSTITUTIONS MATTER - HOW TO PROMOTE RRI BY SETTING SUITABLE INSTITUTIONAL INCENTIVES

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Aim of the proposal:

Aim of this paper is to investigate whether the EU funding context makes a difference regarding attitudes and activities towards RRI and how institutional frameworks support the implementation of RRI activities within research organizations.

Background:

For many years, the EU's Directorate-General for Research has supported the objective of bringing research and society closer together with the help of its central financial instrument, the Framework Programmes (FPs). The science-and-society pillar within the FPs changed terminologically but also conceptually over the years - from "science and society - SaS" in the 6th Framework Programme (2002-2007) to "science in society - SiS" in the 7th Framework Programme (2007-2013) to the current "science with and for society - SWAFS" in Horizon 2020 (2014-2020). During the 7th Framework Programme, the new concept of RRI (Responsible Research and Innovation) entered the scene and plays an important role in H2020. In operational terms, the European Commission divides the umbrella term RRI in six 'key areas': gender equality (GE), science literacy and science education (SLSE), public engagement (PE), open access (OA), ethics (E) and governance (GOV).

Until now, little is known about the practice and perceptions of RRI among researchers in Europe. This lack was addressed by two large-scale surveys that were launched in the course of the EU funded MoRRI project (Monitoring the evolution and benefits of RRI, Contract number RTD-B6-PP-00964-2013, Duration 09/2013-03/2018). In the surveys, researchers were asked about their views on the relevance, benefits, barriers and hindrances of RRI within their daily research activities. Based on the survey data we were able to investigate whether and to what extent institutional frameworks support the implementation of RRI activities

Methodology and empirical base:

In order to analyse the activities and attitudes towards Responsible Research and Innovation (RRI), two online surveys were conducted: In a first step, we surveyed researchers listed on the EC CORDA database, which was delivered by the Commission Services to the study team. This dataset contained contact details of researchers funded by the Horizon 2020 framework programme (including the European Research Council and Marie Skłodowska-Curie Actions). Before launching the first survey among these EU-funded researchers, the data were cleaned by the Fraunhofer ISI study team (deleting duplications, etc.). In a second step, Fraunhofer ISI generated a control group based on selected main characteristics of the EU researchers' group: country of work, gender and scientific discipline. However, unlike the first group, this group of researchers had not received any EU research funding within the last five years. This

was controlled by matching the EU database with the list of control group addresses but also by integrating a control variable at the beginning of the questionnaire (see below). We used the Scopus Author IDs to compile the control group. The control group approach aimed to analyse whether the EU funding context exerts an influence on the perceptions and concrete activities of researchers through its promotion of RRI.

The first survey - among the EU funded researchers - was launched on 17 November 2016 and reminders were sent in late November and then mid-December 2016. In total, 22,947 persons were contacted by e-mail, but 673 could not be reached. Of the remaining 22,274 persons, 3,117 responded actively to the survey request, a response rate of 14%. In total, 2,755 participants completed the survey (completion rate: 12.4%). The average process time for the survey was 15:57 minutes.

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As mentioned above, a filter question was positioned at the beginning of the control group survey in order to ensure that participants have not received any financial research support from the EU over the past five years. 417 respondents indicated that they had either received funding from the EU Framework Programme (FP7 or H2020), ERC Grants, EUREKA, COST or other EU research programmes. Consequently, this group was excluded from further analysis, leading to an adjusted de facto control group of 528 participants that factually had not received any EU funding

Results:

Based on the survey results, we analysed whether the respondents already conduct(ed) research and innovation responsibly or whether they intend to do so in the future, regardless of whether they are explicitly familiar with the notion of RRI or not. In the description of RRI activities, we follow the main dimensions defined by the European Commission, i.e. public engagement, science education, gender equality, open access and ethics (without governance). The kind of activities we asked about were deducted from the dimension reports compiled in the course of the MoRRI project (Griessler et al. 2015, Mejlgaard, Ravn 2015, Meijer et al. 2015, Wroblewski et al. 2015, Stilgoe, Lindner 2015, Talmon-Gros, Teichler 2015). By means of multivariate statistics we identified the following activities with the largest, statistically significant differences between the EU-funded and control groups: two out of seven science education activities (appearances on TV / radio; science cafés, science festivals, researcher's nights; three out of five gender equality activities (I encourage gender-balanced teams in my work environment; I actively support female colleagues within my teams; I consider gender aspects in my research design); one out of five ethical activities (I submit my projects to ethical reviews); seven out of eight public engagement activities (involvement of citizens in determining what research should be performed; discussing the consequences of research / its application (including technology; communicating and disseminating the results of the project; commercialisation / exploitation of results; but also: I actively consider how my research and innovation results will be perceived; I work with people who specialize in holding dialogues with citizens and civil society; I engage with industry in my research) ; but only one

out of six open access activities (implementation of research data management plans).

This leads to the conclusion that public engagement, gender equality as well as science education are strongly shaped by the EU framework whereas this is less the case for ethics and open access.

In order to obtain a realistic picture of RRI benefits, we asked the respondents: (1) whether they have already observed any benefits when conducting a respective activity in the area of gender equality, science education, open access, public engagement or ethics as the five main pillars of RRI, for example, when using open data repositories, (2) whether they expect respective benefits in the future or (3) whether they do not expect any benefits. Another answer category was “don’t know”. We follow the analytical benefit categories defined by the study team and already applied during the case studies (Wuketich et al. 2015). These categories are economic benefits, societal benefits and democratic benefits. In view of the main target group of the survey, researchers in Europe, we decided to add one additional benefit category, namely “scientific benefits.

Among the most important already observed scientific benefits are the emergence of new research topics and enhanced visibility in the research community. Regarding the economic benefits, the faster diffusion of knowledge is particularly highlighted. The control group is less likely to indicate concrete benefits of RRI than EU-funded researchers are. This is in line with the control group’s degree of familiarity with RRI and lower RRI practice: even if, in most cases, more than 50% of the control group indicated an observed or expected benefit, the share of control group respondents who do not expect any benefits is substantially higher than the same share among the EU-funded researchers. This holds true for all four benefit categories, i.e. scientific, economic, democratic and social benefits, but the largest differences are for scientific and economic benefits.

To give an example: while only 34% of control group respondents affirm the emergence of new research topics, this is the case for 43% of the EU funded researchers. Furthermore, 25% and 23% of the control group indicate a higher relevance and quality of the scientific outputs compared to 33% and 31% of the EU-funded survey participants. Finally, only 11% of the control group have already made a positive experience with mobilising research funding through RRI, whereas this holds true for 24% of the EU-funded researchers.

All in all, the multivariate analysis confirms that the majority of the benefit items differs significantly between the EU-funded researchers and the control group: within the dimension “scientific benefits”, five out of six benefit items are proved to be different (emergence of new research topics; enhanced visibility in the research community; higher relevance of scientific outputs; higher quality of scientific outputs; mobilizing funding) whereas especially the access to research funding underlines that EU-funded researchers did already have a respective positive experience.

Regarding “economic benefits”, six out of eight items show significant differences (decreased costs of introducing S&T innovation; improved products and services as consumer demands are better addressed; increased intrinsic satisfaction with science & engineering positions; stimulation of innovation; effectiveness of public investment; faster diffusion of knowledge)

The most important supportive factors to practice RRI are, from the point of view of the respondents, personal motivation but also the institutional strategy, which can play a decisive role. The existence of respective institutional strategies has a positive influence on the extent of activities within the RRI dimension concerned. An additional instrument to promote RRI is the prospect of better access to research funding. These results are in line with the personal main drivers described above and underline the crucial role that the institutional environment can play regarding the promotion of RRI. Thus, from the surveys we can see that about half

the respondents in both survey groups indicate a certain kind of institutionalised support for each of the RRI activities they conduct. This support may exist in an institutional budget, in institutionalised units like committees or offices or in concrete overall strategies. The existence of an institutional strategy does indeed exert a positive influence on RRI activities for each of the five RRI pillars, but to a varying extent: gender equality and ethics are the two areas of RRI display the strongest relationships

Conclusions:

The analysis of the two groups of researchers, one receiving funding from the EU and the other not, showed that the framework programme designed by the European Commission makes a difference to the practice of responsible research and innovation. Not only are EU-funded researchers more familiar with the concept of RRI, they also associate more benefits and supporting factors with it than researchers from the control group do. Furthermore, the EU-funded researchers are more likely to practise activities related to the five main pillars of RRI, i.e. open access, gender equality, science education, public engagement and ethics. Presumably, this is a direct effect of learning through EU-related policies and requirements, as RRI was developed and implemented first by the EU and is not yet – at least not as an acronym – fully known within national research and innovation systems.

The survey results confirm that the institutional environment can positively influence the degree of RRI activities and the general attitudes towards more responsible research and innovation. Researchers working in an institutional environment that systematically supports the practice of RRI, for example, through funding incentives, dedicated staff in charge of RRI pillars etc., are more active in RRI practices than researchers who cannot rely on such structures. Thus, from the point of view of policy makers, active support of institutional changes might help the dissemination of RRI. As we saw from the survey results, the definition of success and/or eligibility criteria for research funding is a further mechanism that encourages a positive attitude towards RRI

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Abstract 109

RESPONSIBLE INNOVATION IN EHEALTH? HOW MODES OF INNOVATION ENABLE AND CONSTRAIN DIMENSIONS OF RRI

Konrad K.*, Benneworth P., Schulze Greiving V.

University of Twente ~ Enschede ~ Netherlands

Aim of the proposal:

In our paper we study if and how dimensions of Responsible Research and Innovation are addressed in the innovation process of two contrasting projects and how this relates to characteristics of how the projects emerged, were organized and governed. We build on frameworks developed by Stilgoe et al. (2013) and Walhout et al. (2016).

Background:

Information and communication technologies are increasingly utilized to support health care practices. These so-called eHealth innovations embrace a wide variety of applications, for instance communication platforms which facilitate the interaction between patients and various actors involved in the care process, or sensor environments supposed to support healthy ageing and independent living of elderly or people with chronic diseases. eHealth applications do not only differ in the types of applications and practices they support, but also in their innovation process and governance – the types of actors that take initiative and are involved in different ways, the geographical scope, the funding and project structures etc.

Methodology and empirical base:

The study is based on semi-structured interviews conducted in 2017 with actors involved in different roles in the innovation networks of the two cases. The project has been supported by the Norwegian Research Council and the Dutch Province of Overijssel.

Results:

Stilgoe et al. (2013) suggested anticipation, reflexivity, inclusion and responsiveness as key dimensions of responsible innovation. Anticipation refers to techniques and practices envisaging possible impacts, relevant developments and opportunities, including a reflection on what is deemed plausible, more or less likely, and potential alternatives. Anticipation helps making choices mindful of future uncertainties and implications, allowing different stakeholders to express their preferences regarding potential trade-offs. Reflexivity involves considering one's own role, activities, value system, pre-assumptions and framings, and reflecting on the consequences that one's innovation process choices have for others, including those with other world views and value systems. Inclusion refers to mobilising forums where a broad set of stakeholders and citizens come together, not only the most powerful or visible ones. Responsiveness means that innovation products and processes are actually attuned to signals coming from different stakeholders, and emerging from considering the other three dimensions.

Stilgoe et al. (2013) also pose the question whether consideration is necessary for the institutional conditions and innovation system' characteristics enabling or constraining the

suggested RRI dimensions. This concern for understanding the conditions for RRI also emerges in Walhout et al. (2016)'s approach. They suggest to study processes of "RRI in the making" indicating there are many existing 'de-facto' practices, processes and governance arrangements in current research and innovation systems contributing to features of responsible innovation, irrespective of whether these explicitly refer to the concept. Furthermore, they demand further attention for how existing actor landscapes, governance arrangements and practices condition such RRI in the making (p.48). This perspective foregrounds the specific actor constellations, governance arrangements and practices within which innovation processes unfold. Thus, following Walhout et al. (2016), we contend more attention is required for different kinds of contexts where 'responsibility in the making' is evident. Walhout et al. address predominantly the governance of innovation, but their approach provides useful perspectives for studying the conditions of specific innovation trajectories as well.

The first eHealth application we studied, emerged as a user-driven, local project, responding to a perceived imminent problem related to the care of elderly in their homes, which was triggered by changes in the Dutch health care policy (Konrad et al., forthcoming). This application is a communication platform that creates a network around a particular client who is in need of regular care, and between the patient's care network, such as caregivers, family members, general practitioner and caretakers, or municipality. The client or the other involved parties can for instance ask questions, exchange data, inform about therapy, or order medication. In this way, the involved parties are updated about the care of a particular person and about the actions of others in the care network, with the aim to increase the quality and efficiency of the care. The eHealth application was initiated by a local group of caregivers and is promoted, distributed, and maintained by an independent foundation set up by the initiating group. The patient decides who participates in the network. The application was developed on the basis of existing software, and further adapted according to user experiences. Initially, in 2013/14 it was applied in the local municipality of the caregiver group, and has since then diffused to more than half of the municipalities in the province, and to a smaller degree beyond, largely via regional networks of actors involved in healthcare including doctors, municipalities, carers and insurances.

The second, more technology-oriented application was developed in the context of a European research project, and later on created the basis for a start-up that aims to commercialize the application across multiple European countries. The application allows to monitor the daily activity and medical condition of chronically ill or elderly clients, and aims at motivating them to exercise physical and mental fitness; the care network is envisaged to be involved at a later point as well. This project focused on the development of the technology, the user interface, and applied a number of systematic procedures to derive user requirements and test the application. The implementation of the gained insights was, however, difficult within the prestructured boundaries of a European research project.

Conclusions:

Within our paper we show how the modes of innovation, more specifically the characteristics and conditions, such as initiating and participating actor networks, geographical scope, prevailing problem definitions, institutional and financial settings, enabled and constrained the different dimensions of RRI suggested by Stilgoe et al. (2013) showing that different dimensions were facilitated to different degrees (the role of the regional dimension has been discussed in Benneworth et al. (2018) in more detail). In so doing, we contribute conceptually

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and empirically to our knowledge about RRI and the responsiveness of science and technology developments, as well as to a critical discussion about the potential of eHealth applications.

Please note: a similar proposal was made for last year's EU SPRI conference and accepted for an oral presentation, but due to personal circumstances had to be withdrawn. We would be happy, if you could consider it for this year's conference.

References:

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F4 RESEARCH INFRASTRUCTURES 2

- Special Session –

Friday 07 June 2019 from 09:00 to 11:00

Abstract 12

PROPOSAL OF A SPECIAL SESSION ON:

“DATA QUALITY ISSUES IN RESEARCH, EDUCATION AND INNOVATION STUDIES: STATE OF THE ART, PRACTICES IN USE AND NEEDS”

Daraio C.*

Sapienza University of Rome ~ Rome ~ Italy

Aim of the proposal:

The aim of this Special Session is threefold:

- i) making a state of the art about the theoretical developments in Data Quality for Research, Education and Innovation studies,
- ii) reporting about the data quality experiences carried out in the ETER and RISIS 1 Projects.
- iii) get feedbacks about current practices and needs from experts engaged in the management of specialized databases for Research and Innovation studies.

Background:

The quality of data and of related information for studies in Research, Education and Innovation is related to add value and improve the awareness and better exploitation of the available data, enhancing data quality-aware empirical investigations, highlighting problems and areas where to invest for improving the coverage and interoperability of data in future data collection initiatives.

The quality issue becomes even more important when datasets are linked, integrated and enriched.

Methodology and empirical base:

Methodology: theoretical developments in Data Quality for Research, Education and Innovation studies

Empirical base: RISIS databases

Results:

In the following we report an outline of the session's presentations and discussions that altogether will take 2 hours.

1. Presentation on the state of the art and of the experiences done in ETER and in RISIS 1 (Cinzia Daraio) 40 min
2. State of the play and challenges for Data Quality in different RISIS datasets
 1. CWTS Bibliometric database (Ed Noyons) 10 min
 2. CIB (Patricia Laurens and Antoine Schoen) 10 min
 3. EUPRO (Thomas Scherngell) 10 min
 4. Vico (Massimiliano Guerini) 10 min
3. Presentation of the users' perspective (Benedetto Lepori) 10 min
4. Feedbacks and discussions about current practices and needs (30 min)

Conclusions:

Extended discussions and useful collection of feedbacks for the organization of the Training on Data Quality within the RISIS 2 Project.

F6 IMPACT ASSESSMENT

- Special Session –

Friday 07 June 2019 from 09:00 to 11:00

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REAL-TIME IMPACT ASSESSMENT FOR TRANSFORMATIONAL RESEARCH AND INNOVATION

Joly P.*[1], Matt M.[1], Molas-Gallart J.[2], Boni A.[2], Giachi S.[3], Robinson D.[1], Hopkins M.[3], Gulbrandsen M.[4]

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^[4] TIK ~ Oslo ~ Norway

Abstract:

The need

The societal impact of research and its ability to address ‘grand challenges’ is an item high on the agendas of innovation policy makers and large national and international public research organizations. In Europe, Horizon 2020 focuses on excellent science and industrial leadership, and managing societal challenges. In the US, the National Science Foundation (NSF) claims that every grant has the potential to advance knowledge and benefit society. Many research funding organizations (the European Commission, NSF, the Dutch Technology Foundation...) evaluate both the scientific merit of proposals, and their broader impacts on society including their potential to produce broader societal effects (Bornmann 2013). Public research organizations (including the French National Institute for Agronomic Research (INRA), Consultative Group on International Agricultural Research (CGIAR), Biotech and Biological Sciences Research Councils in the UK (BBSRC)), higher education and research institutions (Research Excellence Framework in the UK – Martin, 2011) and academic scientists more generally are not only in charge of producing scientific knowledge, but also in charge of addressing societal challenges and diffusing knowledge to socio-economic partners and contributing to public debate and policy decisions. The 2015 Lund Declaration ¹ discusses how the European Research and Innovation Area might be reorganized and reoriented to better address global challenges: aligning national and European strategies, instruments, resources and actors; supporting frontier research, interdisciplinary collaboration, mobility of world-class scientists and research infrastructures; developing global partnerships with top scientists and innovators; and reinforcing open innovation and the role of end-users.

The current « grand challenges » differ from the previous mission-oriented policies (e.g. the Manhattan and Apollo projects) which supported the military-industrial complex (Gassler et al. 2008) and the development of specific technological capabilities. “Today’s grand challenges are broader in nature and require efforts that are structured for the long run” (Foray et al. 2012, p. 1698). The technologies that will need to be developed will require the involvement of numerous stakeholders, complex evolving networks, public-private interactions, and contributions from end-users. Funding for research and development (R&D) and innovation activities, and the resources needed to develop and diffuse the new technologies will be provided by both governments and several other central actors in the value chain.

¹ <http://www.vr.se/lunddeclaration2015>

These new technologies will enable to unlock current technological paradigms and trajectories, and will require social changes. As Kuhlmann and Rip (2014) rightly point out, grand challenges are about systems transformations. They involve changes to social, economic, and technical systems, and objectives which are not given at the outset but emerge along the pathway. This new framework will involve new policy rationales, new policy requirements related especially to the design of research programs, and new methods of evaluation and RIA (Amanatidou et al. 2014).

The challenge

The complex nature of grand challenges poses new challenges related to evaluation (Joly and Matt 2017). Such challenges need multi-disciplinary approaches, scientific, technological, and social innovations, multi-level governance, policy coordination, multi-actor engagement, and a long-term vision. The evaluation challenges include dealing with or overcoming the existing scientific and technological fragmentation, the multiple impact types, the multiple levels of policy actions, the existing policy silos, the broader set of stakeholders, and the identification of research impact. RIA involves collective and system level learning, and should be seen as a tool to guide complex transformation dynamics (formulation of coherent sets of policies and programs, new organizational forms, new social norms...). It is imperative for there to be an awareness of the conceptual changes at stake. RIA must be designed and conducted to enable a better understanding of the impact generating mechanisms, i.e. the various chains involved in the translation of research results into impacts (Joly et al. 2015). System transformation is a long and complex process with multiple causes and consequences which needs new RIA approaches suited to the interactions between research, innovation, and society.

The session at EUSPRI 2019

In the context described above, real-time impact assessment approaches will play a crucial role. This session will discuss current research aimed at designing and experimenting such approaches. What are the theoretical foundations of such approaches? How is it possible to steer research toward grand challenges, while nurturing its creativity? What are the main shortcomings of current practices? How can scholars of our research communities contribute to overcome such shortcomings?

Tracing impact of science from the user side

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Sophisticated new approaches to impact measurement have been developed the last decade that are based on strong theoretical perspectives and that allow for detailed studies of how impact processes unfold (Joly et al. 2015; Molas- Gallart & Tang 2011). Investigators take a research project or similar as a starting point and study the many translations (Callon 1990) and various forms of “productive interactions” (Spaapen & van Drooge 2011) that constitute the pathway to impact. These systematic and structured mappings have given us fresh methods and many new insights into impact processes, and may be seen as attempts to bridge qualitative and quantitative approaches (Matt et al. 2017).

In this paper, we present a complementary approach that looks at the process in a similar way but strictly from the user side rather than from a research project or research unit point of view.

Impact is fundamentally about *use* of research for various purposes like innovation, healthcare, policymaking, agriculture and more. However, users are often missing from analyses of and policies for impact, or they have a limited role through user surveys and expert panels that serve mainly to verify the characteristics of a certain event, as initially told by researchers and their documentation. The main narrative is one of a piece of research travelling through a complex field of practice, and the process can be promoted by asking researchers to be more collaborative, more open and to incorporate societal challenges and missions into their proposals.

Our idea is to develop a methodology that allows for a different type of narrative. An assumption behind our suggested approach is that the processes of impact – making policy decisions, improving healthcare procedures, developing innovations and so on – are largely independent from the process of research. This does not mean that there is not interaction, co-production and many meeting points between the two, this is frequently the case, but the driving forces, temporalities and organisational and institutional contexts differ significantly (Garud et al. 2013). Technological innovation starts in most cases from technological and socioeconomic problems, needs and opportunities, not from research results, although research can be useful in the innovation process for evaluating ideas, reducing uncertainty and providing new framings and insights (Kline & Rosenberg 1986). Our assumption does not depart radically from earlier perspectives, e.g. that research is often in itself not useful but is made useful through various steps and transformations (Joly et al. 2015).

The paper outlines how the impact process can be studied through the user side. We have developed the heuristic of a “problem area”, a related set of practical challenges for which one or several “user sites” have responsibility or take an interest. Marine biodiversity, work inclusion for the disabled, analysing and interpreting seismic data, and dealing with rare diseases are examples of problem areas in which we can find organisations that most likely would benefit from using research. Some of the problem areas can also be tied to the grand challenges that form a fundamental justification for current public investments in R&D.

Activities in some user sites can be followed in real time to get new insights into how research enters a practical setting and becomes linked to various needs, challenges and decision-making processes. The paper will discuss strength and weaknesses of the approach, illustrated with examples from case studies that are starting winter/spring 2019.

Tracking teams of scientists to identify progress towards impact using the Diversity Approach to Research Evaluation (DARE)

Frederique Bone¹, Michael Hopkins¹, Joshua Hutton¹, Jordi Molas-Gallart², Ismael Rafols^{2,3}, Gail Davey⁴ and Tony Carr⁵.

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³CWTS, Leiden University

⁴Brighton and Sussex Medical School

⁵Genome Damage and Instability Centre, University of Sussex

Traditional research evaluation tends to focus on assessment of outputs (e.g. publications) and longer term social and economic impacts, following a period of funding. These evaluations are necessary, ensuring accountability of funders and researchers, but they have limitations. In particular, the well-established growth of ‘team science’ raises questions about traditional evaluation modes (Academy of Medical Sciences 2016). Team science involves multiple individuals working together to solve complex problems in ways that can make it difficult to

attribute outputs and impacts to individual team members. Moreover, actually accomplishing goals through increasingly collaborative research projects is a substantial challenge (NRC 2015). This is partly because collaboration brings together individuals that are potentially diverse in many different dimensions: in their cognitive approaches, social networks, geographical location, institutional logics, and organizational affiliations (Molas-Gallart, D'Este et al. 2016). Such diversities need to be bridged through productive interactions (Molas-Gallart and Tang 2011, Spaapen and van Drooge 2011). This raises the question of how to define and implement evaluation approaches that can capture the process of collaborative research processes. These interactions are the first step towards outcomes and ultimately impact. If these interactions can be tracked, this raises the possibility of understanding how interactions lead to impact and developing support to ensure that promising interactions can be nurtured towards fruitful impacts. When such interactions are identified and analyzed in real time, we are developing a real-time approach to evaluation of research impacts.

Our proposed approach to evaluation is formative - we aim to use evaluation to provide feedback to improve researchers' and funding programmes' capabilities in team science. In recent work funded by MRC's Economic Impact Programme, we were able to map and measure changes in the composition and strength of collaborative links during research projects (Bone et al. 2017) using a series of analytically-relevant dimensions identified following seminal work in economic geography by Boschma (2005). Having demonstrated a proof-of-principle for an evaluation approach that operationalizes novel diversity measures of team composition and interactions, we now propose to establish which additional dimensions of diversity could usefully be incorporated into the DARE approach.

This contribution will first briefly describe how diversities were conceptualized and operationalized under the original DARE approach. The complex ways in which collaborative links are established and the different dimensions of diversity that these links need to bridge generated a burdensome research design. We will present our current attempts to streamline the DARE approach to be used efficiently in the monitoring of research projects. Our current work aims to identify the dimensions of collaboration that matter most to researchers, research administrators and funders, as well as their expectations concerning the design of approaches to support fundamental understanding of team science and its formative evaluation, and will explore how existing datasets gathered by funders can be used and complemented to enable the study and evaluation of collaborative research in ways that minimise or reduce reporting burden on researchers.

A formative approach to the evaluation of Transformative Innovation Policies

Jordi Molas-Gallart, Alejandra Boni, Sandro Giachi

Ingenio (Csic-UPV)

Transformative Innovation Policies (TIPs) postulate that addressing the key challenges currently facing our societies requires profound changes in current socio-technical systems. To trigger such "socio-technical transitions" calls for a different, broad mix of STI policies, with particular attention being paid to policy experiments conducted in protected niches. Therefore, TIPs can operate at different levels, but are often based on small scale experiments developed in protected niches. This poses a substantial challenge to the evaluation of such policies: how can we evaluate small specific interventions or sets of interventions, with a narrow geographical and temporal scope, when the final objective are ambitiously systemic?

How can we know whether a specific experiment has set ourselves up on the way to systemic transformation?

This problem can be seen as a specific instance of the common challenge posed by the impact assessment of policies that occur a long way upstream from their intended final objectives, as for instance societal-challenge driven research policies, or local interventions aiming at socio-economic development. In addition, however, TIPs proponents propose a set of policy characteristics that form part of the specific transformation logic they seek. For instance, policy interventions have to pursue changes in the structure and culture of governance, emphasizing inclusive participatory processes and have to aim to generate “second-order learning”. We argue that these characteristics have to be extended to policy evaluation methods and practices, and imply crucial modifications in the roles of the actors involved in evaluation activities, as well as changes in the organizational routines within which these evaluation practices are inserted.

This paper will propose an evaluation strategy that addresses these challenges in a way that is consistent with the principles of TIPs. The strategy proposed builds upon approaches to the evaluation of related policies (sustainable innovation policies, sustainable transition policies, responsible research to leverage sustainable transformations, etc...). We will argue that to do so, the evaluation approach needs to be formative; that is, it needs to aim to improve the specific policy or sets of policies under evaluation, and to do so with the involvement of policy participants. This requires evaluation to be conducted in real-time, as a form of constructive monitoring. The way in which the results of a real-time evaluation can inform us as to whether we are progressing towards the achievement of long-term, systemic goals, is by using, both generic and specific, “Theories of Change” to underpin the evaluation. To enable second-order learning such Theories of Change need to be flexible, and should be revisited as part of the formative, real-time evaluation processes. The approach proposed includes a three-step process to build and revise the specific Theories of Change required to guide the evaluation process.

Real time impact assessment for transformational research – A literature review and a research agenda

Pierre-Benoit Joly, Mireille Matt, Douglas K. R. Robinson

Lisis (Inra-CNRS-Upem-Esiee)

The objective of this paper is to build a theoretical framework that will ground the development of research management tools for real-time impact assessment (the toolset is labeled ASIRPA^{real time}). These research management tools will help researchers and research project managers to design and conduct projects/programmes that will lead to transformative changes addressing societal challenges/missions. Real-time assessment will inform the stakeholders about their progression towards the goals or missions intended by the projects and/or programmes. The challenges of ASIRPA^{rt} is to develop management tools based on a better understanding of the mechanisms that generate research impact and to coproduce them with potential users (Robinson and Rip 2013).

Given the uncertainty and complexity that characterise the transformation processes linked to research activities, we do not intend to design ballistic steering tools but to produce tools to foster learning processes, coordination and reflexivity of the actors involved. Our approach is founded by different streams of literature, some are more conceptual and others propose more practical tools. The Theory of Change approach supposes to define goals and possible

paths to achieve the intended changes. It takes into account serendipity, complex contexts and situations, and flexibility (possibility of revise the objectives). Depending on the level of dynamic monitoring, the theory of change will differ. This supposes to design a nested approach. Processual analyses such as innovation journey (Van de Ven et al. 1999) assume that transformation processes cannot be steered and planned because they generate new knowledge, new socio-technical associations and their effect depends on the progressive alignments of many heterogeneous elements. Developmental evaluation (Patton 2016) and Strategic intelligence (Kuhlman, 2003) have developed tools (foresight, monitoring, ...) that should foster competences of the actors involved in research activities and research programming, as well as strengthen collective learning and coordination. This second set of approaches supposes to introduce non-linear thinking and to develop dynamic assessment criteria.

The real-time approach will draw on lessons learned from ASIRPA *ex post* and the core concept of "impact pathway" (Joly et al. 2015). Among the main lessons, we will retain that the phases of the impact pathway are qualitatively different and do not follow a linear sequence; the dynamics are related to translations that allow to create new links between different elements (both human and non-human) and to transform and extend socio-technical associations; "productive configurations" take into account both the organisational complexity of the research activities considered and their embedding in a wider context; the role of intermediaries play a key role in the dynamics of key translation processes; and the generalisation or scaling up/out phase is often quite problematic.

The real-time evaluation process will be based on an iterative model as follows:

- 1/ *Target identification* (anticipated transformation and impacts)
- 2/ *Construction of the impact pathway by backward induction* (key actors, intermediaries, blocking and facilitating factors)
- 3/ *Identification of critical points*
- 4/ *Scenario construction (scripts - steps, bifurcation)*
- 5/ *Step by step decision and implementation*
- 6/ *Evaluation at each step and new loop*

It is a sequential approach, which aim is not to resolve all the questions from the outset but to conduct a process in which the main stages are analysed and scattered by internal or external information gains from the project. The principle is to identify the elements necessary to improve INRA's contribution in the present sequence, bearing in mind the uncertainty about the future.

G1 LOW CARBON TRANSITION

Friday 07 June 2019 from 11:30 to 13:00

BRUNO TURNHEIM, Chair

Abstract 45

TECHNOLOGICAL AND SECTORAL INTERDEPENDENCIES IN MARITIME LOW-CARBON TRANSITIONS

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Introduction:

Further acceleration of sustainability transitions is dependent on the development of complementarities between different technologies and sectors, because one technology may enhance the effect of, or serve to circumvent bottlenecks of, another. For instance the supply of renewable energy depends on developments in energy storage solutions and grids, where growth in one may require complementary developments in others. This challenges scholars and policy-makers to move beyond the common focus on singular niche-innovations, and expand towards perspectives that can cover a full system change towards sustainability (Markard, 2018b). However, such perspectives have thus far attracted relatively little attention in the study of sustainability transitions. In this paper, we address this research gap by investigating the role of interdependencies in the development of technological innovation systems (TISs) around low-carbon technologies in the maritime shipping sector (MSS).

Driven by public innovation and development programs, private investments and national ambitions to reduce emissions, several low-carbon technologies in the Norwegian MSS have emerged in the recent years, including battery-electric, hydrogen and biofuel technologies. For instance, application of batteries on ferry and passenger vessels as well as in offshore supply vessels is well underway, and demonstration projects using hydrogen technologies are under development. Battery-electric, hydrogen and biofuel technologies share certain similarities, e.g. the same societal ambition of reducing emissions in the MSS. However, due to their individual technological characteristics, amongst them the use of different energy sources, they have different linkages to surrounding sectors. In part this is due to the nature of the respective supply and distribution chains and associated infrastructures of the differing energy sources. This enables the analysis of interdependencies between TISs and sectors, and the resulting complementarities and competition between the low-carbon technologies in terms of required policy support. The paper therefore not only contributes to better understanding of whole system transitions (Geels, 2018), consisting of several interdependent sectoral transitions, but also provides insights for decision-making in innovation policy.

Technological innovation systems and sectors

A technological innovation system (TIS) can be defined as a system of actors, institutions and networks developing, diffusing and using a new technology or a process (Carlsson and Stankiewicz, 1991, Bergek et al., 2008). The TIS approach argues that a technological innovation takes place over time through a set of innovation system processes (functions of a

TIS), such as knowledge development, market formation and resource mobilization (Hekkert et al., 2007).

Relatively “good” performance in different functions of TIS is therefore required for a technological innovation to take place. Two main phases of TISs are often differentiated. First, the formative phase stands for the initial phase where innovation is characterized by several technological concepts, high uncertainty, entry of many firms, poor technology performance and small markets (Klepper, 1997, Bergek et al., 2008). Second, if a technological innovation gains enough traction, the TIS may enter into a growth phase, which is characterized by diffusion of technology, growth of the markets and firms, and a shift towards cost reduction and mass markets (Bergek and Jacobsson, 2003). The development of a TIS is also influenced by external factors, such as other technologies and TISs, sectors, spatial contexts and politics (Bergek et al., 2015). While all such contextual factors can be relevant for how a TIS may develop, in this paper we focus on the interdependencies between sectors and TISs.

Sectors stand for chains of production, distribution and use of technologies that serve a certain societal need. Sectors consist of a similar type of structure as TISs (actors, institutions and networks), but are more institutionalized, and rely on a larger set of technologies (Bergek et al., 2015). Sectors can have significant influence over TIS development by strengthening or undermining TIS functions (Wirth and Markard, 2011, Hanson, 2018, Mäkitie et al., 2018). Particularly in the formative phase of TIS, such interactions are likely to be one-directional, where the sector has a strong influence on a TIS, but not the other way around. In the growth phase, this interaction may develop into a more 2-way relationship, where a TIS begins to influence developments also in sectors (Markard, 2018a). Such 2-way relationships between TISs and sectors have the characteristics of interdependencies.

We apply the concept of interdependencies to refer to both complementary and competitive relations between a given technology and a sector. Both of these types of relation may have significant impact on the focal technology (Sandén and Hillman, 2011). Rosenberg (1979) notes that technological complementarities are important because the development, effectiveness and significance of one technology may depend on the development and achievements of other technologies and industries. This dependence may lead to postponement and delays in the development, and ultimately in the societal impact of the focal technology. Competitive relations, on the other hand, may emanate from the use and applicability of resources in multiple settings. A single TIS and a sector can have interdependencies with multiple sectors and TISs at the same time (Markard and Truffer, 2008).

Methodology:

The main material of this study was the approximately 60 semi-structured interviews with varied types of actors relevant for low-carbon innovation in the Norwegian MSS. Interviews lasted on average an hour. All interviews were recorded and transcribed. Due to the vast size of the interview material, the data analysis was performed by several researchers.

For this purpose, a common coding scheme was designed prior to the data analysis, which allowed a comparable process of analysis between the researchers. This coding scheme

utilized the TIS framework, and differentiated e.g. between different actors, technologies, institutions, networks, functions and contextual factors (such as the interactions between the low-carbon technologies and any relevant sectors). Common understanding of the coding scheme and key terminology was ensured through a common workshop, trial coding, and close communication during the coding. The interviews were coded by using the NVivo software. Moreover, we used document material, such as reports regarding MSS and the different technologies, to triangulate our findings. Finally, with the help of the coding, we identified the key interdependencies of the battery-electric, hydrogen and biofuel TISs with sectors. The following section presents the preliminary results of this analysis.

Preliminary results:

Our preliminary results show that the battery-electric, hydrogen and biofuel TISs in the Norwegian MSS have varied interdependencies with surrounding sectors, which influence the innovation system processes (i.e. TIS functions) in these technologies. For instance, the development of grid and charging infrastructure is necessary for further growth of battery-electric vessels. Especially in sparsely populated areas with little prior need for large grid capacity, future growth of battery-electric technologies may require significant investments in grids. Moreover, both battery-electric and hydrogen vessels require a supply of low-carbon electricity: in the former to charge battery-packs on-board, and in the latter to produce hydrogen through electrolysis. This may become particularly relevant in the possible growth phase of these innovations, as the demand for renewably-produced electricity increases. However, hydrogen can be produced in several ways. While such “green hydrogen production” would (ideally) use renewably produced electricity through the process of electrolysis, an alternative of “grey hydrogen production” also has gained traction. This latter way to produce hydrogen is dependent on the use of natural gas and carbon capture and storage (CCS), and thus has a differing sectoral interdependency. Meanwhile, biofuel and biogas vessels are dependent on the availability of biomass. In the possible growth phase of the biofuel TIS, this biomass have to be produced in e.g. forestry and agriculture sectors, thus reducing the availability of land and biomass for e.g. the production of food and other bio-based products. This negatively affects the legitimacy of the biofuel and biogas technologies in MSS.

Despite such differences in interdependencies, the three TISs also share commonalities in how they link up with the surrounding systems. All technologies, especially in their formative phase, have benefitted from the knowledge development in the land-based transport sector around battery-electric, hydrogen and biofuel powered vehicles. Moreover, they are dependent on the existing physical infrastructure, such as the harbors, as distribution facilities for the new energy sources. The preliminary results of this paper are summarized in Figure 1.

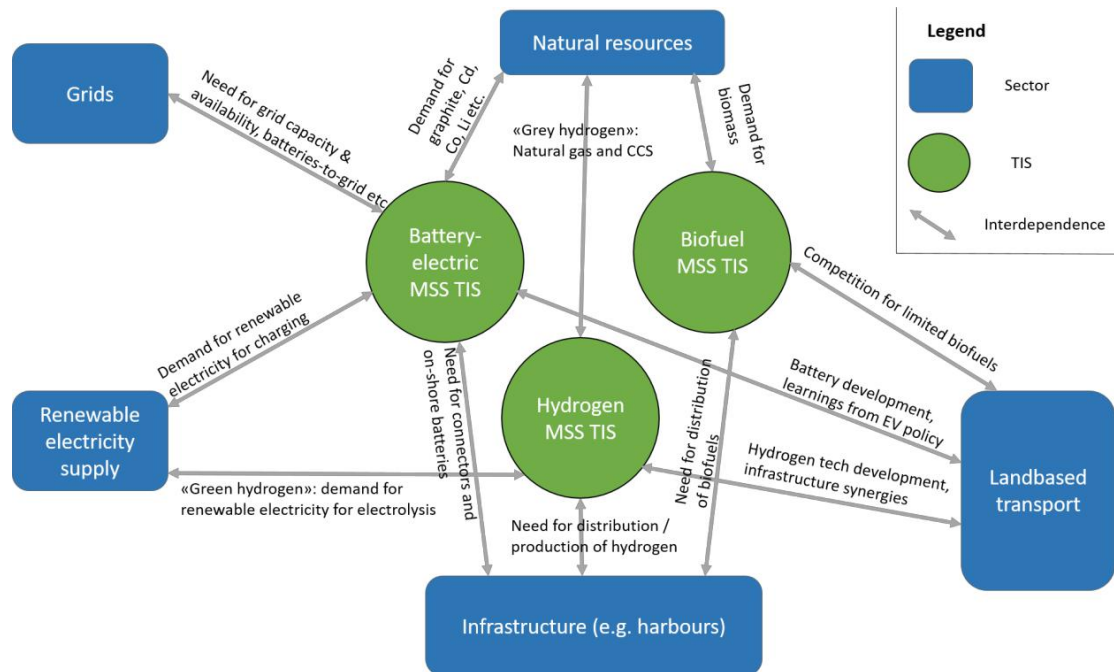


Figure 1 Sectoral interdependencies of battery-electric, hydrogen and biofuel TISs in the Norwegian maritime shipping sector.

Discussion and implications for policy:

Recent calls in the sustainability transitions literature have been made for more 'whole-system' approaches in the study of sustainability transitions, and how low-carbon innovations in one sector may be dependent on simultaneous innovation in other interdependent sectors (Geels, 2018, Markard, 2018b). Our paper has contributed to a better understanding of such phenomena. Our results show that the sectoral interdependencies of different low-carbon technologies in a sector may differentiate from each other. This means that, depending on the direction that the low-carbon innovation in a sector takes, innovation in very different kinds of other sectors may become central for a further acceleration of the low-carbon innovation. Such sectoral interdependencies may also change over time, with some system linkages becoming highlighted in the formative phase of the technology, while others may gain importance only in the growth phase.

Hence, in order to accelerate low-carbon innovation in one sector, innovation policy may need to target also other interdependent sectors through means of policy mixes (Kivimaa and Kern, 2016, Edmondson et al., 2018). Due to limited resources available for policy-making, acceleration of sustainable energy transitions may therefore require "picking the winners", as it may not be possible to effectively support innovation in all low-carbon technologies and their interdependent systems.

However, multiple low-carbon technologies may be dependent on the same systems (e.g. "green hydrogen" pathway and battery-electric TISs in MSS on low-carbon electricity supply). Due to such possible synergies between low-carbon technologies, identifying sectoral interdependencies of low-carbon technologies may assist decision-making in innovation policy.

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Abstract 51

WHAT DO WE KNOW ABOUT THE ENVIRONMENTAL, TECHNOLOGICAL, COMPETITIVENESS AND SOCIAL OUTCOMES OF POLICY INSTRUMENTS FOR THE LOW-CARBON TRANSITION: THE IMPORTANCE OF POLICY DESIGN

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Aim of the proposal:

Policy makers are debating more aggressive steps supporting the transition to a low-carbon economy. The literature assessing policy instruments has increased significantly, not only with a focus on environmental impacts, but also on a broader set of outcomes such as technology cost reductions, economic competitiveness and innovation, distributional effects, and acceptability. Using available insights to inform policy making is however challenging: results are often not in agreement, methodologies are not easily comparable, and the overall strength of evidence is hard to assess. We develop a framework for a systematic literature review of the impacts of ten widely-used policy instruments on seven key outcomes: environmental, technological, cost-related impacts, innovation, competitiveness, distributional and other socio-political impacts. We use the framework and an independent double coding on a set of 180 peer-reviewed papers and outstanding reports to summarize the evidence regarding the positive, negative, or lack of impacts of policy instruments on these key outcomes and identify those policy design features for which results are more in disagreement. This paper is complemented by an interactive online Policy Evaluation Tool to provide additional insights.

Background reference to the problem to be addressed, the research questions and the theoretical background of the proposal.

Addressing climate change is a key societal challenge. Notwithstanding the almost universal commitment to the Paris Agreement goals, it is now apparent that limiting the mean global increase in temperature to under two degrees Celsius above to pre-industrial level will not be enough to lower the dramatic risks associated with global warming (IPCC 1.5 Report, 2018). More stringent targets than those currently implied by the Nationally Determined Contributions (NDCs) will be needed at the national level (EC, 2016; Van Soest et al., 2017; Robiou du Pont and Meinhausen, 2018).

Increasing the level of commitment will only be possible through more stringent policies. Yet, governments need to mitigate climate change while also advancing other crucial sustainable development policy goals, with an eye to reducing policy costs, improving competitiveness, and ensuring energy security, affordability, and fairness (Anadón, 2012; McCollum et al., 2018; Fuso-Nerini et al., 2018; Mazzucato, 2018). The extent to which all these goals can be pursued simultaneously is a matter of heated debate (IPCC 1.5 Report, 2018). Understanding if and how different policy instruments can be used to lower trade-offs among the diverse set of societal goals or to promote 'additional benefits' or co-benefits (Stokes and Warshaw, 2017;

Ansolabehere and Konisky, 2014; Deng et al., 2018; Hulme, 2009, Roberts and Zeckhauser, 2011) lies at the heart of informing policy makers on climate-related issues, and is thus a crucial research question. This is particularly true given to the long-time horizons which characterize climate-related matters. Not accounting for a possible 'negative' effect of a given policy on one important outcome in the short term may hurt the ability to create and sustain policies in the long term (Anadon and Nemet, 2013).

This paper (and its associated Policy Evaluation Tool) is a first step towards a rigorous, systematic, and transparent understanding of the peer-reviewed body of evidence on the impact of ten regulatory and economic policy instruments on a broad set of technological, economic and societal outcomes. The main contribution of our work is to summarize and interpret the (often conflicting) evidence emerging from several streams of literature which rely on diverse, complementary methodologies, including qualitative case studies, quantitative assessments and integrated assessment modelling.

More in detail, our paper accomplishes three goals. First, we develop a framework for the systematic evaluation of the evidence regarding the impact of key low-carbon policies on key economic, societal and environmental outcomes. Second, we apply our framework to systematically review the large primary research conducted between 2000 and 2018 (180 peer-reviewed papers) and focused on understanding how individual policies (e.g., FITs) affect specific outcomes (e.g. technology deployment or innovation). And third, we identify and highlight the trade-offs associated with a given policy instrument type, and the key policy design features which characterize the policy instruments displaying the higher disagreement. Our systematic review also identifies important research areas and questions to support governments considering an increase in the number and stringency of policy instruments. We also shed light on those instruments, outcomes and research questions that have not yet received enough attention from the literature on policy evaluation. We now provide more information on how we achieve these three objectives.

Methodology and empirical base: clearly state the methodology used in the paper and the source of data used.

The first goal of developing a framework for the systematic evaluation of the evidence regarding the impact of key low-carbon policies on key economic, societal and environmental outcomes entails identifying

(a). policy instruments to be considered (a typology of policy instruments), (b) the set of key economic, social and environmental policy outcomes (i.e. metrics) that policy makers, and the public, care about, and on which the instruments are evaluated, and (c) a classification of the methodologies used in the different studies that we systematically review. To identify the policy instruments to evaluate, we modify the classification used in the IEA/OECD Policy and Measures Databases. We include in our analysis 10 policy instruments, namely green public procurement, environmental taxes and tax exemptions, energy auctions, feed-in tariffs, tradable green certificates, building codes, white certificates, renewable energy obligations, R&D investments and emission trading systems, as illustrated in Figure 1. To select a set of policy outcomes to evaluate, we present and apply a typology of the seven high-level outcomes: environmental, technological, cost-related impacts, innovation, competitiveness, distributional and other socio-political impacts. These were identified complementing the existing set of outcomes found in the literature of induced innovation in the energy sector (e.g., Gallagher et al., 2011; Wilson et al., 2012) to include additional policy-relevant metrics. The set of policy outcomes analysed in the paper is shown in Figure 2. To describe the

methodology used in the papers, we distinguish between specific categories of methodologies, such as qualitative case studies, theoretical analyses, empirical approaches or randomized control trials. Table 1 presents our classification, which builds on existing literature, and which we then use to assign weights to measure the strength of evidence.

The application of our framework to systematically review the large primary research conducted between 2000 and 2018 (180 peer-reviewed papers) showed that a full-range of research methods, ranging from theoretical models to empirical approaches and forward-looking integrated assessment models were used. To provide policy and scholarly insights on this matter, we not only report (a) whether a given analysis attributes a positive, null or negative impact of the policy instrument under consideration on the outcome that the paper is investigating, but also (2) an aggregate metric of the strength of evidence calculated by attributing different “weights” to each of the methodologies used in the studies; and (3) the level of (dis)agreement among the analyses focusing on the same policy instrument and outcome.

In order to select the relevant literature for systematic review, we search for peer-reviewed articles published in English between January 2000 and August 31, 2018 and explicitly addressing the evaluation of one of the policy instruments we selected (as per Figure 1) on one or more indicators (as per Figure 2). Three complementary processes were used to this end: a Scopus and ScienceDirect search, a policy by policy and outcome by outcome (i.e., issue-by-issue) search in key journals, and a review of references in pre-selected articles, based on with key authors, conferences and reports identifications.

The methodological steps we implemented for the selection are summarized in Figure 3. In particular, for the Scopus and ScienceDirect search we first identified the keywords of the search. Our main goal was to collect academic literature about the performance of ongoing or completed policy instruments, in a set of different criteria. Fig. 4 provides an initial overview of the number of publications for each of the policy instruments (Note that the sum of the size of the evidence by policy instrument is 235 publications instead of 180 because there are papers that assess more than one policy instrument).

In particular, note that we collected evidence on 584 evaluations, since some papers analysed the impact of more than one policy instrument on more than one outcome (Fig.5).

Results: achieved definitive or provisional results can be described, including their relevance with respect to the existing literature and the contribution they provide to the field of STS studies.

Our exercise contributes to the identification of what policies or policy design features can best maximize the climate impact while minimizing the negative social and economic impacts. In this sense, the analysis enables environmental and technological efficiency, competitiveness, distributional and social outcomes to be considered in an integrated manner. Furthermore, our analysis clearly shows that (at least) short-term socio-economic trade-offs are associated with policies in place or under consideration.

To give you an illustration of how our methodology is used, Figure 6 summarizes the available evidence on the relationship between each of the 10 policy instruments and the outcome “competitiveness”, which is measured in terms of job creation, industry creation, economic growth or productivity. Figure 7 provides a snapshot of the Policy Evaluation tool, --please do not distribute, as it is not yet finalized--.

One of the biggest concerns for policy makers is pursuing decarbonisation without hurting competitiveness. Generally speaking, this includes employment effects and, more generally,

labour market outcomes, but also industry creation, export and imports (e.g. of RE technology equipment), productivity and, more generally economic growth measured as variations in GDP or GNP. Notwithstanding some positive statements from international organizations such as UNEP or ILO regarding the ability to promote competitiveness and growth through decarbonisation, the evidence from the peer-reviewed literature is inconclusive. 35% of the papers evaluations (31 out of 89 evaluations for all the policies) report positive effects, while 38% and 27% reported no impacts and negative impacts (34 and 24 out of 89), respectively. Indeed, together with distributional effects, competitiveness is one of the criteria that shows a higher dispersion in terms of agreement.

Taking into consideration a global picture, strong evidence exists for the effectiveness, efficiency and relevance of some instruments, particularly in the area of GHG emission trading systems, Building codes, FITs, Tradable Green Certificates and Taxes whereas the evidence in other areas is generally of lower strength from a methodological quality perspective, e.g. Government procurement, white certificates or renewable energy auctions. However, it is not the purpose of the paper to judge in which context different methodologies may offer a better or more reliable conclusion in terms of internal or external validity. We embrace a multidimensional view of quality (Donnelly et al., 2018). We establish a default strength of the evidence assessment by policy. However, we are aware that this scale can be different for different users, e.g. users may want to prioritize and give more importance to ex-ante modelling papers than to quantitative papers using panel data models. This is why in the associated PET the user will be able to modify the scale following their own preferences.

Coordinated policies for a low-carbon transition at any governmental level are required to address the multiple societal goals that governments are trying to advance beyond improving environmental outcomes. In the context of economic awareness, understanding which are the policy instruments that generate more consistent positive impacts, across criteria, is essential to lead the aforementioned transition. Fig. 8, summarizes what we know, and we do not know, about the impacts of the selected ten policy instruments across a typology of seven criteria. This review has identified a wide range of interventions and policy options available for governments to comply with national and supranational environmental targets while transforming the economy and facilitating low-carbon transitions in a sustainable, i.e. environmental, economic and social, manner.

Broadly speaking, further research is needed regarding distributional and other socio-political outcomes. From the analysis, evidence seems to confirm that it is not easy to positively influence all the goals and objectives that one economy may have. We see that only the policies related to the building sector show positive impacts (when there is available evidence), in all the criteria. However, because of the nature of the outcomes analysed in the literature for the building sector, further research is needed to understand if these outcomes are purely theoretical or if they represent realisable positive effects, mostly on energy efficiency and energy savings in buildings. In this line, the results confirm that there is no a single policy instrument (white certificates are the exception), in which we do not find mixed evidence for some of the criteria. Competitiveness related outcomes, are the ones in which less agreement is found regardless the type of policy instrument. Further quantitative research is needed in this realm to establish the direction of correlation/causation between the portfolio of policy instruments and the potential adverse effects that these policies may generate in outcomes like economic growth, exports or levels of employment. However, we must highlight that some of this mixed evidence is due to the specificities of the sectors affected by the instruments and the specific technologies. That is why further research considering the economies as a whole is needed.

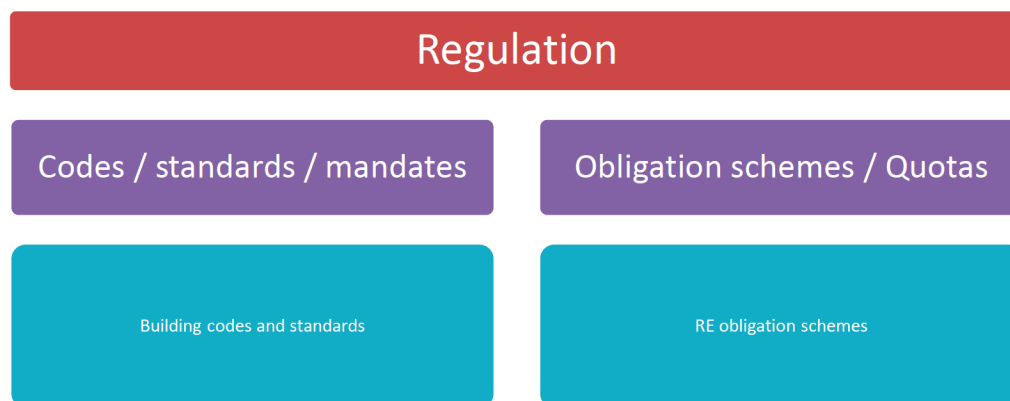
Conclusions and policy implications of the findings:

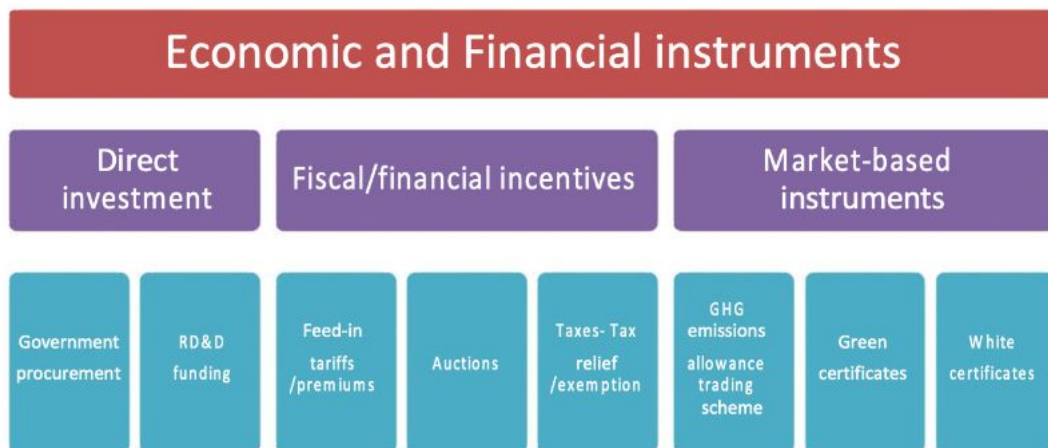
The evidence-scoping exercise reported in this paper maps-out the available knowledge about what we know in regards to the different effects that policy instruments used to enable the transition towards a low carbon society have had or will have. There is a confirmation that policy makers at different governmental levels are considering taking more aggressive steps towards facilitating a transition to a low-carbon economy. In order to take decisions about the portfolio of policies that may be implemented, practitioners will find in this paper and in the associated Policy Evaluation Tool, a place in which the available evidence to support policy decisions, about alternative instruments to achieve various goals related to the energy transition, is centralized and synthesize in terms of policy types, goals/outcomes, context and evidence quality.

The synthesis relies on a robust independent double coding of the primary literature with a common set of criteria, methods, and context and an aggregation at the policy level. This provides academics and policy makers with an integrated tool analysing and synthesizing what we know about the policy instruments that can enable a low-carbon transition of the economy. The complementary online tool makes the results available and allows users to select papers and aggregate results based on the policy instrument, the outcome, and the method that was used in the individual papers (allowing researchers to select only quantitative econometric studies, integrated assessment results, or qualitative case studies). The evidence becomes available for researchers and policy makers and can be used to influence decision making in the near future. As Donnelly et al. (2018) conclude, an accurate, concise and unbiased synthesis of the available evidence is one of the most valuable contributions that researchers can offer to policy-makers.

As mentioned before, the multiplicity of governmental goals as well as the priorities that different policy makers may have, prevent us from concluding which is the most effective, efficient, relevant and acceptable policy globally. What works in terms of policies enabling low-carbon transition follows a multidimensional approach and we let the reader to decide which they value the most. Potentially, the best policies would be those ones maximizing the effectiveness of the policy, environmental or technological, while minimizing the negative social impacts. In this sense, efficiency, competitiveness, distributional and social outcomes tend to be interconnected.

Fig. 1. Policy instruments focus of the systematic review.





Source: Own elaboration

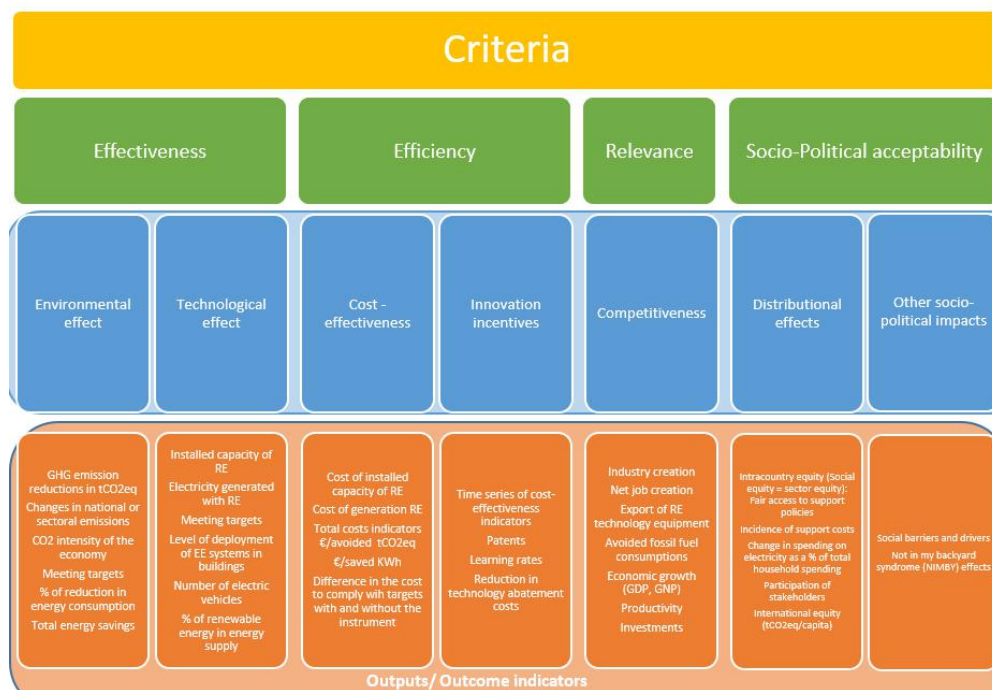


Fig. 2. Typology of the outcomes used to evaluate the impact of 10 policy instruments for the low-carbon transition.

Source: Own elaboration based on EC, 2015; IPCC, 2007; IRENa, 2014; Neil and Astranj 2006; Kondari and Mavarakis 2007, Del Rio et al., 2014; Schneider and Wagner, 2002; Spree, 2013, Field and Olewiler, 2011.

Table 1. Classification of the type of evidence.

	Design	Level
Systematic reviews and meta-analyses of randomized controlled studies	Systematic reviews and meta-analyses of randomized controlled studies (RCS)	1
	Individual RCT with definitive results or without definitive results	2
Observational studies/Quantitative studies	Systematic reviews and meta-analysis of non-randomized controlled studies and/or before and after studies, and systematic review of cross-sectional surveys	3
	Panel data analysis with control group	4a
	Panel data analysis with control variables (without counterfactual)	4b
	Individual cross-sectional survey with IV	5a
	Individual cross-sectional survey with control variables	5b
Qualitative studies	Self-report studies with data about feelings, attitudes and/or beliefs	6
	Comparative case studies and single case studies	7
Integrative evaluation	Integrated assessment modelling	8
	Traditional literature reviews / Theoretical projections	9

Source: Own elaboration

Fig. 3. Methodological steps

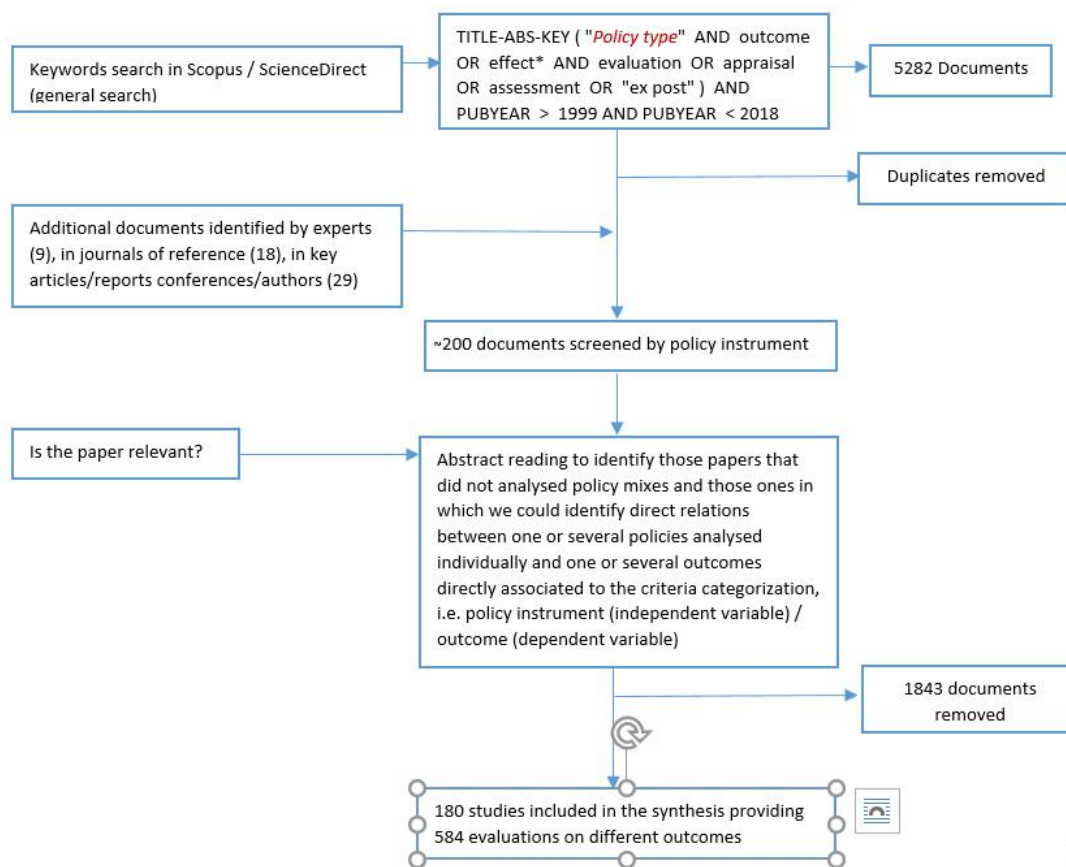
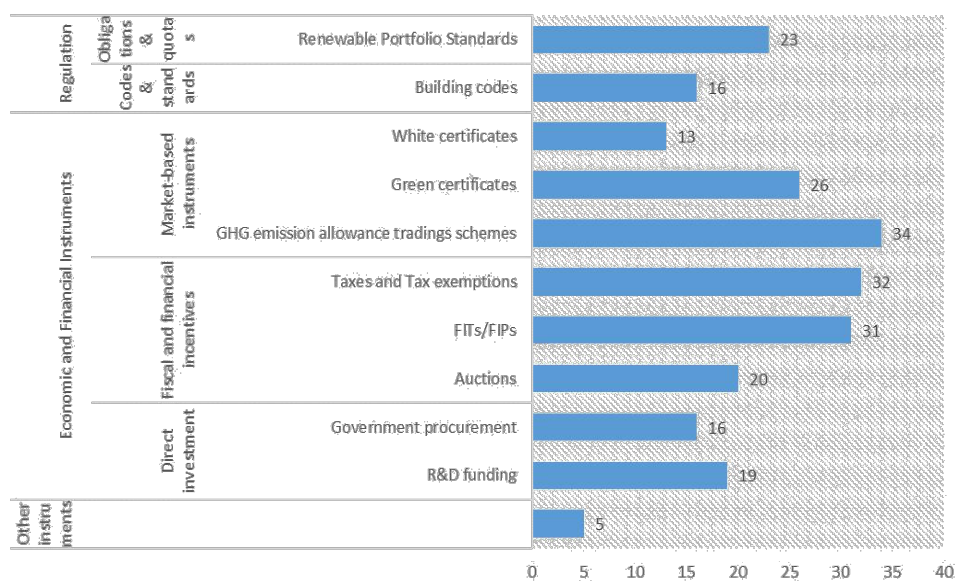
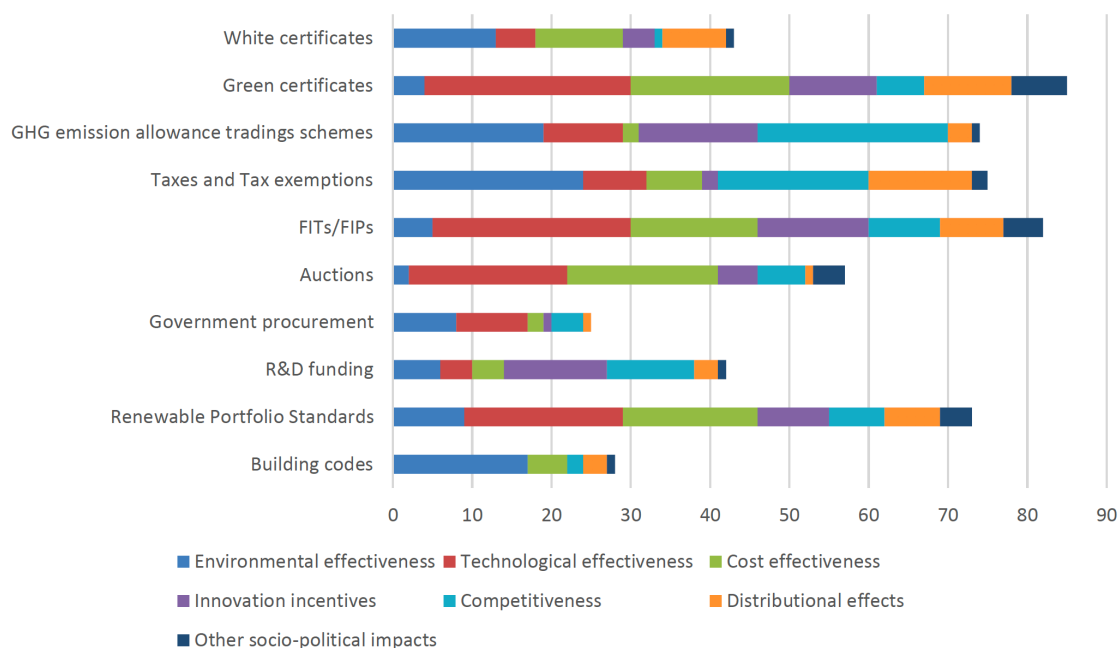


Fig. 4. Papers identified in the systematic review evaluating the impact of particular policies



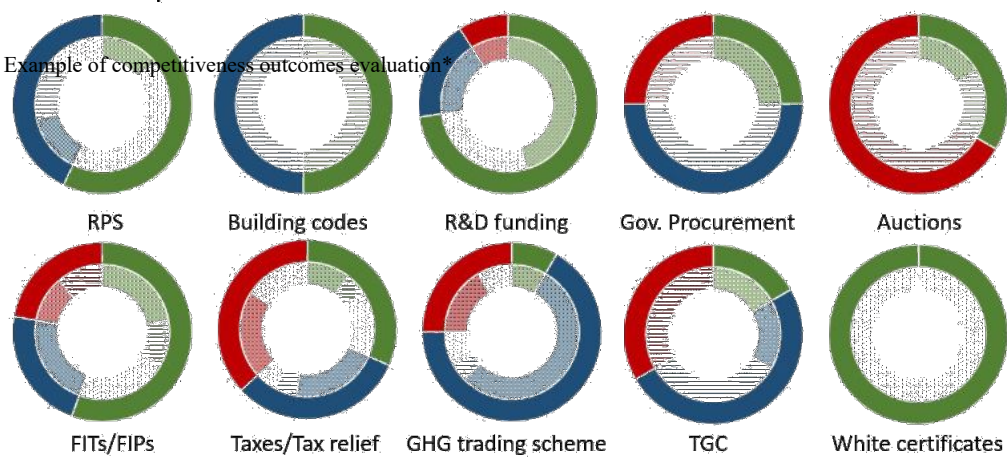
Source: Own elaboration

Fig. 5. Number of evaluations per policy, broken down by the type of outcome analyzed.



Source: Own elaboration

Fig. 6. Example of competitiveness outcomes evaluation*



Source: Own elaboration.

*Green shadow represents positive impacts, blue no impact and red negative impacts. The patterns represent the different types of methodologies: full pattern=quantitative methodologies, bands=qualitative methodologies, dots=theoretical methodologies

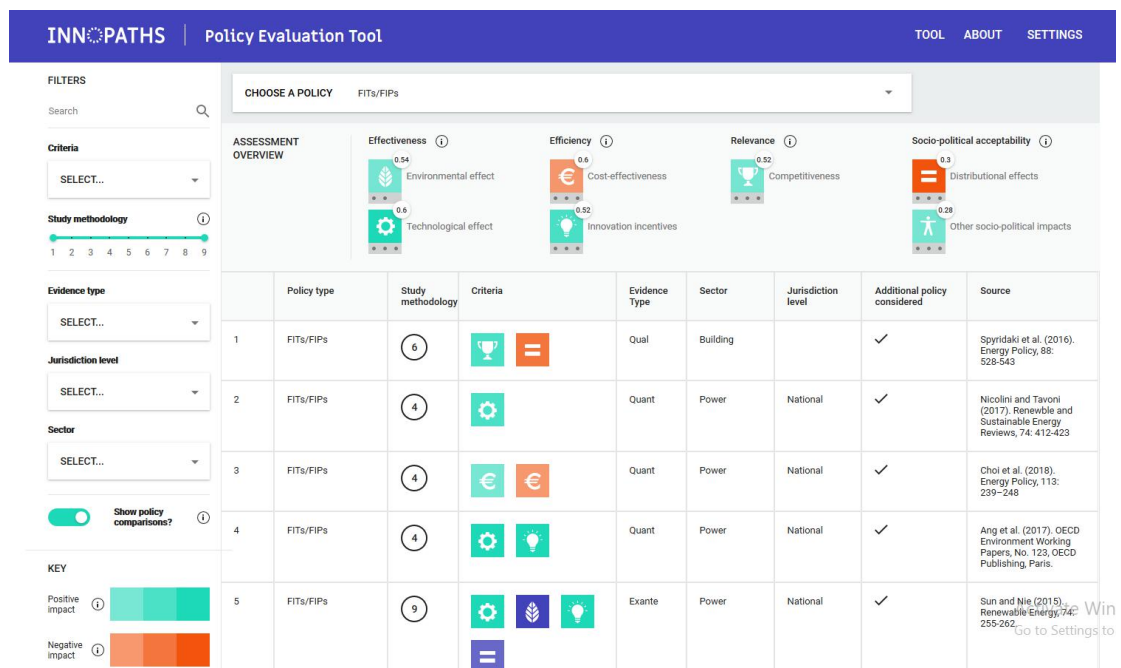


Fig. 7. Snapshot of the PET (under construction)

Fig. 8. Level of agreement and disagreement and size of the evidence by policy instrument and criteria¹

	Environmental effectiveness	Technological effectiveness	Cost effectiveness	Innovation incentives	Competitiveness	Distributional effects	Other socio-political impacts
Building codes	PL ***	NE	PC **	NE	PM *	PC **	PC *
Renewable Portfolio Standards	PL ***	NIM ***	NM ***	NIL ***	PM **	PM ***	PM **
R&D funding	PM ***	NIM **	PL **	PL ***	PL ***	PC **	NC *
Government procurement	PC ***	PM ***	PM **	PC **	NIM **	PC *	NE
Auctions	PC **	PM ***	PL ***	PM **	NM ***	NC *	NL **
FITs/FIPs	PM ***	PL ***	PM ***	PL ***	PM ***	NL ***	PM ***
Taxes and Tax exemptions	PL ***	PL ***	PL ***	NIM *	NM ***	NM ***	PM *
GHG emission allowance trading schemes	PL ***	NIM ***	PM *	NIM ***	NIM ***	NM **	NIC *
Green certificates	PL **	NIM ***	NM ***	NIM ***	NIM **	NL ***	NM ***
White certificates	PC ***	PL ***	PC ***	PL **	PC *	PL ***	PC *

Source: Own elaboration

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¹* 1 paper/** 2 to 4 papers/ *** more than 5 papers per criteria and policy. PM: Positive mixed evidence, PL: Positive largely consistent evidence, PC: Positive consistent evidence, NIM: No impact mixed evidence, NIL: no impact largely consistent evidence, NIC: No impact consistent evidence, NM: Negative mixed evidence, NL: Negative largely consistent evidence, NC: Negative consistent evidence.

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Abstract 102

EXPLORING THE ROLE OF POLITICAL LANDSCAPE PRESSURES AND INDIVIDUAL MOTIVATIONS IN LOW-CARBON DECISION-MAKING IN ENERGY INTENSIVE INDUSTRIES IN GERMANY

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Aim of the proposal:

Greater understanding of decision-making of managers active within industries faced with severe landscape pressures arising from societal challenges - such as climate change and digitisation - and the respective role of mission-oriented policy mixes and individual motivations for R&I and transformative change through an evaluation drawing on novel and original company survey data collected within German industry in the end of 2018

Background:

Mission-oriented policies to address societal challenges have seen a rapid increase in attention over the past few years, particularly at the EU and national level (Fisher et al 2018a, b; Mazzucato 2018). A prominent case in point is the challenge of climate change and the associated low-carbon energy transitions. These low-carbon energy transitions and how they can be accelerated have been the subject of various analyses within the socio-technical transitions literature (Markard et al. 2012). Within this literature, it has been argued that the multi-level perspective (Geels 2004, 2014) should not simply differentiate between niches, regime and landscape levels, but that on the landscape level particular attention should be given to a distinct political landscape (Langhelle, Kern and Meadowcroft 2017).

In addition, policy mixes for governing transitions to more sustainable systems of production and consumption have been receiving greater attention (Rogge et al. 2017), with empirical studies pointing to, among others, the importance of policy mix credibility and consistency for low-carbon innovation of new entrants and incumbents (Rogge and Schleich, 2018; Rogge and Dütschke, 2018).

Apart from this greater attention to policy, a second stream of literature has been arguing for the need for sufficiently theorizing individual behaviour when analyzing transition processes (Boegel and Upham 2018), suggesting multiple theories from environmental psychology for better conceptualizing individual decision making within transition processes.

In this paper, we draw on both lines of literature to build an interdisciplinary framework which enables a better exploration of decision-making of managers active within industries faced with severe landscape pressures arising from societal challenges, such as climate change and digitalization, but high regime stability and limited niche momentum, such as is the case in energy-intensive sectors.

Methodology and empirical base:

For investigating this phenomenon empirically, we have chosen Germany as one of the pioneering energy transition countries and take a broad perspective focusing on climate change and energy efficiency. We focus on energy-intensive industries due to their importance for greenhouse gas emissions but their rather stable regimes and only incremental innovations in the making, thereby posing a formidable challenge for accelerating sustainable low-carbon energy transitions.

Methodologically, we pursue a quantitative approach which draws on company survey data which – after a pretest in December 2017 – we have collected in the fall of 2018 through the means of an online survey and computer assisted telephone interviews conducted in Germany. For this, we have designed a questionnaire which captures managers' perceptions of three levels – the landscape (including the political one), the regime level and niches – as well as managers' personal motivation (including environmental ones). The survey also includes questions on the policy mix and on investments in energy efficiency and climate mitigation.

Results:

Overall, 605 companies primarily from the sectors "food and beverage production", "paper, cardboard and printed matter production" and "chemistry and pharmaceutical production" have answered our survey. 419 respondents are members of the top management of their company, 56 are head of a department, 33 are energy managers while the remaining 97 participants have another background (e.g. production staff, project managers etc.).

Based on this novel and original data set we will present the survey results, which enable both new empirical insights into how managers navigate the conflict between ambitious climate targets but weak instrument mixes on the one hand, and personal motivations for energy efficiency and climate mitigation on the other hand. Based on multivariate analysis we attempt to determine how these personal attributes together with multi-level energy system characteristics influence managerial decision making towards low-carbon innovation and investment. We discuss our findings in light of recent political developments in Germany and derive implications for research and policy, with a focus on lessons to be learned for accelerating sustainability transitions.

Conclusions:

We thereby aim to contribute empirically grounded insights on the gap between existing mission-oriented policy mixes and societal challenges such as climate change and how to overcome these. We will also reflect upon relevant conditions for mission-oriented policy mixes having a transformative effect. At the same time we will critically discuss the broader suitability of our novel survey instrument for evaluating the outcomes of mission-oriented policy mixes, and discuss implications for the design of mission-oriented policies.

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G2 STI POLICIES 3

Friday 07 June 2019 from 11:30 to 13:00

PIERRE-BENOIT JOLY, Chair

Abstract 129

MAKING EXPERIMENTS WORK: EMBEDDING LOCAL EXPERIMENTS FOR SOCIETAL CHANGE AND THE ROLE OF INTERMEDIARIES

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Keywords: experiments, intermediaries, scaling, embedding, societal challenges

1. Aim of the proposal:

Science and innovation policy increasingly focus on societal challenges, such as addressed in the Sustainable Development Goals (SDG's). Reaching these goals, such as affordable and clean energy, sustainable cities and communities and responsible consumption and production, will require strong commitment and action at all levels of government. The challenges are complex, the stakes are high and there are no evident solutions. Hence, politicians, policymakers and scientists alike call for new ways to address these challenges (e.g. Kuhlmann & Rip, 2018; Mazzucato, 2018). In addition to conventional policy arrangements and instruments new approaches will have to be developed (Kuhlmann & Rip, 2018).

As part of this call for new approaches to govern societal change, both policymakers and academics foresee an important role for local experiments. The complexity of these contemporary societal challenges requires an experimental way of working to develop novel solutions and learn about possible transition paths. As Matschoss and Heiskanen (2017) discuss, there are multiple ways for an experiment to contribute to wider societal change: by aggregating lessons, the introduction of new practices and documenting and disseminating lessons for impact beyond the experimental context. In all instances there is a need to go beyond experiments in order for transition paths to emerge (Turnheim et al., 2018). Hence, the wider embedding of the outputs of the experiment is of crucial importance if the goal is to use experiments as an instrument for societal change. The embedding of experiments is however anything but self-evident. To harness the potential of experiments through embedding requires actors or organizations dedicated to the scaling process. Here we refer to these other actors as intermediaries, who can be individuals, groups or (parts of) organizations. These intermediaries play a role in embedding results in new and existing practices and facilitate wider transformation. In this paper, we aim to add to the understanding of embedding experiments for societal transformation, and highlight the role of intermediaries. Therefore, we explore the following research question: How can we understand the process of embedding the outputs of local experiments, such as living labs, and what role is there for intermediary actors?

By answering this question, we aim to develop a "sense-making framework", rooted in the literature and our empirical material, which offers policymakers and stakeholders the opportunity to develop an informed perspective on embedding and the role of intermediaries.

2. Background: theoretical frame

Because of their focus on learning and open-ended nature, experiments are seen as a suitable means to explore different solutions to contemporary societal challenges that are characterized by complexity and uncertainty (“wicked” problems) (Torrens & Schot, 2017; von Wirth et al., 2018). This is particularly the case when experiments take place in a real life environment and aim at co-creating solutions or innovations with a broad variety of actors (Maas et al., 2017). When these experiments are well rooted in a specific local context, this increases the likelihood that the solutions developed will actually “work”.

However, when the experiment intends to have a wider societal impact, or even contribute to systemic change, the outputs of the experiment need to find their way beyond the experimental context. Some of the main benefits of a local experiment – that it is sensitive to the local context, includes a variety of actors and addresses not only technical but also non-technical aspects of innovation – now become potential hurdles. The more complex the context in which the solution has been developed, the more difficult it will be to decontextualize (elements of) the solution, and re-embed these in a different context (Geels & Deuten, 2006).

This turns our attention to the process of scaling: what an experiment will contribute, depends to a large extent on the goal of the experiment and what happens with the outputs after the experiment is finished (Karvonen, 2018). While scaling might be depicted as a linear process which will evidently occur when the outcome of an experiment is a working solution, scholars and practitioners alike have criticized this perspective. Instead, they argue, scaling is a complex process that requires a vision (is it desirable to go to scale, how? Wigboldus, 2018) and dedicated effort (Hermans et al., 2016; Kivimaa et al., 2017; van Buuren et al., 2018; von Wirth et al., 2018). Therefore, we use the concept of embedding. In our view, the concept of embedding better reflects the effort needed to make an experimental output fit with new or existing practices. Below, we unpack some elements of the process of embedding.

First of all, embedding is not only a technological but rather a socio-technical process since the local experiment enables learning in a specific context about the non-technical aspects of an innovation, including market and user preferences, cultural meaning as well as implications for regulation and government policy (Schot & Geels, 2008). Hence, we distinguish among four dimensions along which the output of an experiment can be embedded: technological, economic, regulatory and societal.

In addition, we distinguish among four different scaling *patterns* following Turnheim et al. (2018). The first pattern is growing the experiment by widening the area or the number of participants. Second, they distinguish a replication pattern whereby the experiment is replicated in different contexts. A third pattern is circulation, whereby experimental outputs are circulated to inspire other initiatives. The fourth pattern is institutionalization: innovative solutions become “normal practice” and are embedded in norms, habits and regulations. Naber, et al. (2017) make a similar distinction among growing, replicating, accumulation and transformation.

Finally, the conditions in which an experiment take place often differ to a large extent from the broader context in which potential outputs will be embedded. Described by van Buuren et al. (2018) as the “pilot paradox”, these differences between the (protected) experimental setting and the broader context complicate the scaling of solutions or innovations. As such scaling also requires different activities than running an experiment. Because scaling is such a

complex process, scholarly attention has begun to highlight the role of intermediaries in connecting local context specific experiments with broader societal goals (Kivimaa et al., 2017). Although there has been a long standing interest in innovation studies in the role of actors who develop and maintain networks through which knowledge can be spread (Howells, 2006), more recently attention has been focused upon the role of intermediaries that are specifically focused on transitions (Kivimaa et al., 2017).

Intermediaries can help experiments scale on the different dimensions of scaling:

Technological: Intermediaries provide technical expertise or aid innovation management. Examples are engineering firms, or firms specialized in (technological) project management.

Economic: Public and private organizations can help entrepreneurs develop innovations or use knowledge, expertise and networks to build and grow new products and markets. Examples are incubators, chambers of commerce, valorisation centres or organisational consultants.

Regulatory: Intermediaries that interpret new and existing laws, rules and regulations, develop novel standards and protocols or lobby for new regulations. Examples are law firms, standardization organisations or learned societies.

Societal: Intermediaries that can connect to the broader societal context and engage users. Examples are patient organisations, consumer organisations or NGOs.

3. Methodology/empirical base:

We have explored the concepts of experiment, scaling and intermediaries through a thorough literature review. The insights from this review have been summarized in the previous section. Based on these insights we conducted our empirical research. We were aware that the practical experience with embedding experimental outputs was likely to be limited (Maas et al., 2017). Therefore, we focused our research design on historical case studies of domains in which experience has been gained with scaling locally developed, context-specific knowledge and innovation. The aim of these case studies is to provide historical insight on scaling and the role of intermediaries and in doing so, inspire current practice. Particularly we looked at three domains: the agricultural sector in the Netherlands, the water sector in the Netherlands and international development studies. The historical case studies are based on an extensive literature study for each of the domains.

4. Results: Embedding and intermediaries in historical examples

In this section, we present the results from our study of three historical examples in which increased complexity provoked a transformation of the organization of knowledge and innovation development. This often resulted in more local and experimental approaches towards knowledge and innovation development, allowing the context to be taken into account as well as a broader range of actors to be involved. We argue that these historical case studies can help to increase our understanding of embedding complex, context-specific knowledge and innovation in new and existing practices, and the role of intermediaries herein. For each of the domains we have documented the role of scaling and the role of intermediary activities in fostering these scaling processes. How did the prevailing mode of knowledge development change, and how did this affect both practices of embedding and the role of intermediaries?

4.1 Agriculture

The importance of a self-sustaining agricultural sector became an important policy goal in the Netherlands in the years after the Second World War. For this goal to be realized the competitiveness and efficiency of production of Dutch agriculture needed to be improved. This led to the development of the so-called OVO-triptych in which Research (Onderzoek), Counselling (Voorlichting) and Education (Onderwijs) came together in which new knowledge was developed by research institutes, for example in experimental gardens and experimental farms, then this knowledge was actively disseminated by counsellors to the farmers. These counsellors functioned as an intermediary between research and the workplace.

This model functioned well until the 1980s when environmental degradation and animal welfare concerns emerged together with farmers becoming more educated.

This led to a diversification of policy goals and discussion about the direction of knowledge and innovation for agriculture, as well as farmers that were better able to comment on and discuss research results. In response to this development the Transforum project was initiated, characterized by a more co-creative approach whereby researchers, farmers, government representatives and societal organizations together worked on, for example, environmentally friendly and animal friendly stable concepts for chickens. Within this new approach, counsellors were appointed as well, but now these counsellors functioned as knowledge intermediaries between these different stakeholders. Rather than bringing new research results to farms, these knowledge intermediaries orchestrated networks of different stakeholders around an innovation challenge.

Embedding knowledge and innovation in the agricultural sector thus developed from a linear approach towards a more co-creative endeavour whereby in both cases there was an intermediary, but with a different role. These intermediary actors were dedicated professionals that were specifically trained and appointed to fulfil this intermediary function.

4.2 Water

After the National Flood of 1953, water management in the Netherlands was characterized by a defensive approach. This approach focused mainly on technical solutions such as the construction of dikes and flood defence mechanisms. At the end of the last century, a few “almost” disasters showed that the water management and coastal defences of the Netherlands were not fit to deal with the risks of climate change. Hence, a new vision on water management has gradually been developed, in which the focus has shifted to “living with water”, and water management is connected to other issues, such as climate change and spatial planning.

To ensure coordination of this integrated approach towards water management, the Delta program was established. In addition, there is a national research and innovation program: the National Knowledge and Innovation Program Water and Climate. The program connects both science and practice, as well as different levels of government, and combines knowledge about a large diversity of water-related tasks: from research lines aimed at refining climate models to lines aimed at disseminating knowledge about climate-proof cities. Especially concerning climate mitigation measures and rivers, more context specific solutions have been developed and introduced. Here, the umbrella organization of the Delta program enables the exchange of practices and experiences and in doing so facilitates cross-area learning, joint action and the prevention of duplicated efforts.

The water domain is an example of a domain in which knowledge sharing and learning from each other are actively organized from a broadly felt urgency. Although the development of

innovative solutions is increasingly taking place on the local scale, especially concerning climate mitigation in the cities, the Delta Program tries to enable wider embedding of these solutions through the national coordination of efforts.

4.3 Development studies

Within the development sector, many projects take place on a small, local scale. Even when these projects are successful, successes do not automatically spill over to other local contexts, or are picked up by politicians and policymakers. In addition, support from external financiers and development organizations is often temporary. Therefore, both spreading and sustaining successful projects is a challenge. A shared urgency is felt to increase the potential impact of small-scale interventions, especially in the context of the SDG's, which require sustainable impact and development action at a larger scale.

This observation has drawn the attention of both development scholars and practitioners to how successful projects can be scaled. They expect that by increasing the knowledge about (successful) scaling processes, the potential of scaling efforts can be improved and therefore, a community of organizations, practitioners and academic has emerged with the aim to support learning from current experience with scaling. These actors for example develop scaling methods and guidelines, are involved with monitoring and evaluation of projects or assemble experiences with scaling to formulate insights that can be applied in other contexts. An important insight from the development studies community is that the successful scaling of an initiative requires that structural attention is paid to possible scaling from the start of a project. Therefore, learning throughout the process is crucial for the potential success of scaling efforts. This requires continuous questioning whether the project achieves the intended goals, and what is needed to facilitate scaling. This can be achieved by implementing a monitoring and evaluation strategy. One of the conditions to enable scaling of success is attention for capacity building from the start of a project – the involvement of stakeholders at the beginning of a project or pilot ensures that these can be mobilized at a later stage.

5. Conclusions:

Based on our research, we formulate two preliminary conclusions, based on the literature review and our empirical research.

1. **Systematic approach towards embedding:** For broader societal impact, it is crucial to view experiments as instruments for learning. Hence, the potential of broader embedding the outputs of the experiment at a later stage should be anticipated throughout the experiment.
2. **Intermediaries:** The process of embedding demands different skills than running an experiment as well as time and effort. Therefore, intermediaries that are dedicated to the process of embedding are necessary. This requires that resources are made available for intermediary activities and could also include the organisation of a learning community on embedding to develop experience with what works in embedding processes, as well as which, and when, intermediaries are needed (cf. international development).

Based on these preliminary conclusions, we aim to develop a coherent sense-making framework to guide stakeholders in the development of a perspective on embedding and intermediary activities. At the Eu-SPRI conference, we aim to present our framework and discuss our perspective on experiments, processes of embedding, and intermediaries.

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Abstract 28

PRIVATE (AND PUBLIC) INVESTIGATIONS: HOW DO PUBLIC AND PRIVATE INCUBATORS CHANGE DIFFERENT TYPES OF INSTITUTIONS?

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Utrecht University ~ Utrecht ~ Netherlands

Aim of the proposal:

To study how public and private incubators change regulative, normative and cultural-cognitive institutions in their ecosystem.

Background:

Entrepreneurship has long been recognized as an important source of innovation and economic growth. However, entrepreneurs cannot innovate in isolation, they are influenced by, and dependent on, the institutional context as part of the ecosystem in which they operate (Alvedalen & Boschma, 2017; Stam, 2015). The institutional context consists of normative, regulative and cultural-cognitive institutions (Scott, 2008). Regulative institutions are formal rules and laws. Normative institutions include social obligations and expectations, such as norms and values. Cultural-cognitive institutions largely have historical roots; they are based on common beliefs, 'taken-for-grantedness' and a shared understanding of how things are done. Together, these institutions form a regime that shapes the behavior of actors, and is continuously reproduced by these actors (DiMaggio & Powell, 1983). However, actors can deviate from these institutional demands, and ignite a process of institutional change (DiMaggio, 1988; Garud, Hardy, & Maguire, 2007). These actors are called institutional entrepreneurs, which are defined as actors who mobilize resources, allies and narratives to create new or transform existing institutions. (Battilana, Leca, & Boxenbaum, 2009; DiMaggio, 1988; Dorado, 2005)

The institutional entrepreneurship literature has given us great insight in how and when actors change institutions. However, two important research gaps remain to be explored. First, existing studies on institutional entrepreneurship implicitly assume that all institutions are changed in the same way (Pacheco, York, Dean, & Sarasvathy, 2010). Yet, change in regulative institutions is formal by nature, and implemented by agents with the appropriate powers, such as policymakers (Oliver, 1991). Change in informal institutions, such as normative or cultural-cognitive institutions, is essentially a diffusion process of attitudes or practices throughout society (DiMaggio & Powell, 1983; Oliver, 1991). However, the institutional entrepreneurship literature does not systematically differentiate between these different types of institutional change.

Second, most empirical evidence for institutional entrepreneurship comes from either public sponsored actors (Maguire, Hardy, & Lawrence, 2004; Perkmann & Spicer, 2007) or from large private actors (Garud, Jain, & Kumaraswamy, 2002; Greenwood & Suddaby, 2006; Munir & Phillips, 2005). Both types of actors are likely to differ in their strategy to change institutions. Large private actors are focused on mobilizing resources for institutional change (Greenwood & Suddaby, 2006; Kukkk, Moors, & Hekkert, 2016). Private actors are often focused on

changing institutions surrounding new products, which means they create awareness for the product and change consumer behavior (Garud et al., 2002; Kukk et al., 2016; Munir & Phillips, 2005).

Public actors have a broader perspective on institutional change, often working on changing political and cultural institutions (Perkmann & Spicer, 2007). For publicly sponsored individuals, personal legitimacy is found to be important driver of institutional change (Maguire et al., 2004). Public and private actors, thus engage in institutional entrepreneurship in different ways, however, no study has made a systematic comparison between them.

To understand if the public or private origin causes the differences in strategy for institutional change we need to study a type of actor that can be of both a public and private nature in similar contexts with similar resources. Incubators are an example of this. Incubators are organizations support start-ups using a combination of office space, resources, coaching and network access (Bergek & Norrman, 2008). They are well-positioned to become institutional entrepreneurs since they occupy a central position in social networks (Van Rijnsoever, Van Weele, & Eveleens, 2016) and possess status and resources needed for institutional entrepreneurship (Aernoudt, 2004; Hansen, Chesbrough, Nohria, & Sull, 2000). We study incubators in different ecosystems to explore how the context influences the strategy of public and private incubators to change different types of institutions.

Battilana (2006, 2009) and Dorado (2005) propose several enabling conditions that explain when and how institutional entrepreneurs have the opportunity to implement institutional change. These conditions can be divided in two groups of enabling conditions: the first is related to the transparency of the field the institutional entrepreneur is in. The second is related to the abilities of the institutional entrepreneur (chapter 2.3). These abilities involve the legitimacy and agency of the institutional entrepreneur (Battilana, 2006; Dorado, 2005; Emirbayer et al., 1998; Maguire et al., 2004). Once institutional entrepreneurs have been enabled an opportunity to develop new institutions, they should also be capable of implementing these new institutions. A vision on the new institutions must be crafted, and framed in a way that appeals to actors needed to implement the change (Battilana et al., 2009; Rao, 1998; Rao et al., 2003). Framing a vision for change can be done by explicitly noting the failure of existing institutions and delegitimize them, but also by motivating actors to embrace a new institutional frame (Clemens & Cook, 1999; Rao et al., 2003). The second step, which is often intertwined with the first, is mobilizing allies and resources behind the vision (Battilana et al., 2009; Fligstein, 1997; Leca & Naccache, 2006). The institutional entrepreneur must form alliances with actors embedded in existing institutions to get them to support new institutions (Fligstein, 1997; Garud et al., 2002).

Methodology and empirical base:

We selected incubators as the case in this study for two primary reasons. First of all, incubators are in the unique position that they have both a public and a private variant. Secondly, incubators are central actors in social network that consists of a diverse amount of actors, such as start-ups, policymakers, corporates, and investors (Van Rijnsoever et al., 2016). Therefore, we expect incubators to have both the incentive and the legitimacy required to engage in institutional entrepreneurship. This makes incubators particularly well suited as an exemplary case study to study institutional entrepreneurship. Finally, the contribution of incubators to their institutional context is also a useful addition to entrepreneurial ecosystem

(EE) literature, as incubators are a prominent actor in entrepreneurial ecosystems and EE literature needs more attention to its institutional context (Alvedalen & Boschma, 2017). The difference between public and private incubators is defined by their ownership and source of funding. Private incubators are owned by entrepreneurs, shareholders or corporates who take equity in their startups as a source of income (Barbero, Casillas, Ramos, & Guitart, 2012). Because of a focus on business development, private incubators are often more sector specific than public incubators (Frenkel, Shefer, & Miller, 2008; Grandi & Grimaldi, 2004). Public incubators are owned collectively and are funded by public organizations such as universities and governments. Public incubators are often established to stimulate economic development in regions, for which they depend on public funds acquired through taxation (Barbero et al., 2012; Thierstein & Willhelm, 2001).

This study adopts a qualitative design, since this provides us with detailed accounts of the processes behind institutional entrepreneurship. In total, we conducted 28 interviews with seventeen incubators, as well as a number of supporting organizations from 7 Dutch cities. These cities were selected to study institutional entrepreneurship in varying institutional fields. The interviews were done following a semi-structured interview guide. Semi-structured interviews start from a basic structure, which should make sure all relevant concepts and topics are covered. However, the interview guide consists of open questions and leaves room for improvised follow-up questions, to allow for novel insights. This gives respondents the ability to give detailed and original answers, which helps provide an in-depth picture of the concepts. The interviews were coded using the Gioia method. First step of this analysis involves creating first-order concepts. This means that each sentence or statement is coded in such a way that the code represents the essence of the statement (Gioia, Corley, & Hamilton, 2013). The first-order concepts stay faithful to the terms of the interviewee and little attempt is made to categorize these concepts. Between these concepts, similarities and differences are sought, and the concepts are sorted into second-order themes. These themes are more related towards the theory and aim to translate the terms of the interviewee to the theoretical concepts studied (Gioia et al., 2013). It is possible for one first-order concept to be connected to multiple second-order themes. Finally, the second-order themes are translated into aggregate dimensions, which are connected to the main concepts of this study.

Results:

We find that incubators are active as institutional entrepreneurs, and that the mechanisms behind institutional entrepreneurship indeed differ between the different institutional pillars and between public and private actors. Both public and private incubators are active in changing normative institutions, which they do by mobilizing their resources. Public and private incubators are less active in changing regulative institutions, although we find that public and private incubators both lobby for supportive policies. We find the strongest differences in institutional entrepreneurship between public and private incubators in how they change cultural-cognitive institutions. Public incubators are trying to involve universities and governments whereas private incubators are working more with corporate partners. Also, there is more informal contact and information sharing between public incubators. Private incubators do have some formal collaborations with public incubators, but they have less informal contact and do not work together with other private incubators. The results show that public incubators also work closer with governments in removing legislative challenges for startups, private incubators do not do this. Private incubators are on the other hand, more

involved with changing behavior of their corporate partners, teaching them startups methodologies and involving them in their incubation programs.

Conclusions:

Based on the results, this study concludes that public and private incubators change institutions differently when the institutions affect their ecosystem, so when institutions concern the direct context of the incubator. When institutions concern their ecosystem, incubators try to change them by mobilizing allies.

When incubators try to change normative institutions in their startups and partners, they mobilize resources. Our conclusion is that institutional entrepreneurship literature should account for differences in different institutional pillars, which is a new insight in institutional entrepreneurship literature. Furthermore, scholars and practitioners should be aware of differences in institutional entrepreneurship between public and private actors, which are important in shaping institutional contexts to support innovation.

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Abstract 148

SUSTAINABLE DEVELOPMENT GOALS, MISSIONS AND POLICY CAPACITIES IN SMALL STATES

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Introduction:

Finding new development paths while meeting the emerging societal challenges such as climate change or ageing societies has put mission-oriented policy-making back at the centre of innovation policy debates (Schot and Steinmueller 2018; Kattel and Mazzucato 2018). While Sustainable Development Goals (SDGs) and other mission-oriented policies (e.g. as discussed by the EU to contribute to SDGs) are important tools for directing public policy efforts towards most pressing societal challenges, the current debates have largely neglected the issues related to the capacity of small states to implement and contribute to those globally or regionally defined societal challenges.

In this paper we address this issue by (1) developing a framework for understanding the impact of the small states context on missionary innovation policies, (2) use the framework to learn from the recent experience of designing and implementing missionary innovation policies in Estonia, and (3) discuss how should small states reconfigure their policy and administrative capacities to focus on such global and transboundary policy goals. Our paper is guided by the following research question: How does the context of small states shape the evolution of missionary innovation policy capacities?

Conceptual framework:

Previous studies have identified several central policy capacities that governments need to develop and nurture for transformational innovation policy, including capacity to direct, experiment, articulate demand and adjust policies (Grillitsch et al 2019). These capacities assume that governments are capable of controlling and coordinating complementary capabilities such as investments into R&D and market shaping capabilities as well as legitimization, policy coordination and administrative capabilities (Kattel and Mazzucato 2018). Yet, when confronted with task to develop and integrate these capabilities, governments need to cope with the limits determined by their contexts, which act as selection environment for these policy capacities.

Following the current debates, we assume that SDGs and other emerging societal missions cannot be separated and made superior to other existing socio-economic development priorities, but need to be integrated with the latter: tackling long-term SDGs needs to feed directly to existing socio-economic development paths. We assume that SDGs and other emerging societal missions require at least two types of policy reconfigurations. First, horizontal reconfiguration of existing policy domains/silos as most SDGs and missions require some forms of horizontal collaboration (e.g. environmental issues can be treated as opportunities and inputs for economic and industrial development policies). Second, vertical reconfiguration of existing divisions between local, regional, national and international policy arenas (e.g. speeding up energy transitions towards renewables requires global standards and coordination while allowing also for local experiments and small-scale initiatives on the level

of micro-grids etc, which were not deemed efficient in previous centralized fossil-fuels-based models).

Informed by the policy capacity (Painter and Pierre 2004; Wu et al., 2018; Karo and Kattel 2018), challenge- and mission-oriented innovation policy (Weber and Rohracher 2012; Mowery et al., 2010; Kattel and Mazzucato 2018) and small states (Karo and Lember 2016; Kattel et al., 2010) literatures we develop a framework to understand how the context of small states shapes the creation and evolution of missionary innovation policies. As the existing contextual understanding has predominantly focused on networks and institutions (see a recent overview in Grillitsch et al 2019) as well as on the tensions between globalization and nation states (Schot and Steinmüller 2018), we add to the literature by explicitly bringing in the contextual limits imposed by smallness of a country.

Empirical case and policy implications:

We use Estonia as our empirical case. More specifically, we draw on:

- the original results from three recent innovation policy studies on Estonian (a) national technology programs, (b) smart specialization, and (c) participation in European Framework Programs; the authors of the current paper were related to all these studies);
- document analysis (national strategies and supporting analytical documents, including the ongoing RDI investment strategy debates);
- participant observations (one of the author is a current member of the National Innovation Policy Council and a previous member of the National Industrial Strategy Board, both led by the Minister of Economic Affairs).

Based on the case of Estonia, we show that small countries face a particular challenge in adopting SDGs and similar missions as their strategic policy directions. Due to their limited financial, human, organizational and other resources, they cannot just add new layers of priorities into existing policy systems, but need reconfigure existing policies (rationales, mixes, policy designs) to contribute to SDGs and also benefit from this global direction. We focus on the domain of innovation policy as it is a horizontal policy arena that could contribute to all SDGs and similar missions and show how the growing focus on global challenges creates conflicts with domestic policy priorities.

While SDGs and missions require innovation policies to focus on big societal changes and new technologies, local socio-economic development requires more incremental transitions, e.g., next to investing into renewable technologies, also investments into maintenance of existing fossils (oil-shale) based systems to provide energy, jobs, and markets for local industry. While ideally, these should be parallel processes of policy making, we show that small countries lack resources for such approach and need to reconfigure global SDGs and missions to fit their local contexts by piggybacking on global and regional trends and carving out local niches to both contribute and benefit from the global SDG/missions discourse. We will discuss the implications following from these observations on public policy and administration capacity in the context of small states.

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G7 PUBLIC SECTOR 2

Friday 07 June 2019 from 11:30 to 13:00

LUCIO MORETTINI, Chair

Abstract 63

AN EASY MATCH? EVIDENCE-BASED POLICY MEETS SCIENCE-BASED IMPACT

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Aim of the proposal:

What happens when a public organisation develops a knowledge strategy in order to use research in a more thorough and systematic way, and at the same time the relevant research units encounter more explicit demands to demonstrate their impact and usefulness? On the surface, these two developments may represent clear synergies and opportunities for fruitful collaboration and joint work on innovation, but under the surface tensions and challenges may linger. This paper addresses the question through an ongoing study of how the Norwegian Welfare and Labour Administration (NAV) supports and uses research-based knowledge. The “evidence movement” is seen in how public organizations increasingly seek to base their policy and services on scientific knowledge, and the “impact movement” is a main aspect of current science policy, denoting how researchers need to systematically account for their usefulness both ex post and ex ante. Our perspective is that these two movements represent two distinct institutional logics (Friedland & Alford, 1991). In this paper we have two main questions that we want to explore related to these logics. First, what are the main characteristics of the logic of ‘science-based evidence’, recently emerged in NAV, and what are the main characteristics of the ‘impact of science’ logic encountered by the work and welfare related research units in Norway? Second, what happens when these two logics meet?

Background:

We are particularly interested in relational aspects (Garud & Gehman 2012) of the emergence of the “evidence logic” in NAVs complex institutional landscape (e.g. Høiland, 2018) and its encounters with the “impact logic” of the related research units. We want to explore the practical settings and the situations and processes that emerge from the meetings of these two types of organizations. Our expectations are that the instrumental orientation of the evidence logic and the accountability orientation of the impact logic are not necessarily easy to fuse. Tensions may require new forms of interaction between NAV and researchers, which in turn can influence the development and implementation of policy as well as the impact of research. Over time, a rather symbolic use of research and superficial referral to the research’ usefulness might be replaced by new combinations of knowledge production and use. Our study sheds light on the emergence of logics and the complexities of situations where multiple logics meet. We bring perspectives from processual research impact studies (like Donovan 2011, Gaunand et al. 2015; Weiss, 1979) into the understanding of institutional logics, but also a clear institutional perspective into the field of impact studies, which is dominated by evaluation perspectives.

Institutional logics and complexity

Friedland and Alford (1991) introduced the concept of institutional logics into organizational studies and described society as comprised of organizational fields associated with institutional logics. They defined institutional logics as ‘a set of material practices and symbolic constructions which constitute its organising principles and which is available to organisations and individuals to elaborate’ (p. 248). Logics provide guidelines for actors on how to interpret and function in social situations (Greenwood, Raynard, Kodeih, Micelotta, & Lounsbury, 2011). In many situations, an organisation or organisational field will be characterised by multiple logics simultaneously (Kraatz and Block 2008). Some of the literatures describe this situation of institutional complexity as filled with tensions and paradox (Greenwood et.al, 2011), some describe it as co-operative or blurred, (Waldorff, Reay, & Goodrick, 2013), and yet others find that it can be characterised by synergy or interpretative flexibility (Besharov and Smith 2014). It has been argued that the degree of centrality and compatibility of the logics can explain the type and degree of tension (ibid.).

We argue that the push from decision-making rooted in professional values and practice towards evidence-based decision-making – where evidence is taken to mean scientific evidence – represents a specific institutional logic. Similarly, the idea that research much more clearly needs to demonstrate impact (or related terms like utility, value, relevance) – both ex ante in research proposals, in the actual setup of research activities, and ex post in evaluations – represents another logic. Both can perhaps be tied to new public management, but they are rooted in very different sectors with different values and traditions. We see the question of their centrality and compatibility in our setting as an empirical question. Here we provide some more general points about the background of these logics.

The evidence movement

The public sector in most countries increasingly endorses the idea that policy and practice should be “evidence-based”, which in most cases implies that they should be based on a systematic review and implementation of relevant research. In this way, research results and perspectives can be used to improve existing policies and practices and introduce innovative approaches. The “evidence-based movement” started in the field of medicine and was introduced as a “new paradigm” in the early 1990s for the practice of clinical medicine. (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). The intention was to deemphasize the role of intuition and unsystematic clinical expertise (Satterfield, 2009), such as professional know-how and experience. This was done by developing and promoting an explicit and rational process for clinical decision making that could be taught, refined, and applied by all clinicians. It was defined as “the conscientious and judicious use of current best evidence from clinical care research in the management of individual patients” (Sackett et al., 1996, p. 71). Evidence Based Medicine was the forerunner to Evidence-Based Practice (EBP), which spread to other health professions and other service fields such as education, social work and welfare. EBP is based on the assumption that interventions by public services to service recipients need to be grounded on scientific research and that evidence and policy decisions and clinical practices in these fields are expected to be based on documented effects and the best available science (Satterfield, 2009).

EBP favors methods of using experimental and control groups to provide scientific evidence as to whether an intervention is effective or not, and randomized controlled trials (RCT) is held as the gold standard of evidence-based research. Manuals or procedures that describe how practitioners should work are often developed, and fidelity to the manuals is supposed to guarantee that the methods will give the prescribed result (Satterfield, 2009). Today in many EBP circles, it is taken as a given that scientific evidence from RCT is relevant in all types of cases, situations and intervention decisions. The use of experimental designs and principles based upon medicine in more complex service sectors such as welfare, social work and education has been questioned (Wieringa, Engebretsen, Heggen, & Greenhalgh, 2017). Although the evidence movement more broadly has been criticised for simplistic perspectives (neo-positivist, technocratic, medicine-based etc.), the call for more and better use of research in the public sector remains very strong (Greenhalgh & Russell, 2009; Head, 2008). Many of the critical voices also come from the academic community.

The Impact movement:

Researchers and research units increasingly meet explicit demands that their scholarly activities should have impact. This refers both to how the research is organised – more applied, in a closer collaboration with users, with new forms of societal engagement – and to the selection of research problems and perspectives (Gaunand et al. 2015; Donovan 2011). A primary point is that impact should be clearly demonstrated through indicators and/or strong case-based narratives.

Generally speaking, research impact is a multidimensional phenomenon that denotes how research results and the people and organisations that produce them contribute to changes elsewhere. These changes may appear in the form of innovation and economic growth, but are equally important in areas such as health and care, agriculture, national security, environmental issues, and policymaking (Donovan 2011). Furthermore, impact is not necessarily related to instrumental or problem-solving effects but to wider forms of conceptual, political and symbolic consequences (Amara, Ouimet, & Landry, 2004; Weiss, 1979).

The impact agenda and concept are intimately tied to science policy and its attempts at steering science towards the main problems of society. Contemporary science policy is dominated by this rationale termed “grand challenges” or “societal challenges” denoting fundamental international and shared problems where research (and innovation) are seen as major activities in large-scale concerted societal efforts (Kuhlmann & Rip 2015). Studying impact means to scrutinise the uptake, transfer or interchange of knowledge emerging from a research setting. This can be conceptualised in different ways: as interorganizational contacts (Spaapen & van Drooge 2011), as a “translation” or reconfiguration of networks of social and material elements (Callon 1986), or as a multidimensional array of communication between researchers and wider stakeholders (Abreu & Grinevich 2013).

Methodology and empirical base:

The Norwegian Labour and Welfare Administration (NAV) is a result of the largest public reform in Norway in modern times, merging social services, employment services and national insurance into one large organization in 2006. The purpose of the reform was to provide holistic and effective services to the citizens of Norway in order to better deal with the ‘grand challenges’ of the welfare state. As a result, NAV has a major role in Norway by providing

citizens with multiple welfare and employment services and assurances, representing about one-third of GDP. Partly due to NAV's important role and large budget, there are high expectations that their decisions should be based on documented effects and the best available science. Even small improvements may have significant practical and economic effects. To meet these expectations, NAV has developed a large R&D budget and substantial research partnerships, assuming that these investments will lead to better services, more efficient use of public resources and improved outcomes.

We draw on an ongoing case study on the impact of research in NAV. Since we focus on the relational aspects (Garud & Gehman 2012) of the emergence of the logic of "science-based evidence" and its encounters with the logic of "impact of science", we will look for various interaction and "translation" activities (e.g. Callon 1986), including informal interaction based on personal contacts, formal collaboration about research and its use, and the funding of R&D and impact-oriented activities.

We use a qualitative research design in order to tease out characteristics of institutional logics that may not be immediately obvious (Reay & Jones, 2016). We are now studying documentary evidence such as R&D policies, research evaluations, reports, research guidelines and priorities in NAV and other relevant documents which all will help us answer the first and partly the second research question. In addition, we are conducting a series of semi structured interviews this winter and spring with relevant NAV and research unit stakeholders in order to gain more insight into relational aspects of what happens when the logics meet.

Results:

Preliminary findings

Three relevant developments within the search for knowledge for the development and legitimation of NAVs policy and service progresses seems to be prominent in NAV and surrounding research organizations. The first is a move from professional know-how to research-based policy development in the planning and advances of policy and services of welfare and work inclusion. Two main types of knowledge have been conceptualized in NAV: practice/experience-based knowledge and scientific/evidence-based knowledge (Breit, Fossetøl, & Pedersen, 2018). A recent study portrays these two kinds of knowledge in NAV as competing in the organization, with evidence-based knowledge usually ranked highest (ibid).

The second development is the way that the research is being utilized. In our case study on NAVs funding and utilization of research, we observe a trend from using research to inform or support the development of specific policies or services in NAV (conceptual and symbolic/political utilization of research, cf. (Amara et al., 2004; Weiss, 1979) to also using research to solve specific problems and in finding specific solutions (instrumental utilization). This last tendency can be observed in the way that a devoted research/knowledge department in NAV orders, funds and collaborates with research institutes in the development and implementation of evidence-based research results. This evidence basing of frontline policy, especially using experimental designs such as Randomized Controlled Trials (RCT), has gained a strong follower base in the R&D department of NAV through a multitude of ongoing and concluded projects. Many of the projects are executed on a rather small scale, in collaboration with research institutes that document and evaluate the processes as they progress. There is a clear tendency that such projects are designed to be implemented in a

limited number of frontline offices to start with for testing and developmental purposes, before they are to be scaled up to all of NAV if found to be effective.

In addition, a third development also influences the search for knowledge and legitimization in NAV. NAV is subject to a vast amount of externally founded research, particularly through the Research Council of Norway. As in other research councils in the EU system, the Norwegian council requires that the research it funds must document utility value and societal effects as systematically as possible.

Conclusions:

Preliminary points of analysis and implications

Where the 'evidence movement' can be seen to be about changing/developing policy and practice in line with research, the impact movement can be seen as being about also shifting research towards finding solutions to 'grand' or 'societal challenges'.

The way that organizations or policymakers use research has been theorized as instrumental, conceptual and symbolic/political uses. Little is known about combinations of these uses or how they may be linked over time, which is a goal to shed light on in our analysis. In the case of NAV, the uptake, transfer or interchange of knowledge, and its use, emerging from a research setting is particularly visible in the activities of a devoted research/knowledge department in NAV and how it orders, funds and collaborates with researchers in the development and implementation of evidence-based research results. The increasing emphasis on one type of evidence in the NAV R&D department is not very clear from the document analysis and is currently followed up through ongoing interviews. It seems to be related both to wider societal trends, to the competences of the R&D departments, to academic trends (like "nudging" in behavioral economics and the scientification of evaluation) and possibly other aspects. We also note that NAV's earlier use of research seemed more conceptual and political, using an established pool of research-based knowledge in discussion about future decisions. Current use is more instrumental and designed to be diffused as quickly as possible.

The relationship between impact and innovation in public services is not clear from the literature. Innovation can on the one hand be seen as a main form of impact, which is relevant with a wide definition of innovation that includes non-economic and incremental changes where some of the process can be attributed to research. We see that some of the NAV associated research units have used NAV-based research in their impact cases for recent evaluations, where one logic (evidence) thus acts as a proof of the other (impact).

Alternatively, we can see innovation as an intermediary process that does not measure wider societal impact but is a necessary step towards achieving it. This is most likely rather common – also because impact takes a lot of time and is often a messy process, which is problematic both for the reporting from research projects and the reporting from public organizations and is associated with tensions between the logics.

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Abstract 119

FORESIGHT AND MODELLING FOR MISSION-ORIENTED HEALTH POLICY

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Keywords: mission-orientation, health policy, foresight, non-communicable diseases, personalized medicine, scenarios

Aim of the Proposal:

Research, technology and innovation policy has been transforming from a technology push approach to a mission-oriented approach over the last few years. This process is still ongoing. In our paper we want to show what a mission-oriented RTI-policy approach means for the health sector, especially with regard to personalized medicine and non-communicable diseases that require more than 70% of the health budget in the EU.

Background:

Mission-oriented research, technology and innovation policy (RTI policy) is addressing grand societal challenges. One of this societal challenges is without doubt a sustainable solidarity-based health system and the management of a balanced public health budget in the face of rising costs. Drivers of rising costs are for example lifestyle-related diseases (non-communicable diseases such as cancer, cardio-vascular deficiencies, diabetes, depression), the unbalanced age pyramid in the European Union where less and less work force have to pay the burden for a growing elderly population; and also new technologies (some fall in the category of personalized medicine) that are highly specialized and require complex procedures, infrastructures and services.

Methodology and empirical base:

In our health related Foresight projects FRESHER (FORESIGHT AND MODELLING FOR EUROPEAN HEALTH POLICY AND REGULATION¹) and HEcoPerMed (Health Economics for Personalised Medicine)² we discuss policy options with stakeholders from health, research, care, patient organisations, insurances and policy-making that go beyond the usual activities and pose alternatives that promise to be more successful.

In doing so we rely methodologically on qualitative Foresight tools combined with quantitative micro-simulation. In our paper we present a concise analysis of trends that affect NCD development far beyond the usual determinants of tobacco and alcohol consumption, salt, sugar and fat intake or sedentary behaviour. We further ask what role personalised medicine can play to diagnose and treat such diseases more efficiently – and what this would imply for mission-oriented health policy.

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² This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 824997.

The most relevant and significant trends are identified with experts in workshops and an online survey and subsequently combined in a set of scenarios depicting possible futures. Expert surveys and interviews are applied to assess the evolution of risk factors for NCDs and determinants for each scenario. These scenarios contribute to the identification of innovative policies in health and related fields.

Results:

In our analysis we ask: What are the determinants for the future of our European health systems today? How could they be influenced in order become more sustainable and value prevention more?

The options for alternatives presented contribute to the discussion of policies for the future in a comprehensive approach to “health in all policies” in the EU. Out of the box thinking is required to pay tribute to the complexity of future health systems that need to include aspects like equity, literacy, mobility, urban planning, and technological as well as organisational innovation. A systematic and holistic approach is required to address all drivers and determinants leading to a healthy life and a sustainable health system.

Conclusions:

One of our main conclusion is that health as a field of action is connected to many other aspects of life and that, therefore, health policy needs to be extended in order to become mission-oriented. Secondly, policy action usually is a re-action to cope with the fast evolving challenges in the health sector whereas expectations are high that policymakers set wise steps in a forward looking manner to design smart policies for the future and make the European health systems still fundable. Thus, health policy alone is not enough to gain a differentiated picture of the future of health, public health, and on NCDs in particular. At stake is not only the health condition of patients (potentially) affected by NCDs, but the financial and operating sustainability of the solidarity-based European health system (in connection to the social security system).

The inertia of existing structures and institutions in the health and related sectors can get in the way of new possibilities unfolding by considering wider trends and drivers. The traditional tools of policy-making can no longer be used to govern the increasingly diverse aspects attached to NCDs or research and development. Since the policy fields need to be redefined to become mission-oriented, as we argue, decisions are to a large extent determined by factors and developments lying outside the traditional policy field and the traditional sphere of national policy making.

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Abstract 160

THE IMPACT OF SOCIOLOGY IN NORWAY

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Aim of the proposal:

The aim of the paper is to discuss the societal impact of sociology in Norway. Using the impact cases submitted by sociologists to the evaluation of the social sciences by the Research Council of Norway in 2018, the paper address the relation of the sociological discipline to society. Who are the 'users' of sociological research, and how do sociologists' engage with organizations/actors outside of academia? Based on analyses of the narrative impact cases, the paper sheds light on how a discipline is embedded in certain networks and organizational fields that condition their research and its impact.

As the analysis is based on narrative impact cases, the paper will also address the pros and cons of using impact cases as empirical material for research purposes. While the cases provide a rich account of the contributions of a discipline to society, they are produced within a certain context that may limit the scope and conceal the impact of certain sociological research.

Background:

The question of how research contributes to society is a salient issue in science policy and for researchers which is increasingly being asked to document how their research has had a societal impact or is going to get it in the future. It reflects a rising expectation of science justifying the economic transfers from society by displaying the benefits they produce outside of the scientific community. This has led to increased efforts to show the different ways in which research contributes to society, and the heterogeneity of pathways across different disciplines and sectors. This paper contributes to this growing body of research by taking as a starting point the societal impact of the sociological discipline in Norway.

The disciplines are the still the dominant 'building blocks' of the academy. They are commonly defined by a set of shared set of epistemic beliefs and scientific practices, as well as rules of entry and internal hierarchies. These features are usually conceived of as distinct traits to establish the boundaries of disciplines vis a vis other disciplines. In this paper, I will rather discuss how sociology as a discipline establishes itself towards the public domain, and how sociologists engage with society.

Sociology is among the largest social scientific disciplines in Norway, and its relation to society has been a topic of recurrent discussion within the discipline itself. While one part of sociology has a self-image of being in opposition to the government and taking part with the weak in society, sociology has also emerged in close relation to the welfare state in Norway and deals with topics that are linked to the so-called Nordic model. This 'Janus face' of Norwegian sociology forms a particularly interesting background for the exploration of sociology's contribution to society, as outlined in the impact cases.

Methodology and empirical base:

The empirical analysis is based on the 58 impact cases submitted by sociologists to the evaluation of the social sciences (SAMEVAL) in Norway in 2018. The evaluation was initiated and organized by the Research Council of Norway.

The impact cases follow the template of the cases submitted to the REF 2014, as well as their definition of societal impact. There were no financial mechanisms linked to the assessment of the impact cases in Norway.

The impact cases offer a rich source to address the contribution of sociology to society as provides narrative accounts of how research has led to certain outputs in the words of the sociologists themselves. While the impact cases covers all research institutions in Norway hosting a minimum of 10 sociologists, the issue of representativeness remains, as we can assume that the institutions have selected the cases that fits the guidelines of the SAMEVAL best. As such, this analysis is not based on a mapping of the discipline of sociology in Norway as such, but of the share of research that is presented in the impact cases.

The selection bias of impact cases is given special consideration in the methodological section and in the conclusion, where the suitability of impact cases as material for research is discussed.

Results:

The analysis of the cases suggest that sociological research is conceived of as particularly relevant to the sphere of policymaking on national and regional level, as well as to the development of professional services and practices in relation to the welfare state. Nearly 70% of the cases are related to social policy and practice (see attachments). But the cases also display how the impact is largely conditioned by sociologists repeated interactions with policymakers. Many sociologists contribute with expert knowledge and commissioned research and evaluations to policymakers which makes its way into public reports, white papers as well as laws and regulations. The pathways often include a numbers of different channels including

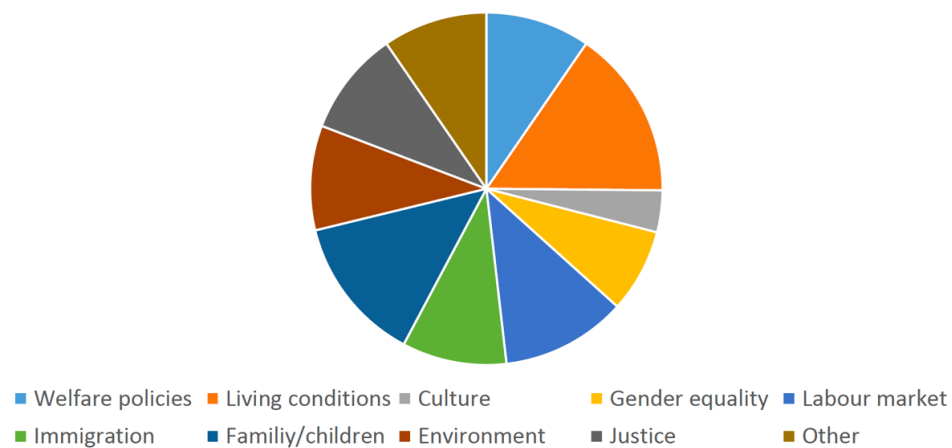
- Commissioned research
- Reports
- Expert advice
- Formal and informal meetings with decision makers /politicians
- Participation on public committees and councils
- Interaction with practitioners
- Seminars, public speeches
- Op-eds, media interviews/performances

But the impact cases also displayed how their repeated interactions open channels of communication with policymakers also has an impact on the profile of sociological research in Norway. Sociological research in Norway, as presented in the impact cases, is also impacted by the networks and the larger organizational field they form part of which facilitates interaction and negotiated agreements in the intersection between research and the policymaking sphere.

Conclusions:

Key findings of the analyses include the observation that a seemingly large proportion of sociological research is produced in relation to the policymaking sphere, and that societal impact is largely conditioned by institutional structures and practices that facilitates interaction between sociologists and their users. The results further display a strong commitment of sociology to the welfare state, suggesting a mutual dependency between the discipline and this part of society. This could also imply a vulnerability of sociology as a discipline on its own.

Themes of impact



P.01 POSTER

Abstract 85

EXPLORING KNOWLEDGE PRODUCTION IN EUROPE. THE KNOWMAK TOOL

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Aim of the proposal:

The Knowledge in the Making (KNOWMAK; www.knowmak.eu) project has developed an interactive tool, which allows selected groups of users to visualise and analyse the production of knowledge in the European Research Area (ERA), with a particular focus on knowledge related to Societal Grand Challenges (SGC) and Key Enabling Technologies (KET). The tool is based on three existing data sources on knowledge production in the ERA, i.e. scientific publications derived from the Web of Science database (CWTS-WoS database), patents derived from PATSTAT (UPEM-PATSTAT database) and European projects derived from CORDIS (AIT-EUPRO database). Additionally, the project is integrating two additional data sources, one concerned with social innovation projects and actors, the other with user attention as observed through social media.

This presentation is intended to introduce the tool, discuss its main characteristics and functionalities as well as the indicators that can be visualized and extracted for further analysis, providing a novel picture on knowledge creation processes across Europe. Further, based on preliminary analyses, we will provide examples of how the KNOWMAK tool and the underlying datasets can be exploited for deeper explorations of knowledge production processes in Europe.

Background:

Understanding knowledge co-creation in key emerging areas of European research is a critical issue for policy makers in order to analyse impact and make strategic decisions. However, current methods for characterising and visualising the field have limitations concerning the changing nature of research, the differences in language and topic structure between policies and scientific topics, and the coverage of a broad range of scientific and political issues that have different characteristics.

The move towards open linked data in STI studies is generating new opportunities, but also new challenges that are at the core of this paper. The opportunities concern the ability to interlink different kinds of data sources, such as publications, projects and patents, in order to provide a richer view of knowledge production (RW.ERROR - Unable to find reference:3735, Light, Polley and Börner 2014); the challenges are related to the need for a robust approach to identify and model relevant topics, such as those associated with specific policy and scholarly questions (Cassi, Lahatte, Rafols, Sautier and De Turckheim 2017).

A central issue in this respect is how to map diverse kinds of knowledge outputs to central topics in the science policy debate. Traditional classification systems for characterising research, e.g. the Web of Science Journal classification (Leydesdorff and Rafols 2009) and the IPC codes for patent classification (Debackere and Luwel 2005), are typically simple, stable, and have widespread coverage. However, combining such schemes in order to depict an overall view of scientific knowledge production that encompasses different data sources is inherently challenging as each scheme is closely related to a specific type of data source, and

despite wide-ranging efforts to map different classification schemes (Schmoch, Laville, Patel and Frietsch 2003), they remain largely incommensurable. Furthermore, mapping these classifications of scientific basis to policy-oriented topics presents a further issue due to terminological and conceptual divergence. On the other hand, textual methods such as keyword extraction and overlay maps (Rafols, Porter and Leydesdorff 2010) provide fine-grained views of the scientific field, but are not easily scalable to broader topics and remain bound to specific language of each data source.

We address these problems through the use of ontologies to drive the development of a web-based tool providing interactive visualizations on European knowledge production activities. The tool is designed to provide information to users wishing to understand the nature of, and connections between, key European research. Ontologies share with classifications the fact that they are constructed upon some intellectual understanding of reality; while their creation can be assisted by all kinds of text-based methods, they ultimately require some method of expert-based arbitration and must rely on some kind of “shared vision of the structure of the domain of interest” (Daraio, Lenzerini, Leporelli, et al 2016).

The ontology that has been developed in the KNOWMAK project is organized around two central topic areas central to policy makers: Key Enabling Technologies (KET; <https://ec.europa.eu/programmes/horizon2020/en/area/key-enabling-technologies>) and Societal Grand Challenges (SGC; <https://ec.europa.eu/programmes/horizon2020/en/h2020-section/societal-challenges>) as defined by the European Union. From a policy perspective, KETs are usually considered as essential generic technologies for the future competitiveness of the EU, and SGC as the knowledge domains specifically crucial for the major societal challenges of the future.

Based on expert opinions and on documentary analysis, these 13 topics have been further disaggregated in around 150 subtopics, such as ‘Genomics’, ‘Energy efficiency’ and ‘Social inequality’. Keywords for each topic and subtopic have been generated from various sources, including also specific vocabularies by each source, like the vocabulary associated with the IPC codes for patents. Finally, the source documents (publications, patents, projects, social innovation projects) have been assigned to the ontology classes based on the combined weighted frequency of keywords (Maynard and Lepori 2017).

Methodology and empirical base:

KNOWMAK integrates data sources on knowledge production of different type, including, data on scientific publications derived from the Web of Science version at the University of Leiden (Waltman, Calero-Medina, Kosten, et al 2012), on European collaborative R&D projects from the EUPRO database developed at the Austrian Institute of Technology (Roediger-Schluga and Barber 2008), and on patents from the PATSTAT version at IFRIS in Paris (Laurens, Le Bas, Schoen, Villard and Larédo 2015). Data refer to the period 2000-2016 and will therefore allow for longitudinal analysis.

All source data have been geolocalised based on the authors’ (publications), participants’ (projects) and inventors’ addresses (patents). This allows for a flexible attribution to regions. A new regional classification has been developed to address some issues of EUROSTAT NUTS regions (<https://ec.europa.eu/eurostat/web/nuts/background>). More precisely, the classification includes EUROSTAT metropolitan regions (based on the aggregation of NUTS3-level regions) and NUTS2 regions for the remaining areas; further, a few additional centers for knowledge production, like Oxford and Leuven, have been singled out at NUTS3 level. The resulting classification is therefore more fine-grained than NUTS2 in the areas with sizeable

knowledge production, but at the same time recognizes the central role of metropolitan areas in knowledge production. Since it is fully based on the aggregation of NUTS3 regions, regional statistics by EUROSTAT can still be used.

The geographical perimeter considered includes EU-28 countries, EA-EFTA countries (Iceland, Liechtenstein, Norway and Switzerland) and candidate countries (Albania, Former Yugoslav Republic of Macedonia, Montenegro, Serbia and Turkey) for a total of 553 regions.

By combining this regional classification to the assignment of data to classes in the ontology, it becomes possible to generate indicators of knowledge production for various spatial entities (and, in the future, also for research actors such as universities and companies) disaggregated by topics and subtopics. This includes for example the number of publications, patents and projects for each entity, but also quality-related indicators (such as publications in the top-10% cited) and network centrality indicators. Further, composite indicators can be constructed, such as the overall share in knowledge production (combining volumes of publications, patents and projects), as well the intensity normalized by the population of the considered space.

Results:

The presentation will illustrate some examples of analyses that can be performed through the KNOWMAK tool.

a) The distribution of S&T activities in European regions. The KNOWMAK tool allows evaluating how knowledge production in the domains of Key Enabling Technologies (KETs) and Societal Grand Challenges (SGCs) is distributed in Europe and what are the most relevant regions in terms of production volume (as a share of the European total) and intensity (normalized by population). This analysis shows that regions with higher knowledge production volumes are mostly concentrated in large metropolitan regions, with Paris (in France), London (in the UK) and Munich (in Germany) ranking in the first three positions. On the other hand, medium-size metropolitan areas like Eindhoven (in the Netherlands), Vlaams-Brabant (Leuven – Belgium) and Uppsala (in Sweden) rank in the first three positions in terms of production intensity, while still having rather large volumes of knowledge production (ranking #10, #30 and #50 and respectively). This emphasises the important role of such medium-size regions, which is likely to emerge even more clearly when analysing specific research domains.

b) Analyzing knowledge production in a specific KET or SGC in terms of the types of outputs (publications, patents, projects) and of the relative importance of subtopics. In the specific case of nanotechnology, the KNOWMAK data display systematic differences between data types, with nanoscale devices being the most important subtopics for patents, nanoscale technology for publications and nanoscale materials for projects. This highlights differences in the science vs. technology orientation of domains within a KET, but also possible misalignments between EU funding policies and the European S&T basis.

c) The relative importance of scientific vs. technological production in European regions. On a specific topic, i.e. genomics, we display systematic differences in the geographical distribution of the S&T basis, with patent production being clustered in a few regions in Western and Nordic Europe, while publications are more distributed across space, including some regions in Eastern countries. This is likely to reflect different geographies of public research vs. industrial innovation, as the top-technological regions in genomics are the seat of some of the largest pharmaceutical companies in Europe, i.e. Novartis and Roche (Basel) and Philips (Eindhoven; medical instruments). In a future release of KNOWMAK, it will be

possible to identify the main R&D actors in each region in order to better understand the observed patterns.

Conclusions:

The examples presented highlight some innovative characteristics of the KNOWMAK tool:

- The development of an ontology allows for a fine-grained analysis of knowledge production at the topic level (13 KET/SGC, about 150 subtopics) that is common across data sources and linked explicitly to political priorities at the European level. This moves beyond current topical analyses based on a single data source or on fixed classification schemes.
- The regional classification developed by KNOWMAK is better suited to the geographical analysis of S&T production, while it remains compatible with EUROSTAT-NUTS and, therefore, allows integrating regional statistics in the analysis. The combination of regional and topical breakdowns is particularly powerful to investigate issues such as regional specialization.
- KNOWMAK has undertaken a systematic process of harmonization of data sources in terms of geography, topics and actors, which allows for fine-grained analysis combining different data sources on the same units of analysis. Eventually, this will also enable the development of smarter composite indicators.
- Finally, KNOWMAK has developed a user-friendly on-line tool that allows visualizing the data, displaying different types of maps and charts and, finally, downloading the data for further analysis. This will contribute to widespread usage beyond the scholarly community to a policy and research management audience.

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Abstract 58

CHARACTERISTICS OF COLLABORATIVE STRUCTURES AND THEIR IMPLICATIONS FOR R&D PERFORMANCE: AN EMPIRICAL STUDY ON PUBLIC R&D PROJECTS IN THE DIGITAL HEALTHCARE SECTOR OF SOUTH KOREA

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Aim of the proposal:

This study aims to understand the characteristics of collaborative structures and their implications for the performance of public research and development (R&D) projects in the Korean digital healthcare sector. More specifically, this research aims (1) to identify why organisations that participate in public R&D projects establish inter-organisational collaboration, (2) to explore why different structures of the inter-organisational collaboration are developed, and (3) to explain how those different collaborative structures have an effect on R&D performance such as output (i.e. SCI papers and patents) and outcome (licensing and commercialisation activities). Accordingly, three research questions to address these issues are:

- a. What are the characteristics of the strategic motives of the focal organisation influencing the development of the public R&D collaboration?
- b. How are different collaborative structures developed in the public R&D projects?
- c. How do different collaborative structures have an impact on R&D performance?

Background:

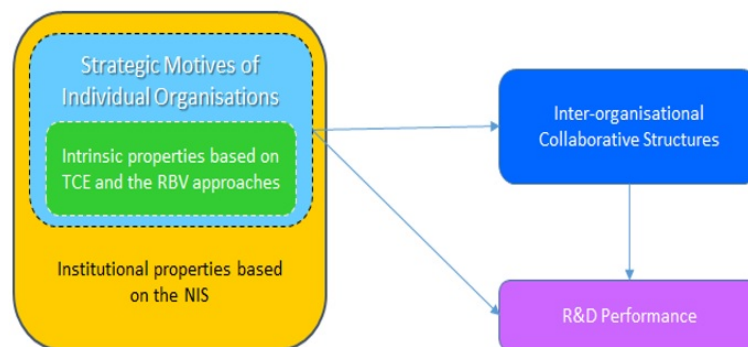
The role of collaboration is becoming progressively vital for achieving innovation in an environment that is continually experiencing rapid technological changes as well as the changing modes of knowledge production. However, little attention has been paid to understanding the characteristics of collaboration and its performance in the digital healthcare sector, an area which is confronted by demographic changes, particularly with an ageing population in many parts of the world, not least Korea. In addition, the digital healthcare sector has emerged thanks to the digital revolution based on information and communications technology (ICT) and demographic changes due to the ageing population. In particular, the market demands for the digital healthcare are expanded from patients only to persons who are not even sick but who are seeking care and prevention, and knowledge integration between bio and medical science and ICT plays an essential role in this sector. Moreover, the issue of ambiguous boundaries between health and social care, for instance at-home medical genetic tests and smartphone-based diagnostic devices, may give rise to problems regarding regulatory applications. In order to adapt properly to these changes with regard to the market demands, the knowledge integration, and the regulatory applications in the digital healthcare sector, we need to know about the key features of the actors involved and how they interact with each other within the institutional context.

Thus, understanding the characteristics of collaboration for developing research capabilities through public R&D should yield important insights and policy implications for this sector.

* Conceptual framework

The strategic motives in the establishment of different collaborative structures, and the relationship between the collaborative structures and their performance are not properly covered by extant theoretical approaches. In order to address this gap, a basic relationship model between collaboration and productivity suggested by Lee and Bozeman (2005) is adopted, which also embraces the importance of individual, institutional, and environmental factors affecting both establishing collaboration and productivity. Hence, it assumes that the strategic motives in establish collaboration are influenced by intrinsic properties of individual organisations (i.e. from perspectives of cost economising and of value maximisation through securing strategic resources) and institutional properties of the national innovation system (i.e. institutions such as regulations and R&D policies). In addition, the collaborative structures depending to the strategic motives have a crucial impact on the level or the direction of innovative performance in public R&D projects of the digital healthcare sector. Thus, the combination of three different theoretical approaches, namely, transaction cost economics (Powell, 1999; Williamson, 1985), the resource-based view (Barney, 1991; Das et al, 2000; Kogut, 1988) and the national innovation system (Edquist et al, 1999; Golichenko, 2016; Lundvall, 1992) is used for arriving at a better understanding of the strategic motives in establishing different collaborative structures and the relationships between different collaborative structures and their performance (see Figure 1).

Figure 1. A conceptual framework of the thesis



* The intrinsic properties of individual organisations are a cost economisation approach based on TCE and the perspective of securing strategic resources for value maximisation based on the RBV, while the institutional properties for the whole system rely on institutions such as policies and regulations in the NIS.

Source: author' elaboration

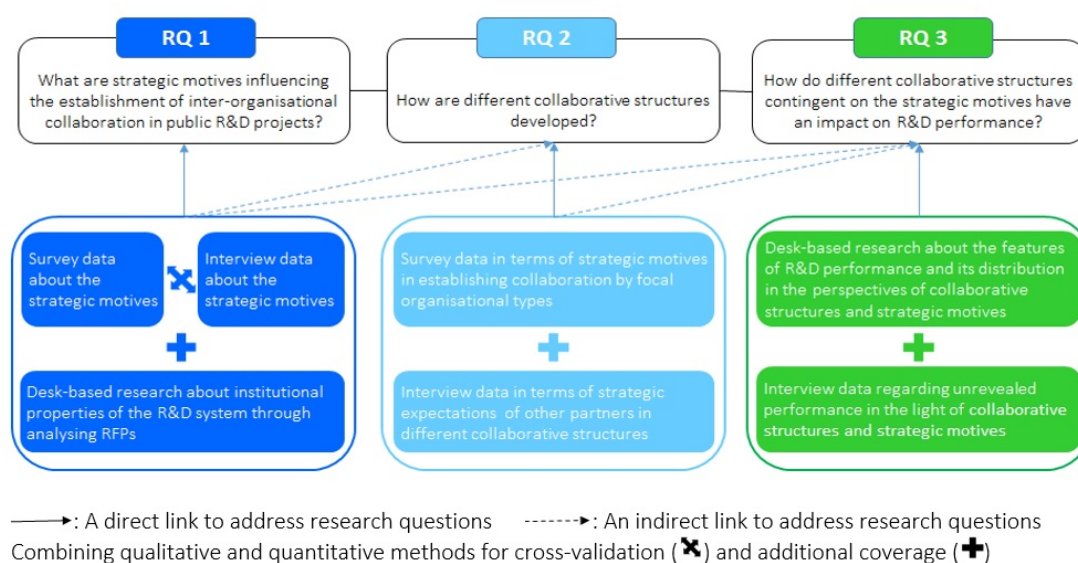
Methodology and empirical base:

The first research question is regarding 'what' while the other two are expressed in terms of 'how'. The 'how' question is more explanatory and is associated with the operational links that need to be traced, and this type of a question is less likely to be dealt with using quantitative methods research only, while the 'what' type of question tends to be better addressed with quantitative methods research such as a survey (Yin, 1994). Thus, mixed methods research in the perspective of pragmatism was appealing and was adopted here in order to address appropriately the research questions in this thesis.

There are primarily two types of data that are collected from the desk-based research regarding the request for proposals (RFPs) of the R&D projects participating in collaboration,

and life-cycle data on the R&D process from information on R&D projects between 2012 and 2015, through to their output performance (i.e. SCI papers and patents) and to their outcome performance (i.e. commercialisation activities). The RFPs were employed with the aim of a providing additional understanding about the institutional motives in establishing collaboration, and the performance data were collected in order to analyse from the perspectives of collaborative structures and strategic motives. The data on the R&D projects were also utilised for identification in the fieldwork studies for a survey and interviews (see Figure 2).

Figure 2. An analytical framework of the thesis



Source: author's elaboration

The data were collected through a survey with 57 principal investigators in the R&D projects in order to understand the strategic motives involved in establishing inter-organisational collaboration and how those strategic motives based on the NIS, TCE, and the RBV influence the development of different inter-organisational collaborative structures. In addition, the semi-structured face-to-face 35 interviews were carried out with the purpose of understanding how different collaborative structures are developed and of shedding a light on unrevealed aspects of R&D performance.

Results:

(RQ a) According to survey data, seven strategic motives were marked 5.00 or over 5.00 in the range of 1 (strongly disagree) to 7 (strongly agree) with six motives related to the RBV and one motive involved in TCE. The most influential motive is 'to access to complementary resources and capabilities' linked to the RBV with 5.81. This result was validated with an open-end question of 'What were your strategic motives in choosing these partners in the suggested project?' The result shows that 30 out of 34 interviewees answered their motive is to obtain complementary capabilities or resources through collaborating with their partners. (RQ b) I am expecting that a result help understanding the characteristics of strategic motives influencing the development of four different collaborative structures by focal organisational type such as a firm, hospital, public research institute, and university. Moreover, why focal

organisations developed collaboration with particular types of collaborating partners and vice versa will be analysed based on the interview data to understand how different collaborative structures are developed.

(RQ c) I am expecting a result shows the distinguish characteristics of diverse R&D outputs and outcomes by different collaborative structures and strategic motives, and their causalities.

Conclusions:

To the theoretical aspect, the combination of the national innovation system, transaction cost economics, and the resource-based view could provide an alternative framework to arrive at a better understanding of the latent mechanisms of establishing inter-organisational collaboration in the public R&D projects. Moreover, utilising life-cycle data, which are directly linked each other, on the R&D process from information on R&D projects, through to output performance and to outcome performance could contribute to a better understanding of the relationships between collaborative structures contingent on strategic motives and R&D performance. Finally, collaboration with hospitals is less well explored in innovation studies. Indeed, Miller et al. (2016) and Thune et al. (2016) even contend that no research has yet taken account of the direct and explicit influence of hospitals in innovation studies. However, this research could contribute to understanding the role of hospitals and their characteristics in the innovation system.

In addition, this study would be practically used for supporting policy-makers' decisions as they allocate national resources and introduce new institutions for effective and efficient knowledge production, and also assign a new role or mission to public organisations such as universities, PRIs, and hospitals in the national innovation system.

Abstract 3

BUDGETING FOR EXPERIMENTATION IN DEVELOPING COUNTRIES; POWER, POLITICS AND PRIORITIES IN THE ALLOCATION OF RESOURCES

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Aim of the proposal:

Public funding of initiatives to transform socio-technical systems is essential to their implementation and potential success. Without such funding, niche experimentation and its subsequent upscaling, could rarely take place. In this paper, we consider the political processes which direct the allocation of resources in the public sector, using examples from research and development (R&D), and environmental management in South Africa. Based on qualitative interviews with senior government officials, and data for R&D expenditure, we assess the flexibility and alignment of budget practices. Although the processes themselves are well-defined and highly procedural, and there are clear points where politics or policy can influence the division of revenue, the final allocations change little, if at all, from year to year, and are highly pathway dependent. Resource-constrained countries such as South Africa, which have stationary or even declining public sector budgets, must seek new approaches to redirect funding in favour of deep transition and sustainability.

Background:

The re-allocation of public funds from existing programs to new initiatives is generally challenging. Funds are approved using a process which relies on historical patterns of expenditure rather than emerging needs and challenges. This pattern tends to reinforce existing socio-technical systems rather than allow for their dismantling as a pathway towards deep transitions. Although South Africa is used as a case study in this project, the problem is apparent in most countries; budget for the programs in national departments are tightly held and protected. Understanding how this protection is constructed is essential to the release of new funds for new experiments, and to the undermining of non-sustainable systems.

Methodology and empirical base:

The project has used a two-stage approach. In the first phase, secondary data sources have been assembled and analysed in order to understand how such budget processes take place and are managed. In the second phase, key respondents, identified through purposive sampling, have been interviewed as a means of understanding the influence of non-explicit and informal processes in the approval of public funding.

Results:

The results are still being developed. However, based on the information generated so far, it is clear that the budget process is well defined in the public sector documentation, leading to a high degree of inflexibility or resistance in the public sector. However, the dynamics between the Executive, Legislature and Administration are constantly changing and at any moment reflect the political power of a single entity within the overall system of Government.

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It is precisely the conditions that lead to changes in these dynamics which this project has sought to elucidate.

Conclusions:

There are opportunities for the re-allocation of public funds to sustainability transitions; how to realise these events will be described in the full paper.

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GOVERNMENT-HEI RESEARCH COLLABORATION FOR PUBLIC SECTOR AGENDAS

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Key words: science-policy interaction, university-government partnerships, civic university, evidence informed policy

1. Introduction: Emergence of new forms of government-HEI research collaborations

Recently, we see several examples of governments (local, regional and national) and higher education institutes (HEIs) in the Netherlands that find new ways to collaborate in knowledge production, especially focussing on mobilising knowledge for public sector agendas. Such research collaboration is organised in various arrangements. An example is the “City Deal Kennis Maken”¹, which is part of Urban Agenda of Ministry of Internal Affairs. This programme aims to accelerate the development of solutions for public sector issues in cities by fostering collaboration between city governments and HEIs in their cities. Another example is Brainport Smart District². This is a joint venture of the TU Delft and Tilburg University, a municipality, a regional triple-helix organisation and the Province of Noord-Brabant to build ‘the neighbourhood of the future’. They do so by simultaneously researching, developing and implementing material and social innovation in an experimental neighbourhood. Lastly, Campus The Hague³ illustrates how a university (University of Leiden) and a city government (The Hague) strategically align the identity of the city as “international city of peace and justice” with research and expertise of the university in order to strengthen the local knowledge ecosystem around these themes.

Government-HEI research collaborations hold a promise of contributing to public sector agendas for themes as public health, an inclusive economy and sustainable infrastructure development. Nonetheless, the mobilisation of science for public sector agendas brings forward questions regarding integrity, the role of HEIs in society, and relevance of knowledge for policy. Therefore, government-HEI research collaborations deserve our attention.

2. Goal and research questions:

This paper is part of a project that aims to understand (1) the emergence of government-HEI research collaborations, (2) the functioning of government-HEI research collaboration and (3) the impact of these collaborations for the partners involved and for society more broadly.

This paper focusses on the first objective: understanding the emergence of government-HEI research collaboration. The overall objective of the project is to develop a sense-making framework of government-HEI research collaborations. Thereby, the project aims to contribute to the mission of the Rathenau Instituut, which is to contribute to public and political debate on the role of science and scientific knowledge in society. The framework

¹This program of the Ministry of Internal Affairs aims to accelerate solving public sector issues of cities by involving researchers, lecturers and students. ‘Kennis Maken’ translates both as ‘producing knowledge’ and ‘getting to know one another’.

²<https://brainportsmartdistrict.nl/>

³<https://www.universiteitleiden.nl/en/the-hague>

can be used to clarify debates and inform decision-making around these types of research collaboration. This paper is the first step towards reaching the three project goals.

To understand why and how government-HEI research collaborations emerge, we will investigate what drives these parties towards each other and create novel forms of collaboration: *What are the drivers of changing government-HEI relations?*

Drivers of partners to set up new forms of collaboration

For governments, government-HEI research collaborations offer a new way of mobilising (new types of) knowledge for public policy agendas. Traditionally, government bodies of municipalities, provinces and the state turn to a variety of specialised policy oriented knowledge organisations to inform, underpin and validate their policies: public knowledge organisations, expert advice bodies and consultancy firms (Hoppe, 2010). HEIs differ from these knowledge-for-policy organisations on various aspects. One of the differences is a greater institutional distance from government organisations. Another is their dual role as both education and research institute. Moreover, HEIs are not founded to be relevant for the policy environment. Our study investigates how changes in the policy environment drive governments to mobilise HEIs as knowledge partners.

For HEIs, government-HEI research collaborations offer new ways to do research, to train students, and to transfer knowledge to society. Especially for the social sciences and humanities, public-public research collaboration offers them similar opportunities as the technical and natural sciences experience from public-private collaborations with firms. Government-HEI research collaborations also offer new strategic options for the institutes to position themselves in society. Such collaborations are part of changing roles that HEIs want to play (and are expected to play) in society (Calhoun, 2006; Goddard & Vallance, 2012). HEIs are a heterogeneous group of institutes. Different HEIs will respond differently to changes in their environments. Our study investigates how changes in the HEI environment drive HEIs to enter into new forms of government-HEI research collaborations.

Research questions

We will study the following questions in this paper:

1. What drives governments to mobilise HEIs as partners to provide policy-relevant knowledge?

2. What drives HEIs to seek governments as partner?

Sub question: What role do HEIs see for themselves in relation to the policy environment?

The research questions below are answered in the project of which this paper is a first step:

3. How do government-HEI research collaborations produce knowledge that is relevant for the public sector policy agendas?
4. How is this knowledge complementary to existing sources of knowledge?
5. What role do HEIs see for themselves in relation to the policy environment?
6. How has this changed over time?

7. How that is currently represented in their –and the researchers’– collaboration strategies with governments?

3. Methods used to answer the research questions:

The methods we use to answer the research questions (of both this paper and the whole project) are literature study and case studies of government-HEI research collaborations in the Netherlands. To achieve a broad understanding of emerging government-HEI research collaborations, we conduct semi-structured interviews with experts of government-science collaborations. The case studies of government-HEI research collaborations are needed to get a full understanding of the dynamics and implications of government-HEI research collaborations (project goals). We will select novel and strategic forms of collaboration. The selection is based on a typology of research collaborations we developed in a previous study on public-private collaborations (Tjong Tjin Tai et al., 2018). There, we distinguished four types of research collaboration: *networking*, *coordinating*, *collaborating* and *strategic partnering*. We are interested in the latter, which is the most intensive, comprehensive and long-term variant. In a strategic partnership, all partners are willing to invest in a long-term relation that offers close interactions and knowledge sharing. The case studies include semi-structured interviews with individuals at various levels in the collaborating organisations. Further the case studies include a desk study of policy documents and reports related to the research collaborations. As stated before this paper is part of a bigger research project. The findings of the empirical investigation for the whole project are discussed in a stakeholder meeting. The meeting informs the development of a sense-making framework. We conclude the project with a critical reflection on the mobilisation of higher education institutes (HEIs) for public sector policy agendas: What is the added-value of these collaborations for society? Which public values are being served or challenged?

4. Findings:

Interactions and relationships between governments and HEIs have existed since day and age, especially at city-scale. Over time, those relationships have changed. Whilst universities now increasingly formulate strategies to be engaged with their local environment in terms of *civic engagement* (Goddard & Puukka, 2008; Ransom, 2015), governments appear to value HEIs as knowledge partner, especially as knowledge provider for complex urban/regional policy agendas. Below, we set out the drivers of research collaborations, starting with the ‘knowledge-for-government-policy’ perspective.

City governments face new responsibilities and challenges in various policy domains, partly as a result of decentralisation of policy agendas in an urbanising world. In response to these new responsibilities and challenges, that often cross traditional government departments, city administrations and ministries alike use new strategies and policies. Policy approaches are becoming more experimental (Evans et al., 2016), based on principles of *learning by doing* (Potjer & Hajer, 2017) and network governance (Scherpenisse et al., 2017). Moreover, current policy challenges are increasingly playing out at the urban scale (Potjer & Hajer, 2017). Building on previous work, we know that changing policy goals and agendas lead to new knowledge needs and knowledge-for-policy agendas. Those in turn imply new knowledge mobilisation strategies (Faasse & Koens, 2017; Koens et al., 2016). In search for relevant knowledge-for-policy, HEIs emerged as partner in knowledge ecosystems that are mobilised for public sector issues.

Another driver is a changing policy perspective on (regional) economic development. Until roughly the 2000s, the policy attention for HEIs was mainly focused on their role as knowledge partners for industry in (regional) innovation ecosystems. HEIs were expected to contribute to the regional development of market economies (Goddard & Puukka, 2008). As knowledge and innovation were seen as determinative for the market-economic performance of a region (Moulaert & Nussbaumer, 2005), governments increasingly collaborated with HEIs in triple helix relations. That also aligned with a growing demand for economic valorisation of science (Etzkowitz & Leydesdorff, 2000). In the last decade, the perspective on economic development has broadened. It also includes environment, health, education, labour, security, trust and inequality. It has become apparent that solely economic competitiveness of regions or cities is not leading towards environmentally and economically sustainable regions that also embrace social cohesion (Goddard & Vallance, 2012; Moulaert & Nussbaumer, 2005). This opens new opportunities for HEIs to be mobilised for policy agendas on these issues.

This broadened perspective on economic growth is also visible in the 'normative turn' in innovation policy. Innovation policy is increasingly oriented by sustainable development goals and missions. This offers HEIs new ways to engage with the cities and regions where they are located. Emphasis on HEIs' contribution to this societal goals and public sector agendas, creates a driver to invest in relations with the public sector.

The *civic university model* implies a broadening of earlier *entrepreneurial universities* (Etzkowitz, Webster, Gebhardt, & Terra, 2000). Whereas entrepreneurial universities framed their third mission strategy strongly in terms of the market economy, civic universities seek to integrate research, education and engagement in broader terms of social, political and economic engagement with society (Goddard et al., 2016; Goddard & Vallance, 2012). Triple helix collaborations may have familiarised the government and HEIs with each other, paving the way for other types of collaboration in other public sector policy domains. That idea resonates with researchers seeking collaboration with policymakers as potential users of research results and as partner in government-HEI research collaborations.

5. In conclusion:

In our paper, we showed how the emergence of new forms of government-HEI collaboration can be understood as a result of various drivers of both government actors and HEIs. For government actors, new responsibilities and challenges in various policy domains, especially at city scale, call for novel policy approaches such as experimentation and interactive policymaking. Those new policy approaches lead to new knowledge needs, knowledge-for-policy agendas and knowledge mobilisation strategies. In this process, HEIs were sought as a knowledge partner by governments. For HEIs, new forms of collaboration with governments allow them to respond to increasing expectations in society to be 'relevant'. Other drivers include the need for new funding sources and the interest in developing new modes of (co-creative) research, student training and knowledge transfer to public sector actors.

This paper is a first step in a project that aims to develop a sense-making framework of the new forms of government-HEI collaborations. This framework aims to give governments as well as HEIs a comprehensive perspective of the various public and private values and interests that are at play. It should contribute to responsible government-HEI collaboration. A sense-making framework is needed, because government-HEI collaborations may have various consequences for the way HEIs function in our society. The promises of these collaborations are clear: they contribute to better informed policy processes and to more

relevant research and education by HEIs. As HEIs become part of knowledge ecosystems that are mobilised for public policy agendas, they may help to accelerate societal transitions that are needed to address the societal challenges. On the other hand, however, our previous study on public-private strategic partnership (Tjong Tjin Tai et al., 2018) has shown that new forms of strategic collaboration also lead to new questions and considerations. Not just for the partners involved themselves, but also for society. For instance, how to guarantee scientific integrity? How to prevent that HEIs become too dependent on their partners? Our earlier work on public knowledge organisations (Faasse & Koens, 2017; Koens et al., 2016; Tjong Tjin Tai et al., 2018) has shown that these organisations are specialised in managing the boundaries between policy and knowledge. HEIs lack these skills, which may cause them to be more vulnerable or less effective and less dependable in creating knowledge that can be used by policymakers. Further, we reflect on the democratic legitimisation of government-HEI research collaborations and their outputs. By reflecting on these matters, we contribute to an answer on the question driving our project: How can science be responsibly mobilised for public policy agendas?

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Abstract 36

PROGRESSING THE BIO-BASED PRODUCTS' GLOBAL VALUE CHAINS BY SOCIAL INNOVATION

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Keywords: Bio-based products, global value chains, bioeconomy, social innovation, inclusive growth

Abstract:

The globe is confronted by numerous challenges impacting society due to unsustainable consumption of goods and services, increased global competitiveness, and adverse health and environmental effects of fossil-based materials. Under certain circumstances, the bio-based products global value chains (BioGVC) can generate social innovations that promote sustainable development with inclusive growth. BioGVC evaluated in the framework of circular bioeconomy include an intricate international productive network of processes and actors, whose interaction shapes product and trade structures, impacting employment, income and living standards of the societies. Promoting the sustainable growth of bioeconomy sectors will contribute to an innovative, resource efficient and inclusive society in transition from a fossil-based society to a bio-based one.

In this context, this paper aims at making a theoretical discussion about how to map bio-based products value chains, considering its different stakeholders. Mapping value chains from a socio-economic perspective is challenging, since it requires the interdisciplinary contribution of different research fields, urging macro and micro, quantitative and qualitative analyses which require case studies. Based on the structuralist theoretical perspective (Rodriguez, 2009) in the field of international political economy, we propose a methodology that combines three modern conceptual frameworks: social innovation, global value chains and bioeconomy. The structuralism privileges a historical approach, recognizing an inter-state system divided in center and periphery with asymmetric power and wealth relationships (Prebisch, 1949; Cardoso & Reis, 2018). The distinguishing characteristic between the two groups is the technological development (Furtado, 1961), which is structurally determined.¹ Historically, the insertion of center and periphery countries in the international flows of goods, services and capital influenced their development and distribution trajectories, shaping and conditioning social, political and economic structures and institutions. In this view, there is reciprocal causality between material evolution and institutional changes.

Our first conceptual framework, social innovation is actually a broad interdisciplinary concept that can be understood from different points of views and emphases regarding its main agents/drivers, means, forms or phenomena, and impacts.

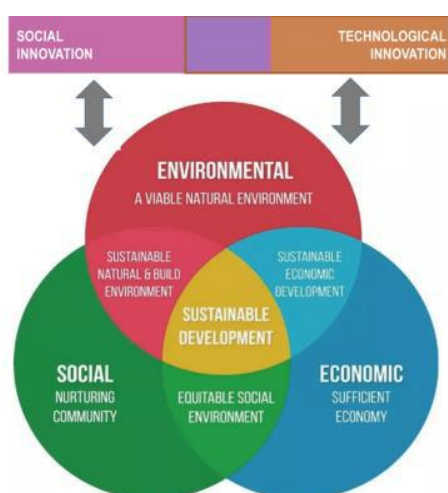
¹ "In this process, as Furtado points out, there are significant differences between the social transformations triggered by technological progress assimilation in underdeveloped and developed countries. Moreover, often the ultimate motivation for technological progress in central developed countries are solutions to their most serious social problems. Otherwise, such innovations are not relevant to the reality of underdeveloped countries, which still have to deal with several other kinds of economic and social problems before assimilating modernization through the emulation of consumption patterns – which, in general, engenders new or reinforces old inequalities according to Furtado (1973)" (Reis & Cardoso, 2019, p. 4).

The Oslo Manual 2018 defines social innovation as “innovations defined by their (social) objectives to improve the welfare of individuals or communities”. The World Economic Forum defines social innovation as “the application of innovative, practical, sustainable, market-based approaches to benefit society in general, and low-income or underserved populations in particular”. Another relevant definition, provided by the Center for Research on Social Innovation at the University of Quebec (CRISES), sees social innovation as: “the implementation of new social and institutional arrangements, new forms of resource mobilization, new answers to problems for which available solutions have proven inadequate or new social aspirations (e.g. Autonomy and Empowerment)”.

“Innovation” itself has various definitions, which converge about the idea that it is more than just an invention or creation of something new, but something new that was put into practice (Fagerberg et al, 2012). “Social” is a qualification that underlines the role of the society in the innovation processes. Although for some authors like Mulgan (2006) social innovation requires its protagonists to be social groups or movements (instead of private companies), nowadays it is consented that “social” essentially regards to who appropriates the results of innovation (Defourny and Nyssens, 2013). Therefore, social innovation refers to the creation, adoption and integration of new and renewed concepts, systems and practices that put people and planet first, so that its scope is broader than technological innovation simply. Actually, some social innovations can also be technological innovations, i.e., green technologies of bio-based products bring social value because they are positive for the sustainable development.

Considering these selection of definitions, for mapping bio-based products value chains, social innovation can be understood as the innovative process or practice that generates social value, produced by public and private, individual or collective enterprises. Particularly, social innovation is a process in which the bioeconomy is promoted at regional and local level, creating economic value through participatory policies, with the goal of contributing to collective and individual empowerment and wellbeing. It is also in line with the sustainable development goals and Agenda 2030 (UN, 2015), as shown in figure 1.

Figure 1 Technological and social innovation for sustainable development.



Elaborated by the authors based on Bruntland Comission (1987), UN (2015).

By its turn, bioeconomy is defined by the European commission as the production of renewable biological resources and the conversion of these resources and waste streams into value added products and bioenergy via innovative and efficient technologies provided by industrial biotechnology. Those three frameworks compose a new model for industry and the economy. OECD countries had explicitly incorporated bioeconomy in their public policies since the early 2010's, envisaging it responsible for a significant share of economic output, involving three elements in particular: biotechnological knowledge, renewable biomass, and integration across applications. In Europe, already in 1993, the term bioeconomy entered into European policy discussions within the White Paper that highlighted the need for non-physical, knowledge-based investments, and importance of biotechnology in innovation and growth. In 2012, a European Bioeconomy Strategy was established, which addressed the production of renewable biological resources and their conversion into vital products and bio-energy, and in 2018, the strategy was updated trying to maximize its contribution towards the SDGs, as well as, the Paris Agreement. In addition, several European strategies (such as the Circular economy strategy) support the strength and scale up the bio-based sectors. In this sense, several funding mechanisms are available which intend to boost the bioeconomy (such as Horizon 2020, BBI 2012). It is worth noting that according to the EU bioeconomy strategy in Europe the links between the bioeconomy and social agendas are still weak, and while technological innovation is seen as a key driver, social innovation is generally ignored. In this sense, it is necessary to create programs and networks in order to transfer knowledge that will demonstrate the concept of social innovation and attract potential investors.

BioGVC are composed by industries that use biological, plant and animal resources, produce bio-based products or services, ideally to be sustainably consumed by generating recyclable or biodegradable waste. This cycle is circular (Ladu & Quitzow, 2017) and social innovations are welcome to make it more "virtuous" (Myrdal, 1956).

Bioeconomy circular cycles integrate activities from primary, secondary and tertiary sectors, shaping local, regional and global value chains (GVC). GVCs comprehend all the activities that firms and workers perform from the creation until the consumption of a product. Therefore, GVC organize the production and trade around the world, having economic, political and social effects. However, this concept does not close the loop of sustainable circular economy, because it does not include post consumption activities. Therefore, "circular economy" is a broader concept that includes the idea of value chains, which in case of bio-based products comprehend the following activities: biomass cultivation/ harvesting, processing/ biorefinery, market penetration (through bio-based manufactures), consumption, waste as biomass and reuse/ recycling – closing the loop triggering biomass (Ladu & Quitzow, 2017). Moreover, a sustainable bio-based product can be considered as a *systemic* product that integrates sustainability across the entire bio-based value chain along with consumer and overall societal needs, defining five elements that compose its chain map:

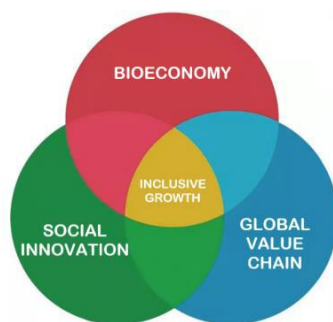
1. The sustainable material – primary product (solid, liquid, gaseous intermediates, e.g.: energy carriers, platform chemicals);
 - a. biomass production (cultivation and harvesting);
 - b. transport, storage and conditioning;
 - c. pre-treatment and production of intermediates;
 - d. transport of intermediates.

2. The sustainable manufacturing – secondary product (a marketable final bio-based product) that implement a definite set of consumer needs as the functionalities of the product (plastics, composite materials, ethanol, ethylene, organic acids, etc.).
3. The sustainable consumption.
 - a. Storage and transport (wholesale and retail system)
 - b. Usage
 - c. EoL options (recycling, digestion, composting, incineration, landfilling)
4. The sustainable ecosystem services – it integrates the above stages in the framework of circularity and stabilization of environmental services
5. The sustainable communities – it transfers techno-economic sustainability assessment into social innovations.

In this sense, the economic, environmental and social value of the product is created by a network cooperation and involvement of different actors at local and global levels.

There are increasing attempts to monitor the value generated by bioeconomy activities. For instance, Piotrowski et al (2016) combines data from sectors that can be fully attributed to bioeconomy (primary biomass production - agriculture, forestry and fishery and food, beverages, tobacco, paper and paper products sectors), with estimated shares of the value produced from renewable energy in textiles, forest-based industry, chemicals, plastics and pharmaceuticals, concluding that in 2013 the bioeconomy generated turnover of more than EUR 2 trillion (14,3% of European Union GDP) and more than 18 million jobs. Taking apart food, beverages, tobacco products, and also biomass production extraction (agriculture, forestry and fishery), in 2013 the turnover was EUR 600 billion and total employment 3,2 million. Those estimates show how important is the contribution of the bioeconomy to the GDP. But nowadays it is a consensus that not only the economic side has to be emphasized for achieving development, but social and environmental spheres too. As outlined at Sustainable Development Goals (UN, 2015 – see figure 1), sustainability, bearability, equity and viability should be also considered. But even at the economic sphere, actual bioeconomy measures are not fully combining its defining elements: “biotechnological knowledge, renewable biomass, and integration across applications”. Moreover, bioeconomy measurements cannot identify tasks or activities involved in the value chains nor its stakeholders. Then, a necessary condition related to progressing social innovation in bioeconomy is to pursue bio-based product circular value chains, in a broader sense.

Figure 2 - Methodological approach for understanding BioGVC: combining transversal frameworks.



Elaborated by the authors. 2019

Figure 2 illustrates our methodological approach for understanding BioGVC, combining three modern and interdisciplinary methodological frameworks – social innovation, bioeconomy and global value chains. In our view, in the context of sustainable development presented in figure 1, the intersections of the three frameworks in figure 2 mean:

- bioeconomy and social innovation: bearable and sustainable bioeconomy innovations;
- global value chains and social innovation: equitable and sustainable vertical and horizontal networks;
- bioeconomy and global value chains: viable and sustainable collaborative circular economy (resource use efficiency).

The essential assumption of our theoretical approach is that in the intersection of social/economic/environmental dimensions and social innovation/global value chains/bioeconomy there is the idea of circular economy, which promotes sustainable development. It is important to note that the methodology to map BioGVC require the identification of the main structural and institutional aspects that should be focused as key drivers and challenges, just as summarized in table 1. Thus, empirical exercises may rely not only on traditional academic research, but also user-engaged research with organizations from public, non-profit and private sectors.

Table 1: Structural and institutional aspects of the circular bio-based products economy that may impact and be impacted by social innovation:

Circular Bioeconomy Activities	Structural aspects	Institutional aspects
Extraction of renewable resources (biomass) to be converted into building blocks and/ or final bio-based products	Business associations, companies, employment, energy, industrial matrix, information and communication	Cultural behavior, financial system, international and national trade, macroeconomic regime, markets national system of
Biotechnology and chemical manufacturing processes of bio-based products		
Consumption of different bio-based products		
Energy recovery		
Organic waste recycling and renewable resource generation	technology, resource endowments, social groups, technology	innovation, property rights, quality infrastructure bodies, regulatory framework

Source: elaborated by the authors.

Lastly, our conclusions suggest that the theoretical framework and methodology for mapping the BioGVC proposed in the paper contributes for identifying social innovations' opportunities for progressing BioGVC while promoting inclusive growth at both, local and global perspectives. Some examples of how social innovations can generate and be generated from progressing in BioGVC to be analysed in more details are: by increasing trade and production's social value, improving quantity and quality of local jobs; furthering people's consciousness about consumption; improving services related to the value chains through development of local infrastructure; fostering the culture of reducing, reusing and recycling, mitigating the environmental impact; integration and empowerment of social communities.

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Abstract 101

BARRIERS AND CHALLENGES OF TRANSFORMING INNOVATION POLICY INTO THE TRANSITION POLICY: INSIGHTS BASED ON CHINA'S RENEWABLE ENERGY SECTOR STUDIES

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Aim of the proposal:

This paper argues that to deal with the grand challenges that we are facing today, it is crucial for policymakers to adopt a concept of the 'transition policy' which deals with the change of the socio-technical system.

Background:

The paper asks the questions of to what extent could a traditional model of innovation policies play a role in the modern societies where facing multiple challenges, which can't be solved with the 'business as usual' solutions.

Methodology and empirical base:

The paper uses two cases, solar and wind power development in China, to articulate the differences of the two kinds of policy concept, and how do the two different concepts exert different momentums for the development of the two low-carbon technologies. The paper adopts the transformative innovation learning history approach to examine the historical events, especially the critical policies for the two technologies. Then it investigates and compares the different logics and focuses on the two different policy instruments. Embedded into the norm that innovation policy for the economic growth, China's policymakers seem to put lots of efforts on the stimulation of emerging technologies while lack of reflective thinking on their further diffusions and that is why we see the system level challenges that these two new technologies are facing. In a way, it reveals the difficulties of transforming the current dominated policymaking regime and the political struggles that we need to bear in mind when it comes to targeting the innovation for sustainable development goals.

Results:

This study maps the differences between innovation policy tools and the transition policy instruments, with a core concept on transforming the 'socio-technical' system. With the interviews with 18 respondents from both the national and local government policymakers and the industry actors, it aims to unpack the policymaking regime in China, to investigate the underlying beliefs on the role of innovation, and the role of innovation policies for the low-carbon transition in China's electricity system.

Conclusions:

It concludes with that there seems a mismatch between the central level and local level's policymakers when it comes to the aims of innovation policy serving for and the understanding on the role of 'innovation' for sustainable development. Policymakers in China are still dominated by the thinking of stimulating the quantity of innovations instead of the quality of innovation or the directionality of the innovations, especially for the policymakers at the local level, they are specifically pointing out the aims of innovation policy serving for the industrial development and local economic growth. This normative thinking is evidenced by the lacking of coordination and balancing among different industries development which will further damage the further development of the emerging industry. For example, in the two cases, high curtailment issues of wind and solar power emerged when there is a lack of 'socio-technical system' thinking of policymakers.

Abstract 89

‘INTERCULTURAL’ PUBLIC SERVICES: ANSWERING THE NEEDS OF THE ‘SOCIETY IN CHANGE’ USING NEW TOOLS FOR EXISTING SERVICES

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Aim of the proposal:

The adoption in 2015 of the 2030 Agenda for Sustainable Development paved the way toward the definition of a very ambitious set of “universal and transformative Goals and target”, defined “comprehensive, far-reaching and people centred” (General Assembly of the United Nations (UNGA), Resolution 70/1 of 21 October 2015, para. 1).

The 2030 Agenda gathers all actors in national, regional and international arena to mobilize and multiply efforts to address challenges as diverse and ambitious as ending poverty and hunger, combating inequalities, building peaceful and inclusive societies, promoting human rights, and ensuring the protection of the planet and its natural resources.

The paper describes a pilot action on ‘intercultural’ public services, carried out within a project, partially funded by the Ministry of the Interior of Italy, in 2017-2018.

Building on this experience and putting it into a larger theoretical framework, it can be maintained that, in addition to legal sources, international soft law instruments may serve the purpose of encouraging the development, the planning and the use of intercultural tools among all actors – States, Governing bodies and employees – involved in the functioning of public services, for answering the needs of the present society in change.

In doing so, public services may contribute to the implementation of the Sustainable Development Goals (SDGs), in fulfilling their duties with a pro-active approach.

Background:

Since its foundation in 1945, the United Nations (UN) used on several occasion soft law instruments to set common priorities on different subjects, under the name of declarations of principles (ex multis, UNGA, Resolution A/RES/217(III) of 10 December 1948, “Universal Declaration of Human Rights”; Resolution S-6/3201 of 1st May 1974, “Declaration on the Establishment of a New International Economic Order”; Resolution 37/10 of 15 November 1982, ‘Manila Declaration on the Peaceful settlement of disputes between State’; Resolution 41/128 of 4 December 1986, “Declaration on the Right to Development”; Resolution 55/2 of 8 September 2000, ‘United Nations Millennium Declaration the Millennium Declaration’). Declarations of principles do not constitute autonomous legal sources of international law, but they contribute to the development of international rules (in particular as relevant practice for the ascertaining of customary rules) and to the establishment of general principles of solidarity within the international community and to the recognition of interdependence of principal issues and concerns of contemporary society.

SDGs can be considered as soft law rules; their implementation can be mainstreamed in national policies through the application of binding international rules.

In the domestic legal order of Italy, primary and secondary law aims at realising those principles of human dignity, equality and non-discrimination, peace, prosperity and solidarity re-affirmed in the 2030 Agenda for Sustainable Development. The Constitution makes express reference to the need of applying international law in Italy.

In domestic legal instruments and in judicial decision, declarations of principles are used often as an additional interpretative tool to reinforce the importance of specific rules affirmed on the international level (e.g. the reference to Art. 15 of the 1948 Universal Declaration on Human Rights in the judgment of the Court of Cassation of Italy of 27 April 2011, No. 9377).

Methodology and empirical base:

The paper combines quantitative and qualitative research.

The source of relevant data for the paper are found in the action carried out by the Institute for Research on Innovation and Services for Development on the National Research Council of Italy (CNR-IRISS) (G.C. Bruno, scientific responsible for CNR-IRISS) for the project “S.I.R.C. – Servizi Interculturali Regione Campania”, partially funded by Fondo Asilo, Migrazione e Integrazione (FAMI) 2014-2020 – Obiettivo Specifico: 2. Integrazione/Migrazione legale – Obiettivo nazionale : 3 Capacity building – let. J) Governance dei servizi.

The implementation of a pilot action for the redesign of public services with an intercultural approach was entrusted to the CNR-IRISS. The redesign took into account not only the 'foreign' users who already address public services, but also the potential users who may need it in the future. On the one hand, the pilot action worked on (welfare) services offered already by a public service (in this case, the Istituto Nazionale per le Previdenza Sociale – INPS), and requested by foreign residents on the Campania Region; on the other hand, experimentation through the pilot action (in this case, for a high school) appeared as a 'preparation for change that will come'.

Service Design was chosen for the implementation of the pilot action, as a strategic and innovative approach for the management of change within an organization, using processes, methods and tools of design centered on users and management of internal operations of an organization. Bringing elements and skills of service design in the public sector meant investing in the experience of citizens and reducing barriers to access to services, making interactions more inclusive and democratic.

The pilot action has had an impact on public areas of the premises of public services (redesign of premises), on the information style (redesign of information panels) and on the interpersonal communication (enhancement of personal skills and of teamwork).

Data deriving from the experience on the ground made in the “S.I.R.C. – Servizi Interculturali Regione Campania” project were then examined, taking into account relevant legal studies and practice, dealing with social innovation in public services and focusing on human and sustainable development.

Results:

The results of the pilot action show that there is a potential (taking into account all components) within public services that can be enhanced by adopting long-term goals, compatible with the SDGs.

A rigorous planning, with adequate financial resources, is a pre-requisite for achieving the result of offering public services to the 'society in change'.

By doing so, national governments, local authorities, subregional institutions, and the society as a whole may act for the effective implementation of the commitments declared in 2015.

Conclusions:

The social sciences have demonstrated the potential contribution of diversity to foster and improve the development (social, cultural and economic) of cities and communities⁽¹⁾. Using intercultural tools is a successful method for building inclusive and sustainable cities and societies.

But, for Italy, it is necessary to act quickly to implement models of intercultural approach within public services, not only to ensure the accomplishment of SDGs, but also for the aim of achieving, in general, better condition of life in the society.

⁽¹⁾ K. Khovanova-Rubicondo and D. Pinelli, Evidence of the Economic and Social Advantages of Intercultural Cities Approach, Council of Europe Intercultural Cities Project, marzo 2012, (<https://rm.coe.int/1680492f80>); R. Zapata-Barrero, Interculturalism in Cities: Concept, Policy and Implementation, Edward Elgar Publishing, 2015.

Abstract 57

CO-CREATION EXPERIENCES IN MONITORING RESPONSIBLE RESEARCH AND INNOVATION POLICY: THE CASE OF SPAIN

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Abstract:

The paper presents results and reflections on the co-creation of indicators with diverse stakeholders within the framework of RRI policy (Responsible Research and Innovation) in the Spanish case.

By offering a national perspective, the work tries to contribute to the European debate in the field, considering the differences observed in the national results, compared to some European monitoring initiatives as those developed by the European RRI Expert Group (2015) and the MoRRI project¹

The results focus on two of the six RRI dimensions (EU, 2012, 2014): public engagement and gender equality. The latter will be more developed due to the large experience in monitoring gender equality during last decades of gender mainstreaming, which allows to put in perspective contribution of RRI in the matter and also due to its potential to reflect on the relevant aspects selected to be monitored.

RRI-gender equality indicators were proposed and prioritized by national experts involved in gender and science and technology issues, such as policymakers, gender experts, research institutions, and equality associations, among others. They have proposed indicators based on participatory decision-making techniques. The results include a complete set of 52 indicators and a reduced panel of 23 indicators—the highest -ranked ones—to monitor relevant aspects that should be measured in gender dimensions from an RRI perspective: differential and asymmetric socialization and education, organizational culture, substantive representation, vertical segregation, work relations, visibility of women researchers, gender perspective in research contents, gender expertise enhancement, and resources. The results offer new indicators that differ from previous indicator panels at the European level. The differences are related to relevant aspects that should be measured and also the typology of preferred indicators (process, outputs, impact, perception).

This diversity suggests the need for a more nuanced debate on the purpose of indicators and the need for national contributions to RRI and to the debate on gender perspective in EU policy.

¹ The MoRRI project is an ambitious initiative aimed at proposing indicators to monitor RRI, supporting the Directorate General for R&I from 2014 to 2018. The project uses EU RRI area descriptions to research possible indicators. It focuses on robustness and includes detailed information on probable periodicity, source, type, and level of implementation. The project also addresses monitoring RRI benefits and includes some possible traits related to measuring gender equality and public engagement benefits.

Finally, the article presents some specific features observed in Spain that could be added to the debate on the specific contribution of an RRI-gender measurement perspective in an already developed gender policy with established monitoring initiatives. We want to highlight that a focus on the organizational level that is also different from previous Spanish initiatives in monitoring in science and innovation has been observed in the prioritization of Spanish indicators (Otero-Hermida & García-Melón, 2018).

In addition, the paper presents the results of the public engagement indicators - developed in the same terms- reflecting on the features in this dimension in relation to the aforementioned observations in terms of gender equality.

Fieldwork has been developed using participatory decision-making methods. We use the multicriteria method Analytical Hierarchy Process (AHP) (Saaty, 1980). This method has been previously tested in the prioritization of indicators in participatory environments (Monsonís-Payá et al, 2017).

Finally, we present some reflections on the dynamics of stakeholders and how these methods could be improved in future co-creation initiatives in monitoring RRI.

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Abstract 35

NANOTECHNOLOGIES IN A LOCAL CONTEXT: AN ITALIAN NANOTECH REGIONAL SYSTEM OF INNOVATION

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Aim of the proposal:

The present paper deals with a specific case of Regional/Sectoral Innovation System (Cooke et al., 1997; Malerba, 2002). In fact it investigates and describes the Regional System of Innovation of Piedmont region (North-West Italy) keeping a specific attention on NST. Several points suggest the interest towards this specific research topic. The regional research context of Piedmont is complex and multifaceted: it is formed in fact by three universities (over a little more than 4 million inhabitants), plus a national research institution (INRIM) based in Turin, plus several Institutes of the National Research Council and other relevant private research centres. On the side of the industries, several small and medium firms, as well as some large industrial groups, study or exploit the features of NST. Piedmont itself is part of the renowned North-Western Italy's "Industrial Triangle", an industrial- and technological-intensive area that, notwithstanding the transformation of the economic and industrial environment, is still at the verge of production and innovation.

The research question withstanding the present work is the following: is a regional context able to express a working and effective Regional Sectoral System of Innovation relative to a specific high-tech disruptive field such as NST? Are the actors in the system able to fruitfully exchange knowledge and to collaborate in order to perform innovation activities? Is an industrial system such as that of Piedmont (witnessing the presence of both mature industrial sectors and proactive small/micro firms and spinoffs on the verge of technologies) able to take up the challenge of an evolving disruptive scientific-technological field?

Background:

Several scientific works witness the relevance of nanotechnologies for industrial innovation (Brabazon et al., 2018; Finardi, 2013; Finardi, 2013b). Besides the discussion on their features also technological achievements and products that are widening their commercialization across time show that nanotechnologies have been, and still are, in the last decades a burgeoning field. In fact nanotechnologies and nanosciences (the scientific area that withstands nanotechnologies) have been considered since the 1990s as a growing field both in research and in industrial innovation (Dowling, 2004; European Commission, 2018; Grinin et al., 2017; Zhu et al. 2017). Nanotechnologies and nanosciences (NST from now on) belong to the group of the Key Enabling Technologies (KETs). Such technologies are those high-knowledge-intensity ones that are deemed able to influence the value chain of many industries, systems of production and economies (Schröcker, 2014). Moreover, NST are also defined as a general purpose and a disruptive technology field (Finardi, 2012).

It is also noteworthy to remark that, as also bibliometric data show, research activities in NST have grown in an impressive way since the 1990s, increasing the number of published scientific works per year (Coccia et al. 2012). Due to these facts NST are also widely studied in social sciences. The social and economic effects of NST, as well as the characteristics of the

organization of research in this field are the topic of several scientific works (Roco and Bainbridge, 2005; Roco, 2003; Salerno et al., 2008).

It is also noteworthy to remark that, as also bibliometric data show, research activities in NST have grown in an impressive way since the 1990s, increasing the number of published scientific works per year (Coccia et al. 2012). Due to these facts NST are also widely studied in social sciences. The social and economic effects of NST, as well as the characteristics of the organization of research in this field are the topic of several scientific works (Roco and Bainbridge, 2005; Roco, 2003; Salerno et al., 2008).

Methodology and empirical base:

To this end the paper exploits several sets of data. The first set is a bibliometric analysis of scientific products, performed with the methodology proposed by Arora et al. 2013. Another set of data has been obtained performing a patent analysis of Italian patents and extensions of Piedmont's CPC class B82 (Nanotechnology) patents. Research activities in the Region's institutions have been described thanks to a set of interviews to scientists of the various research institutions, describing the NST research topics performed in their labs. Finally, another set of interviews to entrepreneurs, industrial researchers and managers, coupled with other types of information, describes firms engaged in NST.

Results:

Research and industry data are arranged in tables in order to highlight the complex features of the research system and of the industrial environment. Data from different sources are compared and put in relation in order to devise whether an effective transfer of technology and a mutual cross-fertilisation occur.

Conclusions:

A SWOT analysis summarises the features of the system. At the end of the paper results are summed up, and conclusions are drawn.

Abstract 162

BETWEEN MOBILITY AND MIGRATION. THE CIRCULATION IN EUROPE OF HIGHLY SKILLED HUMAN RESOURCES FROM NON-EUROPEAN COUNTRIES

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Theoretical framework:

Contemporary society is increasingly propelled towards the transfer of information through virtual platforms which allow individual knowledge to become collective and in the discovery of constant multidirectional travel. Thanks to the development of information technologies this intangible asset that is knowledge can be easily transferred in real-time to any part of the world. Notwithstanding the advances in technology, intellectual mobility in the physical sense remains an intrinsic condition of knowledge dissemination (Gaillard, Gaillard, 1997). To this day, this mobility has acquired increasingly marked traits of a true migratory phenomenon which accounts for, in OECD countries alone, more than 27 million highly qualified migrants (Dumont, Spielvogel, Widmaier 2010). This migrant “élite”, which has increased by 70% in the last ten years according to OECD data, is influenced by attraction factors, such as for example academic prestige, lucrative job offers and advantageous contracts, as well as push factors. Socio-economic instability and difficulty in absorbing highly qualified figures into the job market fall within the latter (Mahroum, 2000). In the article, *International Mobility: Findings from a Survey of Researchers in EU* Børing proposes an alternative to the classic distinction between migrant workers and forms of mobility which does not take into account a change of job role, thus distinguishing the movement of researchers into “mobility with” and “mobility without a defined duration” (Børing et al. 2015). Indeed, for highly qualified professionals such as in the case of lecturers or researchers, the vast majority consider mobility as a necessary condition in order to meet some of their professional demands, such as access to new technologies, the acquisition of new skills and scientific exchange between international groups of research. This mobility is mostly funded and motivated by fellowships and is, moreover, of limited duration. The international scientific community has been questioning itself for a while on how to characterize this category of “globetrotters” (Mahroum, 2000) that, more than other groups, may not necessarily perceive the act of departure as a one-way trip but also as a temporary choice. According to the neo-classical theory, the migrant flux of students and highly skilled workers is steered towards countries which offer greater occupational and economic advantages. For this category of migrants, above all originating from less advanced or emerging areas of the globe, in many cases the decision not to return to the country of origin culminates during or at the conclusion of their study-abroad experience, where job opportunities offered by the host country satisfy and coincide with their expertise (Sabour, Habti 2010). In the transition from the status of student to employed,

mobility may transform into migration. The choice to remain is actually further facilitated by public policy which in the first instance makes mobility and the possibility of undertaking a course of study abroad more accessible thanks to the policy of internationalisation of tertiary structures. Secondly, increasingly open and flexible migratory policies with regards to highly skilled workers represent an ulterior incentive to remain in an advanced economy, definitively discouraging the process of repatriation (Sabour, Habti 2010). The propensity to migrate depends, however, not only on the opportunities offered by the host country or specialty sector, but above all on the capacity of the employment market of the country of origin to adequately place these subjects (Habti, Sabour, 2010). Highly qualified professionals and researchers are attracted by contexts in which return is not only limited to economic factors but also by work environments in which there is a greater possibility to increase their skills and create professional partnerships (Canibano, Woolley 2015). This is confirmed by the definition found in the Frascati Manual, which identifies researchers as professionals occupied in the conception and creation of new knowledge, products, processes, methods and systems, and in project management (2002). Those subjects potentially suited to integration into the national scientific system of the host country also constitute an important cog in the mechanism of the economic and social growth of the country of origin, and as such are a target of research. Identification of these subjects is made with reference to the definition provided by the Canberra Manual, useful in clearly outlining the object of this research: Human Resources in Science and Technology (HRST) are people who fulfil one or other of the following conditions: a) successfully completed education at the third level in an S&T field of study; b) not formally qualified as above, but employed in a S&T occupation where the above qualifications are normally required. (OECD, Eurostat, 1995, p.16)

Aim:

The research proposes a better comprehension of the particular characteristics of the circulation in Europe of Highly Skilled Human Resource (HSHR) involved in scientific research activities, originating from non-European countries. The research aims to understand on what terms the circulation of these figures is conditioned by the diverse contexts of the nations of departure and arrival, starting from the framework of opportunity, and restrictions and limitations demarcated by public policy (Dunnewijk, 2008; Jonker, Castro 2013; Canibano, Woolley 2015). Further comprehension of how and by how much the context of the countries of origin and arrival influence HSHR involved in scientific research activities, in their choice to transform short-term mobility to a definitive act of migration will be sought (Mahroum, 2000; Børing et al. 2015). Specifically, the research focuses on the exploration of the strategies promoted at a national level, by scientific and academic institutes. On the national level, it will investigate what programs by the academic institutions are promoted towards to the integration of international students in the post-doctoral phase into the research community.

Moreover, this research will also examine whether there are programs on mobility which are designed to attract highly qualified profiles originating from non-EU countries.

Method:

The reference sample chosen will be the HSHR target group integrated into the scientific and academic community, in order to investigate how and whether scientific mobility may be transformed into a migratory project. Extension of the sample will include international PhD students as in many cases the decision not to return to the country of origin develops during or at the end of a study-abroad experience, where the job opportunities offered by the host country satisfy and coincide with their specific expertise (Sabour, Habti 2010). This research is explorative in design and as such is articulated within the schema of an integrated approach, both quantitative and qualitative, which avails of: a) datasets contained within databases of international organizations; b) the review of existing literature on intellectual mobility and migration and analysis of selected country cases studies; c) social investigation tools: interview and online questionnaires (Morgan, 2013; Corbetta, 1999; Warren, et al 2010).

A preliminary analysis of the phenomenon HSHR originating from non-European countries in Europe will be carried out and also the principal characteristics of the databases of international organisations, which currently gather data on the highly skilled migration phenomenon will be analyzed.

The online questionnaire addressed to scientific coordinators of Executive Program of Scientific and Technological Cooperation between Italy and third countries from 2003 to 2014. The purpose of the questionnaire is to outline the profile of foreign researchers involved in scientific cooperation actions. The survey also aims to understand whether and how the policies promoted by the Italian Government could be a pull factor in attraction of highly qualified human resources, influencing individual choices to transform the temporary mobility in a long term transfer. The survey also aimed to understand what were the main motivations behind the scientific agreements and what were the predominant elements in the selection of the foreign partner, starting from the hypothesis that previous collaborations or participation in scientific networks are at the base of these choices.

The interview covers two groups of social actors involved, at different levels, into mobility and migration processes of Highly Skilled Human Resources. The first group is composed of institutional figures active in the production and execution of internationalization of research strategies. The figures identified are Vice-Principal for Internationalization; Vice-Principal for Research. The second groups are PhD students, early career researchers and coming from non-European countries.

The research hypothesis proposed is that the incentives promoted by academic institutions aimed at attracting HSHR produce different effects on the mobility of human resources based on the context of origin. This depends as much on scientific quality as on diverse levels of innovation and economic development, as well as on subsidies for mobility promoted by the country of origin. Differences in the contexts of origin and arrival are hypothesized to have an influence on the individual's decision to transform short-term mobility into long-term

migration. The research shall principally focus, in the case of Italy, in the attempt to discern whether attraction factors exist for this category of workers and whether there are attraction strategies aimed at availing of circulation of HSHR (Saxenian, 2005; 2011). The Italian case then will be compared to the Spanish case.

Results:

Thanks to the dataset supplied by the OECD, quantification of the phenomenon within a defined European context was undertaken. In this initial analysis the fact that in Europe, as in the United States, the presence of innovative technology hubs may be an attraction factor for HSHR coming mostly from developing countries. The results of a survey on the mobility incentives offered by the Bilateral Scientific and Technological Cooperation Protocols showed that most of the coordinators of these programs belong to the university, they are part of international research groups and previous collaborations were the predominant elements in the choice of foreign partner. Regarding the professional profile of foreign researchers, instead, they are mainly researchers in the field of industrial and information engineering and have traveled to Italy more than once. The survey show that any HSHR foreigners decided to remain in Italy in a long term. The main finding of interview are: exchange programs promoted by the EU and the internationalization strategies at national level are driving forces for academic mobility; language is significant pull factor; finally participation in international research groups and the "tutor figure" in country of origin and destination could facilitate the inclusion of HSHRs in the context of arrival.

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RESEARCH INFRASTRUCTURE FOR SCIENCE
AND INNOVATION POLICY STUDIES



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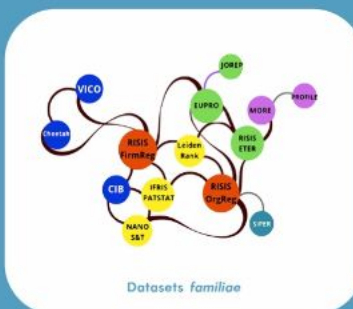
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serving a reference database incorporating the
ETER DB on universities, PROs and university
hospitals).
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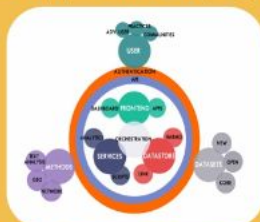
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