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***The Political Economy of Industrial Policy Evaluation: Evaluation-policy biases, system-level effects and dynamic interdependencies***

**Abstract:** Over the last two decades industrial policies have gradually re-entered the political economy debate among economists and policy makers in both developed and developing countries. De-industrialisation, loss of strategic manufacturing industries, increasing trade imbalances and decreasing technological dynamism have been major concerns in advanced economies. Meanwhile in middle income countries, governments have begun to question the sustainability of a growth model mainly focused on natural resource extraction more than manufacturing development. Finally, developing countries have been increasingly threatened by emerging giants capturing global manufacturing production and export shares and aggressively engaging the global technological race.

While the main focus of the debate throughout the 1990s was the theoretical case and historical evidence in support of and against industrial policies, this has now changed. More recently, academics and international actors have been increasingly focusing on the changing nature of industrial and innovation ecosystems as well as on the specific problems connected to the design, implementation, monitoring and evaluation of industrial policies. In other words the debate around industrial policies is increasingly moving from the 'why' to the 'what', 'when' and 'how' of effective industrial policy design and implementation.

The possibility for governments to influence the production capabilities dynamics underlying the structural transformation and the technological upgrading of their ecosystems resides in their capacity to:

- (i) understand and foresee ongoing transformations and complex interdependences within industrial-innovation ecosystems as well as emerging 'macrotrends' at the 'glocal' interface;
- (ii) design, coordinate and implement policy packages composed by sets of discrete interventions operating at different levels (i.e. firm, sector, system and macro) and targeting different factor inputs in new selective and mission oriented ways;

(iii) monitor and evaluate single instrument discrete interventions but also, more critically, system-levels and dynamic effects of implemented policy packages. Monitoring and evaluation are government functions that are increasingly acquiring a central role in the industrial policy process. This is because they allow better understanding of industrial dynamics and related policy effects and, as a result, strengthen policy responsiveness and governments' capacity to align policies over time.

Based on a review of industrial policy evaluation experiences in selected policy areas, the aim of this paper is to identify a number of cross-cutting evaluation challenges and to investigate the political economy implications of the various new evidence-based industrial policy approaches. The paper addresses a number of conceptual and methodological problems affecting the evaluation of single instrument discrete interventions – typically R&D support, finance schemes and public procurement – and, more critically, the evaluation of policy packages operating at the sector or system levels over time. The analysis of these challenges will draw upon selected national industrial policy evaluation experiences in both OECD and catching up economies. This selection allows better highlighting different sets of challenges arising in different contexts as well as the emergence of different evaluation-policy biases.

In the evaluation of the additional effect of single instrument discrete interventions, evaluation exercises have mainly relied on observational methods and randomisation techniques. Even though randomized controlled trials have strong “internal validity,” they are less likely than observational methods to have “external validity,” meaning that the causal effect found among the treated firms may not apply to other firms. Furthermore, the comparability across studies was found extremely problematic. While methodological improvements have been addressing some of these issues, less attention has been given to the policy and political economy implications of evaluation results. With respect to the evaluation of single instrument discrete interventions, the paper identifies and analyses three of them.

Firstly, many evaluation exercises often underestimate critical design/implementation factors that strongly affect policy effectiveness. As a result, when those policies which have been positively evaluated are implemented in other contexts, governments tend to adopt policies blindly. This means that very often governments treat policy instruments as ‘perfect substitute’ and ‘transferable’. Often this lack of knowledge about differences in the design, implementation and institutional settings supporting certain loan schemes (e.g. ZIM in Germany) or hybrid forms of public procurement (e.g. SBIR in US) may undermine their effectiveness in other contexts and, as a result, discourage other governments' industrial policy efforts.

Secondly, single instrument discrete interventions can induce unexpected and unintended outcomes, especially when they interact with other policy instruments. As soon as a number of ‘hidden policy treatments’ are factored in the same idea that single instrument discrete interventions can be evaluated ‘in isolation’ becomes questionable.

Thirdly, evaluations of single instrument discrete interventions have been mainly focused on relatively simpler policies, such as R&D grants, R&D tax incentives, access to capitals for



SMEs' innovation, etc. This 'evaluation bias' was determined by the fact that these policies can be more easily evaluated with rigorous state of the art quantitative techniques. However, this evaluation bias towards relatively simpler policies for which causal relationships and sequential causality are better understood, may induce 'policy biases'. Namely, governments may be induced to adopt only those single instrument discrete interventions for which evidence has been collected, while overlooking more 'difficult to evaluate' policies such as intermediate R&D institutions building and technology infrastructures development.

Although the emerging emphasis that national and supranational governments are giving to system- level industrial policies, rigorous and systematic evaluations of industrial policy packages at the sectoral, cluster and system levels remain scattered and very problematic. There have been various attempts to ascertain the effectiveness of selective industrial policy by looking at the relative performances of the targeted industries against those of non-targeted industries. Apart from various methodological and factual problems with individual studies, there is a problem with this general approach.

First, there are serious problems with the way in which these studies identify targeted sectors. Some studies define targeted industries in terms of some general characteristics without actually ascertaining that the industries were in practice favoured by government policies. For example, the famous East Asian Miracle report of the World Bank argues that industrial policy in the East Asian 'miracle' economies (except for some periods in Japan) was a failure on the grounds that the targeted sectors did not perform better. However, the study assumed that the higher its value-added component and the higher its capital intensity, the more favoured an industry was. However, industrial targeting was never practised in this kind of simplistic way in those countries. Many important industrial policy measures cannot by definition be captured through quantifiable indicators given their intrinsic nature. Sector policies and even more so industrial strategies include: (i) coordination of complementary investments; (ii) coordination of competing investments; (iii) policies to ensure scale economies (e.g., licensing conditional upon production scale, emphasis on the infant industries starting to export from early on, state-mediated mergers and acquisitions); (iv) regulation on technology imports; (v) regulation on foreign direct investment.

Secondly, while industrial policy may target certain industries (or even firms), this is done ultimately for the benefit of the overall economy – a lot of selective industrial policy is about externalities, linkages, coordination, and shifts across industries, with the aim of upgrading the structure of the entire economy. If this is the case, it will be wrong to evaluate industrial policy only in terms of its direct outcomes in the targeted industries. We also need to look at its indirect impacts on the rest of the economy by adopting system-level evaluation techniques.

The problem of evaluating industrial policies does not end with the difficulties related to addressing systemic effects (such as displacement effects or linkage effects) of the policy. An added layer of problem is that the evaluation framework has to account for the existence of long-run effects arising from cumulative dynamics. Even if we recognize the existence of 'time lags' – and thus of qualitative transformations, discontinuities, truncations, and

reversals – we still have to explicitly take into account the question of time scale – that is, the amount of time that firms require to build productive capabilities (as a result of, say, an infant industry policy) and move from low- to medium- and high-tech industries. These time issues become increasingly complex when we attempt an evaluation of a full package of industrial policies but are also extremely relevant even in the more narrow evaluation of specific policies, such as the increasingly widely-adopted randomised control trials. This technique tends to assume that the effect of a certain treatment (i.e., policy) unfolds in a ‘proper’ way, that is, in a monotonically increasing and linear manner. However, this is not often the case, and therefore we can come out with completely different evaluation results, depending on the moment we compare the observed and the counterfactual.

Drawing on a critical review of both single instrument discrete interventions and sectoral/system level industrial policy packages, the paper concludes by sketching a number of principles in support of the emerging developmental evaluation framework and the consideration of the political economy implications of new industrial policy evaluation approaches.

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***Shared pain, half a pain? 'Overcoming' barriers to innovation through cooperation***

**Abstract:** In recent empirical literature an increasing attention is devoted to the obstacles that hamper innovation, their impact on firms' engagement in innovation and their effect on the propensity to innovate (e.g. Baldwin and Lin, 2002; Galia and Legros, 2004; Tiwari et al., 2008; Savignac, 2008; Iammarino et al., 2009; Mancusi and Vezzulli, 2010; Galia et al., 2012; Blanchard et al., 2013).

Investigating innovation obstacles is of obvious policy relevance. It is crucial to enlarge the population of innovators and increase the innovation performance of the existing base of innovative firms (D'Este et al., 2012; 2014; Pellegrino and Savona, 2013). From both an innovation management and policy perspectives, it is particularly important to identify the factors that are more likely to attenuate or overcome the negative impact of innovation barriers (e.g. D'Este et al., 2014).

In the paper we shed new light on the relation between cooperation and barriers to innovation. While it might well be likely that cooperation itself is a source of failure (e.g. Lhuillery and Pfister, 2009), it is interesting to ask whether firms perceiving obstacles to innovation tend to overcome them by establishing cooperation agreements with external partners. We argue that firms experiencing obstacles to innovation undertake cooperative activities in order to mitigate the negative effects of such barriers on innovation. Following this reasoning the presence of barriers to innovation becomes a 'driver' of cooperation. In addition, it can be stated that different kinds of barriers may lead to different kinds of cooperation (e.g. with research organizations or firms) depending on what the firm is searching for and on what kind of barrier-related negative effects is trying to mitigate. As a further step in our analysis, we question whether different types of barriers are complements or rather substitutes in influencing the cooperation propensity.

We exploit the not micro-aggregated information of CIS4 database for France. We restrict our focus to manufacturing firms. In addition, the sample is constrained to innovating firms, because of the CIS questionnaire structure (i.e. cooperation activities are only pursued by those firms declaring to have introduced some kind of innovation).

The model we apply has the following baseline form:

$$\text{Cooperation}_i = a + b_1 \text{Barriers}_i + b_2 \text{CTRL}_i + \varepsilon_i$$

where Cooperation is a vector of cooperation activities/partners, Barriers is a vector of specific types of obstacles to innovation perceived by the firm, CTRL is a vector of controls

and  $\varepsilon$  is the error term. The estimation technique is based on a set of simple probit regressions, which allows us to point out the relations between innovation barriers (cost - COST-, market -MKT- and knowledge -KNOW- ones) and cooperation (general -COOP-; cooperation with other firms -COOP\_FIRM-; and cooperation with research organisations - COOP\_ORG-).

The second part of the empirical analysis tests for the complementary/substitution effects between couples of barriers on the propensity to cooperate. In order to implement the tests we consider the 'cooperation function' of firm  $i$  ( $COOP_i$ ) as the firm's objective function; we focus on two types of barriers at a time that can affect the firm's cooperation function,  $b'$  and  $b''$ :

$$COOP_i = COOP_i(b', b'', \theta_i), \forall i$$

Each firm  $i$  faces a combination of the two barriers,  $(b', b'' \in B)$  and a set of controls  $\theta_i$ , including the remaining barrier. Complementarity between the two different barriers may be analysed by testing whether  $COOP_i(b', b'', \theta_i)$  is supermodular in  $b'$  and  $b''$ . Our aim is to derive a set of inequalities that are tested in the empirical analysis. Each firm is in one of the 4 following states of the world: it faces both  $b'$  and  $b''$ , neither of the two, or one but not the other, giving birth to four consequent elements in the set  $B$  (forming a lattice):  $B = \{\{00\}, \{01\}, \{10\}, \{11\}\}$ . It is possible to demonstrate that  $b'$  and  $b''$  are complements and hence  $COOP_i$  is supermodular if and only if:

$$COOP_i(11, \theta_i) + COOP_i(00, \theta_i) \geq COOP_i(10, \theta_i) + COOP_i(01, \theta_i)$$

or

$$COOP_i(11, \theta_i) - COOP_i(00, \theta_i) \geq [COOP_i(10, \theta_i) - COOP_i(00, \theta_i)] + [COOP_i(01, \theta_i) - COOP_i(00, \theta_i)]$$

In order to test for complementarities or for substitution effects we operationalise the methodological framework in two steps. In the first step we set up the 'Cooperation function', that can be modelled as follows using two types of barriers BARR1 and BARR2, while we control for BARR3:

$$\begin{aligned} [COOP]_i = & b0i[Controls] + aBARR3 + \\ & + b1i[BARR1\_D(1)/BARR2\_D(1)] + \\ & + b2i[BARR1\_D(1)/BARR2\_D(0)] + \\ & + b3i[BARR1\_D(0)/BARR2\_D(1)] + \\ & + b4i[BARR1\_D(0)/BARR2\_D(0)] + u_i \end{aligned}$$

Since the cooperation variable  $COOP$  is a dummy variable (as the two sub-types of cooperation  $COOP\_ORG$  and  $COOP\_FIRM$ ), a set of probit regressions is run, excluding the constant term, given that all the four states of the world must be included in the specification and provided with a specific coefficient each:  $b1$ ,  $b2$ ,  $b3$  and  $b4$ . Once the coefficients are retrieved by the probit, the next step of the analysis is to test the hypotheses implementing a set of Wald tests, which allows us to test the following linear restriction on the state-of-the-world-dummies coefficients:  $b1 + b4 = b2 + b3$ . Where  $b1$  is associated to the (1,1) state of the world;  $b2$  is associated to the (1,0) state of the world;  $b3$

is associated to the (0,1) state of the world and  $b_4$  is associated to the (0,0) state of the world. Coupling the information provided by the Wald tests with the sign of the inequalities -also confirmed by one-sided tests on the linear combination of the parameters- we know the direction towards which a rejection of the null leads us in terms of supermodularity (complementarity) or submodularity (substitutability). On the one hand, if  $b_1+b_4-b_2-b_3 \geq 0$  and the Wald test leads us to reject the null, then we can argue that we are in presence of supermodularity and hence of complementary barriers; on the other hand, submodularity holds if  $b_1+b_4-b_2-b_3 \leq 0$  and the Wald test null is rejected as well.

Results show linkages among barriers and cooperation strategies. Cost barriers are positively related to all types of cooperation. Firms thus resort to cooperation as a result of a cost-sharing strategy. We also notice that cooperation with research organisations is triggered by knowledge obstacles: as expected firms collaborate with research institutes and universities to mitigate shortages of skills and competencies. Concerning the analysis of the supermodularity/submodularity among the barriers, we notice the absence of complementarity and the presence of substitutability effects. In other terms, jointly experiencing high levels of different barriers to innovation does not lead to more cooperation. On the contrary, the joint presence of barriers which involve high knowledge obstacles reduces the propensity to cooperate. A spectrum of innovation obstacles that includes knowledge shortages, and thus possibly involves the lack of sufficient absorptive capacity, leads the firm to refocus on internal innovation activities, abandoning cooperation.

## References

- Baldwin, J., Lin, Z., 2002. Impediments to Advanced Technology Adoption for Canadian Manufacturers. *Research Policy* 31, 1–18.
- Blanchard, P., Huiban, J.-P., Musolesi, A., Sevestre, P., 2013. Where There Is a Will, There Is a Way? Assessing the Impact of Obstacles to Innovation. *Industrial and Corporate Change*, 22 (3): 679-710.
- D’Este, P., Iammarino, S., Savona, M., Von Tunzelmann, N., 2012. What Hampers Innovation? Revealed Barriers Versus Deterring Barriers. *Research Policy* 41, 482–488.
- D’Este, P., Rentocchini, F., Vega Jurado, J., 2014. Lowering Barriers to Engage in Innovation: Evidence from the Spanish Innovation Survey. *Industry and Innovation* 21 (1): 1-19
- Galia, F., Legros, D., 2004. Complementarities between Obstacles to Innovation: Evidence from France. *Research Policy* 33, 1185–1199.
- Galia, F., Mancini, Morandi (2012), Obstacles to innovation and firms innovation profiles: are challenges different for policy makers?. *Proceedings of the 12th European Academy of Management (EURAM) conference University of Rotterdam, Erasmus University.*
- Iammarino, S., Sanna-Randaccio, R., Savona, M., 2009. The Perception of Obstacles to Innovation. Foreign Multinationals and Domestic Firms in Italy. *Revue d’économie industrielle* n° 125, 75–104.
- Lhuillery, S. and Pfister, E. (2009): R&D cooperation and failures in innovation projects: Empirical evidence from French CIS data. *Research Policy* 38, 45-57
- Mancusi, M.L., Vezzulli, A., 2010. R&D, Innovation, and Liquidity Constraints. KITEs Working Papers 30/2010, Bocconi University.
- Pellegrino, G. and Savona, M. (2013). Is Money All? Financing versus Knowledge and Demand Constraints to Innovation. *Institute of Economics of Barcelona WP Series* (forthcoming).

Savignac, F., 2008. Impact of Financial Constraints on Innovation: What Can Be Learned from a Direct Measure? *Economics of Innovation and New Technology* 17, 553–569.

Tiwari, A., Mohnen, P., Palm, F., Schim van der Loeff, S., 2008. Financial Constraint and R&D Investment: Evidence from CIS, in: *Determinants of Innovative Behaviours: A Firm's Internal Practice and Its External Environments*. London, pp. 217–242.

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***Research governance for tackling 'societal challenges': time for radical redesign***

**Abstract:**

This paper uses the Nordic cooperation as a laboratory to explore the claim that the type of state governance and organisation structures we have used for research and innovation policy over the last 30-40 years may have served us well in the past but in the context of the 'societal challenges' we now have to address in policy, they are no longer fit for purpose.

We can think of the organisation and governance of research and innovation the post-War period as involving three 'regimes', each backed by a different 'social contract' between science and society.

- The 'Endless Frontier' regime, in which ministries or departments of state pursued their respective missions while 'basic' researchers were largely funded on trust
- The 'Innovation Policy' regime, beginning with the OECD's work in the 1960s to launch the idea of 'science policy' but which in practice tended to focus on linking research to industry and obtaining returns to society in the form of economic development and growth
- An emerging 'Societal Challenges' regime, in which the focus of research and innovation policy has to broaden beyond industry or individual ministry missions to deal in a more integrated way with more or less existential threats to society such as climate change

The shift from the Endless Frontier to the Innovation Policy regime meant in many countries (especially in Europe – less so in the USA) that the education and industry ministries took the lead in relation to research and innovation policy. They generally organised and governed research and innovation policy by focusing on what the Nordic countries call a 'two pillar' system, focused on these two ministries.

However, two-pillar systems have important weaknesses. They reinforce the long-standing battles between education and industry ministries, representing respectively (to simplify grossly) the view that researchers should drive research on the one hand and that industrial relevance should drive it on the other. This polarisation in some cases leads to a funding deficit in 'strategic' or 'applied' research, creating a gap in knowledge exchange among 'producers' and 'users' of knowledge. They marginalise mission research and create research and innovation policy coordination needs that are hard to satisfy. These coordination issues have been much discussed, for example in innovation system reviews, over the last decade. They become increasingly urgent with the shift to the Societal Challenges regime.

The paper illustrates these developments using the Nordic area and the Nordic cooperation in research and innovation, which has its own set of institutions in the form of councils of ministers at the inter-governmental level and three agencies that answer to these councils.

In effect, the Nordic cooperation mirrors the compartmentalised structures of the national governments' organisation and governance.

The Nordic area has long 'punched above its weight' in terms of its capabilities in research and innovation and in the levels of welfare it has been able to afford its citizens. Global growth, globalisation and changes in the nature of scientific and industrial innovation as well as national and European policies provide pressures for the Nordic area to act as a more unified way – especially in relation to the 'grand' or 'societal' challenges increasingly seen as central to the next generation of research and innovation policy. Like the rest of Europe, the Nordic area needs to build critical mass and quality in research, further improve innovation performance and combine the strength of different sectors of society to address the challenges. This implies reforms at the level of universities, research institutes and – not least – the governance and organisation of the state research and innovation funding system.

Three sets of general challenges relating to research and innovation face the Nordic countries today. One set of challenges concern how to deal with global trends in a very small corner of the world. A second set comprises the challenges Europe faces more broadly and which therefore apply to the Nordic system as well as to the overall European one. The third set is made up of the so-called 'global' or 'societal' challenges, which growing numbers of countries see as policy priorities. We argue that this third category of challenge is game-changing in relation to the organisation, funding and governance of national research and innovation systems. Thus, Nordic Member States' research and innovation policies tend still to be deficient in terms of system governance and policy coordination, lack of focus in thematic priorities and (in some of the Member States) organisational fragmentation. We provide examples from the Nordic countries that illustrate the breakdown of the two-pillar structure when faced with these new challenges.

At the level of the Nordic cooperation, the announcement of a Nordic Research and Innovation Area (NORIA) and the associated reforms of 2004 that led to the current Nordic agency structure were an initial response to the announcement of the European Research Area at EU level. They were based on a 'two pillar' model, essentially imitating the roles and spheres of action of the education and industry ministries at national level. At the time, this was probably best practice.

However, already in 2007, the Nordic prime ministers launched a Top-level Research Initiative (TFI) on energy, climate and the environment launched that cut right across these structures and the associated funding channels. This was the first time the Nordic area had attempted to address one of the major societal challenges at the Nordic level. It revealed that the two-pillar principle and the associated fragmentation of agencies is inadequate to tackle this challenge at the Nordic level.

This analysis has triggered a proposal<sup>1</sup> to create a broad Nordic research and innovation policy implementation agency able to tackle not only the missions of the three existing agencies but also to have the scale and adaptability to tackle societal challenges. This also implies a more integrated organisational and governance approach to research and innovation funding in a time when the societal challenges are being recognised.

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<sup>1</sup> Erik Arnold, *Strengthening the Nordic Cooperation: Societal challenges and the structure of Nordic R&D cooperation*, Oslo: Nordforsk (forthcoming, 2014)



This analysis has implications that go far beyond the Nordic area. The key conclusion is that two-pillar systems are not fit for purpose under the Societal Challenges regime. In very many countries, as well as at the European level, the organisation and governance of research and innovation needs radical redesign.

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***Home green home. Unveiling eco-innovation in energy efficient domestic appliances.***

**Abstract:** The present study uses an original dataset on four large energy-efficient (EE) appliances and provides a methodology for: i) identifying specific clusters of EE technologies; ii) mapping their evolution over time; iii) discovering niches of technological fungibility. Our model exploits the well-known concept of technological relatedness using co-occurrences analysis of patent classes as an input for Self-Organising Maps, an unsupervised artificial neural network able to represent high-dimensional data in visually-attractive and low-dimensional maps. The results confirm the pervasive nature of EE to be nested in many technological niches. Moreover, it is shown that a de-materialisation process affected the evolution of EE technologies over time, in a technological space characterised by high level of complexity and variety. Lastly, we show that digital components of EE technology can be characterised as a case where downstream technology complementarity is relevant.

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***Towards the evaluation of research and innovation policies at system level***

**Abstract:** Introduction

The "Compendium of Evidence on the Effectiveness of Innovation Policy Intervention", a recently completed large scale appraisal of the empirical evidence on the effects of a range of innovation policy instruments came to a rather disillusioning conclusion after reviewing nearly 800 evaluation reports and academic papers from the UK and major developed countries:

"It appears that we are far from a pool of knowledge on the effectiveness of innovation policy that is general enough to guide the decisions of policy makers. The context specificity of policy (actor arenas, capabilities, linkages, economic performance, etc.), the interplay with other instruments, the challenges of implementation and the sensitivity of results to the methods used render the generalisation of findings extremely problematic." (Edler, Cunningham, Gök, & Shapira, 2013, p. 36)

This repeats and brings to the point an insight that previous research has stressed already: it is impossible to cut-and-paste innovation policy measures from one implementation context (e.g. country) to another (Arnold, 2004; Edler, Ebersberger, & Lo, 2008; Falk, 2007; Smits, Kuhlman, & Teubal, 2010). This makes it extremely difficult to formulate general expectations on the overall impact of policy measures once they are implemented in a new context.

We suggest resolving this by reinserting innovation policies back into their context and evaluating the configuration of policy measures at the research and innovation (R&I) system level. This is not a new approach, but one that draws on previous suggestions and established conceptualisations. However, we are aware of only very few attempts of empirical systemic evaluations of innovation policies; e.g. the paper by Magro and Wilson (2013) is one recent example. In this paper we first present our approach that combines innovation system theory and innovation policy evaluation concepts. We then quickly summarise the methodology. The paper will illustrate the approach with three country cases (Switzerland, Ireland, and Sweden).

**Theory**

**Research and innovation systems**

The performance of R&I systems has been analysed mainly with three different focuses:

1. Components or elements of systems, which are either organisations or institutions, and the links between these components have been suggested as the main building blocks of systems (Arnold, 2004; Arnold, Kuhlman, & van der Meulen, 2001; OECD, 2002).
2. Activities or functions performed by the elements of a system in the realisation of innovations were suggested among others by Edquist (2005, 2011) who distinguished ten activities, or "determinants of the development and diffusion of innovations" (2011, p. 1728). The activities model from Edquist has proven its usefulness for the analysis of national R&I systems (Edquist & Hommen, 2008). Bergek et al. (2010) followed a similar logic and introduce seven system functions as key processes which explain the dynamics of technological innovation systems.
3. The idea of systemic failures, bottlenecks or problems points to gaps in system

configurations, circumstances, or arrangements which lead to incomplete innovation systems, less connections and interactions between the elements than possible, missing or not fully effective activities (Arnold, 2004; Woolthuis, Lankhuizen, & Gilsing, 2005). As all approaches have certain advantages and disadvantages using them in parallel would employ different angles and generate more robust results; however, for reasons of timing and resources this is usually hard to achieve in practice. Hence, a parsimonious combination of the different perspectives is most desirable. We suggest such a combination by using two dimensions (see figure 1):

- A production function dimension which stands for the provision of four different inputs – capital, labour, knowledge, and infrastructure – as the main functions of all components in innovation systems. However, it would be simplistic to reduce innovation systems to these main functions, and it would lead to a Sisyphean task to consider all activities or even only the failures or bottlenecks blocking activities.
- Hence, the second dimension is the organizational dimension that assesses how the activities in an innovation system are coordinated and governed and whether its organisations, networks, markets, and sectors are effective to convert innovation inputs into outputs and economic outcomes.

In addition, as science is essentially a public/academic undertaking and technology (or innovation) is primarily conducted in the private/corporate sector, some inputs and organisation forms tend to overlap only partially. We suggest therefore distinguishing science and technology sub-systems. For instance, universities, non-university research institutes, and research councils are organisations of science, whereas start-up companies, or existing companies with all their stakeholders are organisations of technology. Intermediaries such as technology transfer offices or university advisory bodies relate to both.

Figure 1. Analytical framework for research and innovation systems

### Systemic innovation policy evaluations

Evaluations of research and innovation policies have usually focused on four different sets of questions (see among others Edler et al., 2010; Fahrenkrog, Polt, Rojo, Tübke, & Zinöcker, 2002; Miles & Cunningham, 2006): 1) Consistency and coherence (e.g. is the intervention appropriate for the underlying problems, coherent and complementary to existing institutions, measures, or tasks?); 2) Are or were the intervention and the funded projects implemented efficiently? 3) Has the intervention achieved its goals? 4) What are the effects, and are they additional or not, intended or unintended, and who is affected?

However, these questions take little notice of the interconnectedness of policies in an R&I system and potential conflicts or synergies between policies. In addition, the governance of policies is largely ignored (except for the implementation efficiency which, however, covers only part of the relevant governance issues). The OECD stressed already more than ten years ago:

“System management requires comprehensive and coherent policies that are characterised by a good match between individual instruments and objectives as well as compatible instruments and objectives in different policy areas.” (OECD, 2002, pp. 70-71)

Over the years, different suggestions for systemic innovation policy evaluations have been advanced. Arnold (2004) suggested to combine programme and portfolio evaluation, analyses of system health and meso-level bottleneck analyses. Edler et al. (2008) suggest

evaluation syntheses for a number of programmes in a regional, technological or sectoral innovation sub-system, arguing that a full-range synthesis at the highest level would be extremely challenging. However, at the same time they point out that the influence of related systems or higher/lower level systems cannot be ignored. The approach of Magro and Wilson (2013) is the most practical so far: they suggest a "six-step evaluation mix protocol". In step 1 the system is delimited and in step 2 a policy rationale or goal is chosen. Step 3 identifies the domains and instruments contributing to this goal and step 4 the current evaluation practices (through meta-analysis). The end product of step 5 would be a coherent evaluation framework that is applied to all instruments of a policy rationale. If steps 2-5 are repeated for different policy rationales, then step 6 can serve to integrate and summarise the results for the different rationales in the selected innovation system. Though this approach is very systematic, it tends to ignore a number of important issues, such as how policies are formulated, how they evolve, or how system learning is facilitated. In a 2010 paper Smits, Kuhlmann and Teubal put forth the opinion that innovation system policies are insufficiently conceptualized and rarely reflect the current state of knowledge gained by innovation studies. They go on and list nine insights from which three policy requirements can be deduced (Smits, et al., 2010):

1. Policy strategies should favour evolutionary variation, creation of new options, experimentation and (collective) learning.
2. Related to the previous point, as innovation is a collective achievement that needs many actors and contributors, new arenas and mechanisms of interaction and collective action, new forums for exchange and debate are needed.
3. Next, to keep up with its subject innovation policy needs to be interactive, participative, user-driven, and dynamic. It needs to facilitate rather than steer change. Reflexive governance of innovation asks for instruments, mechanisms and platforms that stimulate evolutionary and learning policies (and policy-makers) which are capable to adjust to changing realities or even anticipate the key changes

Synthesising and condensing these suggestions, we focus on four issues to conduct a systemic evaluation of an innovation system (see Figure 2): Issues 1) Consistency and coherence and 2) Goal attainment and effects are located at the level of individual interventions (measures, programmes, institutions etc.) aiming to provide inputs or to coordinate the R&I system. Issues 3) Policy learning and dialogue and 4) Subsidiarity of policies refer to coordination of the system respectively the science and technology sub-systems overall.

Figure 2. Framework for a systemic evaluation of research and innovation systems

## Methodology

The paper implements this evaluation of research and innovation policies at systems level with three cases: Switzerland, Ireland and Sweden.

For each country we collected extensive evidence primarily from academic papers, evaluation reports, sections in cross-national reports. We synthesised the findings with regard to the mobilisation of inputs and the organisation of research and innovation in the respective systems.

## References

Arnold, E. (2004). Evaluating research and innovation policy: a systems world needs systems

- evaluations. *Research Evaluation*, 13(1), 3-17.
- Arnold, E., Kuhlman, S., & van der Meulen, B. (2001). A Singular Council. Evaluation of the Research Council of Norway: Technopolis.
- Bergek, A., Jacobsson, S., Hekkert, M. P., & Smith, K. (2010). Functionality of innovation systems as a rationale for and guide to innovation policy. In R. E. Smits, S. Kuhlmann & P. Shapira (Eds.), *The theory and practice of innovation policy. An international research handbook* (pp. 115-144). Cheltenham, UK: Edward Elgar.
- Edler, J., Cunningham, P., Gök, A., Rigby, J., Amanatidou, E., Garefi, I., . . . Guy, K. (2010). INNO-Appraisal: Understanding Evaluation of Innovation Policy in Europe. Final Report.
- Edler, J., Cunningham, P., Gök, A., & Shapira, P. (2013). *Impacts of Innovation Policy: Synthesis and Conclusion* Nesta Working Paper No. 13/21.
- Edler, J., Ebersberger, B., & Lo, V. (2008). Improving policy understanding by means of secondary analyses of policy evaluation. *Research Evaluation*, 17(3), 175-186.
- Edquist, C. (2005). Systems of Innovation. Perspectives and Challenges. In J. Fagerberg, D. C. Mowery & R. R. Nelson (Eds.), *The Oxford Handbook of Innovation* (pp. 181-208). Oxford: Oxford University Press.
- Edquist, C. (2011). Design of innovation policy through diagnostic analysis: identification of systemic problems (or failures). *Industrial and Corporate Change*, 20(6), 1725-1753.
- Edquist, C., & Hommen, L. (Eds.). (2008). *Small country innovation systems: globalization, change and policy in Asia and Europe*. Cheltenham: Edward Elgar.
- Fahrenkrog, G., Polt, W., Rojo, J., Tübke, A., & Zinöcker, K. (Eds.). (2002). *RTD Evaluation toolbox, assessing the socioeconomic impact of RTD policies*. Seville: European Commission, DG Joint Research Centre, Institute for Prospective Technological Studies.
- Falk, R. (2007). Measuring the effects of public support schemes on firms' innovation activities: Survey evidence from Austria. *Research Policy*, 36(5), 665-679.
- Magro, E., & Wilson, J. R. (2013). Complex innovation policy systems: Towards an evaluation mix. *Research Policy*, 42(9), 1647-1656.
- Miles, I., & Cunningham, P. (2006). *SMART INNOVATION: A Practical Guide to Evaluating Innovation Programmes*. Brussels & Luxembourg: ECSC, EC, EAEC.
- OECD. (2002). *Dynamising national innovation systems* (1 ed.). Paris: OECD.
- Smits, R. E., Kuhlman, S., & Teubal, M. (2010). A sytem-evolutionary approach for innovation policy. In R. E. Smits, S. Kuhlmann & P. Shapira (Eds.), *The theory and practice of innovation policy. An international research handbook* (pp. 417-448). Cheltenham, UK: Edward Elgar.
- Woolthuis, R. K., Lankhuizen, M., & Gilsing, V. (2005). A system failure framework for innovation policy design. *Technovation*, 25, 609-619.

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***Impact of research funding and scientific production on scientific impact: Are Quebec academic women really lagging behind?***

**Abstract:**

A recent Nature paper confirms that women are lagging behind in terms of worldwide scientific production and in terms of citations, taking into account the authors' ranking (first or last). It therefore seems that the glass ceiling is still very much present despite more than a decade of specific policies aimed at supporting women in science. Women scientists publish fewer papers than men because women are less likely than men to have the personal characteristics, structural positions, and facilitating resources that are conducive to publication. Although the literature on scientific production is extensive, few papers have been published on the subject of what resources, structural positions, teams of collaborators are necessary to improve the impact and quality of articles published by women. Inequalities are noted regarding access to research funding and equipment, but that is generally where the arguments stop. For instance, in Quebec women have raised less research funds than men and that their funding is less diversified. The smaller global scientific production of women is likely to be linked to the fact that women receive less funding than men, but the data needs to be examined from an evolutionary perspective to can establish the causal relationships between research inputs and the quality of scientific output.

This paper aims to provide a different portrait of the performance of women, to examine whether it is still worse than that of their male colleagues, taking the province of Quebec, identified as one of the Canadian provinces closest to achieving gender parity, as an example. With 14.5% women working in the natural sciences and engineering fields, and 26.5% women in the health fields in our sample, one could argue that this still remains far from gender parity. While we acknowledge the rarity of women in science in Quebec and their slightly inferior performance, our goal is to try to elucidate where the discrepancies are, to explain the differences (using the data available) and to propose avenues to reverse the tendency.

A large part of the literature on the subject of women in science tends to be bibliometric based. For this research, we build on this literature and use the classic bibliometric indicators as dependent and explanatory variables in econometric models that allow the analysis of many factors at a time. Using panel data to account for the evolution of the various attributes, we are able to establish the causality of these factors on scientific impact, something that bibliometrics alone cannot address.

The article examines whether scientific productivity, impact factor of journals, size of collaborative teams and research funding has an influence on the propensity to receive more citations on average and whether these factors differ across genders. Using a very complete database of bibliometric indicators, we estimate instrumental variable ordinary least square regressions on the normalised citation rates of individual academics in Quebec. Two data sources are required for this study: data on scientific output and on funding. The

first source of information is the Thompson Reuters Web of Science database that lists scientific publications of a widely recognized set of journals. For the second source of information, we are fortunate in Quebec to have access to a very comprehensive database of university funding, the University Research Information System (“Système d’information de la recherche universitaire” or SIRU). This database provides information on all university accounts held by academics in the province on a yearly basis. As each project is attributed a different university account, we are able to distinguish grants from contracts, public funding from private funding, operation costs from infrastructure costs, provincial and Canadian sources from foreign sources, and so on.

Comparing the overall characteristics of men and women, we find that men are more cited, produce more papers, occupy more often the last-author rank and the middle-author rank, and raise more funds from public, private and philanthropic sources. Women, are more often first author on their papers. These results are very much in line with most of the literature on women in academia and women in science. While in the health fields, the average normalised citations are increasing over time, in the NSE fields, they are decreasing, equally for men and women.

Our results show that although most of the indicators examined have a positive influence on citations, when it comes to gender differences, only collaboration appears slightly detrimental for women. No impact is found for productivity or funding. For instance, publishing more articles as a first author implies a greater propensity to be more cited than average in the field. Given the same scientific production and visibility as first, last or middle author, women appear to receive similar numbers of citations. One exception, women in the health fields seem to benefit more than their male colleagues from a higher proportion of first author articles. The average impact factor of journals has a direct impact on the citation rate of individuals who publish in those journals. Contrarily to all expectations, however, it is not in the NSE fields that women are less cited given an equal impact factor of the journal but in the health fields.

The general wisdom dictates that a wider visibility provided by a larger author base has a positive impact on the propensity to attract citations. While the picture is similar for both men and women in the health fields, in the NSE fields, women do not appear to suffer from decreasing returns, but the impact of a larger team is roughly a tenth of that of their male colleagues. Turning now to the impact of gender and funding, we found no effect that would indicate that women are less cited given the same amount of funding as men.

The observed result that given the same amount funding, or similar publication record, women are equally cited as men tend to argue against Lawrence Summers’ remarks at the now infamous NBER conference of 2005 to the effect that few women in academia had reached the highest echelons of the profession because of a lack of aptitude for science and not because of discrimination. All things being equal, women generally perform as well as men... with maybe the exception of the collaboration aspect of their work.



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***Scientific collaborations in Europe: what types of proximities matter?***

**Abstract:** Collaborations between European researchers remain mainly limited by geographical and institutional forms of distances. A review of the literature shows that the studies conducted at the regional level in Europe are failing in taking into account forms of institutional or cultural measures. Apart from the language that is highly correlated with the traditional forms of proximities, the territory and the science activities might be more interrelated and this interrelations better captured. This paper provides an exploration of the literature on proximities and research collaborations, and introduces new proxies of distances, mainly related to cultural aspects into a gravity model. Those results advocate for a better understanding of the different determinants of scientific collaborations amongst European regions. The science policies at the regional, national and European level should not only focus on their budget for scientific collaborations, but should also integrate a better considerations for the reality of their territories, the type of science produced and their cultural environment.

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***Coordinating Sciences, Technologies, Organisations and Policies: translational research in Austria and Germany***

**Abstract:** Genomics quickly has become an area of science in which large investments have been made on a global scale. Until now the sheer amount of new knowledge coming from this research area has not been met by the number of innovative medical practices and medicine products entering the market. There have been efforts in a number of OECD countries to remedy this problem, one major initiative being translational research, i.e. attempts to enhance the cooperation between basic researchers in laboratories and medical doctors in clinics.

Translational research (TR) encompasses not only new ways of interactions between researchers and medical practitioners, but also between the erstwhile as well as funding and regulatory institutions. This calls for new forms of institutions and policy instruments, which are currently being developed. A critical issue for translational research is the question of coordination, both on the levels of science and innovation as well as on the level of governance. Norms, rules, incentive structures all are different between researchers from different disciplines, but also institutions governing research.

In general different actors in TR pursue different and partially conflicting goals, e.g. performing research (scientists), making the national innovation system more competitive (science ministry, research funding organisations), improving health care provision to patients (clinicians, patients), making profits through novel interventions (pharmaceutical industry), delivering health as an outcome of cost-efficient public health systems (public health). These varying goal structures make the need for coordination and appropriate forms of governance obvious. A framework of governance modes, instruments and different levels for the analysis is defined in the paper: system level (e.g. policy coordination; funding and regulation); organisation level (e.g. translational research centres and networks); and group level (e.g. research and clinical practices, project topics).

The paper analyses translational research related governance processes, institutions and policy instruments in Austria and Germany. Special emphasis will be put on a systematic comparison of institutions and policy instruments and the discussion of coordination problems on the different levels of governance, both political (e.g. EU, national, regional, local) and functional (e.g. ministries, agencies, universities). The leading research questions then are: what are similarities and differences in the governance of TR in Austria and Germany and how are the respective TR initiatives coordinated?

Preliminary research results show that although different types of governance innovations can be found in the two countries, the issues translational research programmes should target are almost identical. Moreover it is interesting to notice that whilst governance coordination turns out to be difficult in both countries, different solutions to deal with these coordination problems have been sought.

Regarding Austria the narrow understanding of TR as being merely an issue of technology

transfer and early venture capital, which are displayed in interviews and papers, leaves out many important factors which also typically contribute to establishing TR capacities, such as encouraging increased mobilization of clinical observation and experience in laboratory contexts, or encouraging research that contributes to establishing the clinical utility of a genetic test. This also fails to capture issues such the important role that brokers such as clinician-scientists can play in the TR enterprise. Finally, although we have come across one Austrian project that offers an interesting exception to this, the integration of societal, commercial and regulatory considerations into research strategies also seems to be lacking. In Austria most policy initiatives either are bottom-up oriented, e.g. measures of the Basic Science Research Fund (FWF), and only a few instruments are directly targeting translational research, mainly those from the regional Viennese science funding organisations ZIT and WWTF.

In Germany a sizeable number of initiatives has been active, many predating the instruments in Austria, Finland. On the federal level the High-Tech Initiatives, the Roadmap Health Research, the Pharma Task Force and others entail TR elements. On the regional (Länder) and local/municipal level a large number of TR related initiatives exists, such as the Translational Research Alliance in Lower-Saxony, the Erlangen Center for Translational Research or the Regenerative Medicine Initiative centers in Leipzig and Berlin-Brandenburg. Moreover a number of intermediary agencies has developed instruments fostering translational activities, from the Basic Science Research Fund (DFG) to various foundations such as the German Cancer Society, innovation centres (e.g. German Centres for Health Research), clusters, offices and other organisational structures have been set up.

A commonality of Austria and Germany is that patient preferences and research areas such as health system research or health technology assessment are not well integrated within TR initiatives leading to questions of the accountability of public funding and also potentially to deficits in terms of both commercial and clinical utility.

Coordination efforts are missing on several levels. In Austria no coordination efforts regarding TR exist between science, economics and health ministries. Coordination happens to a limited degree between intermediary agencies at the state (Länder) level, mainly through the initiative Life Sciences Austria (Lisa), an economics ministry financed effort to pool the initiatives of five federal states and the federal agency Austrian Economic Service (AWS). Federal and state levels are linked in the initiative of the federal AWS and the Centre for Innovation and Technology (ZIT) of the Viennese government through the program Life Sciences Vienna Region (Lisa VR). Vienna is of great importance for the biotechnology sector, since the region encompasses the lion's share of the Austrian biotech capacities.

In Germany a number of governance programs carry an element of coordination with them. Most prominently that is the case with the High-Tech Initiative, an effort to coordinate the activities of the two most important RTDI ministries, science and economics respectively. This coordination effort also includes biotechnology and TR, but reach their limits at lower levels of government: in RTDI policy the coordination between federal and state levels in Germany is barely existing. At the level of the states (Länder) coordination of research and higher education policies should take place as part of the conference of education ministers (KMK), an institution that until now has not lived up to this goal.

On the level of research organisations three organisations have been selected representing variants of an organisational form in which central (academic) research cores with specialised (and expensive) equipment of a large, internationally competitive scale that is also attractive to industry are linked to various academic departments and institutions. The

centres provide the whole spectrum of experimental infrastructures and disciplinary expertise required to bring RTD projects from pre-clinical testing to early-phase clinical trials and then engage in collaboration with a large pharmaceutical firm for regulatory approval and commercialisation, create spin-off companies financed by venture capital, and to employ contract research organisations to comply with regulatory requirements (e.g. good manufacturing practices).

They have been purposefully selected in order to cover a broad range of existing TR institutions: the first research organisation is concentrated in a single building next to a university clinic and is focusing on basic research; the second institution is geographically spread over a large area, as it is a cooperative effort of eight disparate large research institutions, engulfing its own facilities and part-time management; the third organisation is concentrated around a town, yet consists of a larger number of partners which notably includes various research organisations and also firms.

From the governance perspective, these consortia show two interesting features: coordination responsibilities for RTD projects mainly are part of the scientific realm, consequently following also a more academic logic, while experimental and commercial risks for pharmaceutical development are moved towards the public sector.

The methodology of this paper includes two dozen expert interviews of between 45 and 90 minutes each, which are transcribed and analysed utilising the software package „Atlas ti“. The data stemming from this analysis is supplemented with insights won through a larger number of background talks as well as document analysis of policy papers, statements, public discussions and interviews. Moreover the results of a quantitative bibliometrical analysis and a qualitative discourse analysis of international journal articles (sources: S(S)CI, SCOPUS) on translational research and a comparative policy analysis of translational research measures are utilised for this paper.

The empirical research for this paper was carried out as part of the international ELSA-GEN project “Translational Research in Genomic Medicine: institutional and social aspects”, which was active from 2010-2013. The research project consists of three research teams, located in Austria, Finland and Germany. Peter Biegelbauer is the leader of the Austrian project team.

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The proposed paper would fit very well into the Special Session „Governance of Health Innovation Stream Part I“ as it takes up the issues of coordination of emerging health technologies, disciplines and sectors as well as new governance models. It furthermore takes up two issues of the EU-SPRI forum conference’s call for papers, namely conference themes number 6 (changing practices of science) and 7 (challenge of coordination).

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***Civil security - the need for new methodologies for evidence-based policy making***

**Abstract:**

Keywords: civil security, security measures, acceptance, multi-stakeholder approach, foresight

The paper addresses one of the identified sub-themes of societal grand challenges, namely the field of civil security. Based on research results of a national project funded by the BMBF it will discuss the specific peculiarities of the innovation system related to civil security and show why the design and implementation of STI policy instruments in the field of civil security requires a new methodological approach of evidence-based policy-making to secure effective, sustainable, and acceptable policy support for the development of new technological solutions in the future.

In the context of increasing mission-orientation of government innovation technology policy at European and national level, the identification and refinement of the technology areas to be addressed is increasingly carried along so-called areas of need in the context of a demand-side STI policy. Alongside climate and energy, health and nutrition, mobility as well as communication, security is identified as a priority area. Therefore, civil security today is an essential aspect of security policy, since hazards, threats and risks of heterogeneous origin are transferred into the same risk context. At both levels, a challenge-oriented innovation policy with regard to civil security is illustrated and will be significant on the level of innovation research.

Security is a model case for demand-side innovation policy that is currently being debated in European and national innovation policy. Civil security research is challenged with regard to the aspects of the multitude of involved and affected stakeholders as well as the societal penetration depth of technological and non-technological security measures. Thus, civil security is of growing importance both at the European policy level as well as on the national level today. At the EU level, there is a broad and integrated concept of security in the new Internal Security Strategy, which was presented by the Commission on 22 November 2010. Furthermore the security research theme as one of the subthemes of the “societal grand challenges” plays also an important role within the European Framework Program for Research and Innovation HORIZON 2020. On the Member State level, the topic of civil security is embedded in different policy programs. In Germany, the security research program is for instance part of the Federal Government’s “High-Tech Strategy 2020 for Germany” (BMBF 2010).

However, as previous studies point out, still little is known about the peculiarities and specificities of the innovation processes’ and innovation systems’ characteristics in the field of civil security. In contrast to well-established innovation system settings in rather

traditional fields of technology, the innovation system in the field of civil security is characterized by the following specificities:

- Involvement of a broad range of different policy areas (e.g. foreign and domestic policy, innovation and research policy, economic policy, transportation security)
- Cross-cutting innovation processes between different industrial sectors (e.g. automobile, electronic, mechanical engineering)
- Integration of multi-disciplinary research fields (e.g. economics, politics, biology, chemistry, history, cultural, social sciences)
- High heterogeneity in demand, preferences, values and norms of the different stakeholders involved
- Security as a social construct underlying social change (Bierwisch et al. 2012).

Due to these special characteristics of the civil security innovation system STI policy at European and Member State level is faced with enormous challenges and requirements regarding the heuristics of policy-making.

In particular, the heterogeneity of involved and affected stakeholders leads to a situation where existing methodological approaches have to be reviewed and adapted in the future. Because of different interests and expectations of the stakeholders which based on different mechanisms (e.g. legal, technological, political or emotional) a consensus building between them is a major challenge. Previous studies in the field of security analysis rather isolated clearly defined topics focusing on individual elements or sub-elements with the goal of finding out more about their logic of action, nature and development path. The interactions between different actors in the innovation system and resulting changes due to dynamic aspects, were not adequately considered.

This paper explicitly addresses this research gap by providing novel insight on the challenges of STI policy-making in the field of civil security. Starting from a conceptual framework building on innovation system approaches, mission-oriented policy and a participatory concept of technology development, the paper shows how a new multimethod approach of quantitative and qualitative analyses, integrating the whole range of key stakeholders in a participative process, might contribute to the design of effective, sustainable and acceptable policy instruments in the future. The multi-method approach presented in the paper was developed and pilot tested along a German research project funded by the BMBF (SIRA – Sicherheit im öffentlichen Raum from 2010-2013). The project dealt with the development and assessment of new technological solutions and new layouts of passenger control at the airport in the future. It integrates a comprehensive literature review, expert interviews, foresight based stakeholder workshops with experts and citizens using novel methodologies like serious gaming to develop a multi-criteria decision tool. Thereby the approach focuses not only on the technical feasibility of new technologies it integrates different stakeholder perspective by considering different stakeholder interests in the early phase of technology development and research. Political, legal, ethical and social concerns are taken into account. This allows a holistic integration of qualitative criteria, inter-dependencies and different perspectives.

The paper highlights how a participatory foresight approach could address the identified main challenges within the civil security research activities. The paper outlines the methodology of developing an assessment approach that considers different stakeholder interests and describes the procedure as well as the results of the project. By showing that

the selected methodological approach was suitable to identify the individual interests and concerns and to enable an exchange of these different interests the paper contributes to the scientific debate addressing the development of novel methodologies for designing policy instruments and funding schemes against the backdrop of the increasing complexity and heterogeneity of challenged driven policy making.

#### Bibliography

Bierwisch, A./ Seitz, R./ Grandt, S. (2012): The innovation system of security: A new quality in the relationship between political, economic and social actors. In: Fraunhofer ISI (ed.): Innovation System Revisited. Experiences from 40 years of Fraunhofer ISI Research. Stuttgart 2012, S. 129-152.

BMBF (Ed.) (2010): Ideen. Innovation. Wachstum. Hightech-Strategie 2020 für Deutschland. Bonn, Berlin: Bundesministerium für Bildung und Forschung.

European Commission (2010): The EU internal security strategy in action: Five steps towards more secure Europe. Brussels: European Commission. 2010, COM(2010) 673 final.



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***The 'added value' of researchers: impacts of doctorate holders to economic development***

**Abstract:** Introduction

This manuscript aims to discuss the professional trajectories of doctorate holders in an emergent economy. It brings analysis of original data from more than 4.000 PhDs in Brazil and examines it having as background the research and innovation scenario in the country. Fostering research training, mainly in PhD degree, is an important feature of science, technology and innovation (ST&I) policies around the world since the 1950s. From the policy perspective, qualified researchers are seen as means to bring benefits to innovation capacity as well as to economic and social wellbeing; from the individual perspective, achieving PhD is seen traditionally as a path to academic career or to a research career in private or public sector, as well as a way to satisfy one's personal interest and curiosity. While doctoral education is still a distinguished component of ST&I policies, a new configuration of job market imposes some challenges to guarantee positive impacts from these investments. The point is that in different countries, the situation is that supply exceeds demand for doctoral graduates.

Since the 1990s the world has watched an increase in the number of doctorate enrollments and graduates and at the same time a relative slowing down of recruitment of researchers, particularly in academic jobs (Mangematin, 2000; Zusman, 2005; Taylor, 2011; Cyranoski et al., 2011, Neumann and Tan, 2011).

This condition suggests a mismatch between human capital formation and research and innovation capacity, enhancing the debate about the role of public funding in professional researchers' education and their social and economic impacts (Enders, 2002; Auriol et al., 2012). In fact, the novelty in the already known general debate about the economic benefits of research – including the provision of trained research personal – and their implications for public policy (Pavitt, 1991; Salter and Martin, 2001) is precisely the recent focus on highly skilled graduates and this changing landscape of labor market.

The consequences of this changing landscape are twofold. From one side, it is necessary to rethink policies and PhD programs to adjust them to this new reality, which means both curricular and institutional changes, which can bring the combination of new knowledge promotion and focus in practical problems, with a closer alignment between the skills developed in doctoral programs and the need of industry and other non-academic sectors, in a more diverse and multi-faceted model (Taylor, 2011; Halse and Mowbray, 2011; Kobayashi, 2012). From the other side, what the situation imposes is the need of dealing with the development of PhD labor market through incentives to retain high-qualified researchers in different sectors and activities.

Tracking career destinations of doctorate holders is certainly a good way of understanding this situation in different regions and countries therefore subsidizing policy design, both



from the supply side – doctoral programs – and from the demand side – academy, industry, government and other sectors.

Some empirical work in this subject has been produced in the last decades and although some of them do discuss the impacts of PhD training policies in important dimensions few of them analyze these features having as background more comprehensive indicators on innovation and economic growth at the country or even at a regional level. In addition, there is an evident lack of studies discussing this changing landscape in less developed and non-OECD countries. The aim of this paper is to contribute to fill this gap with an investigation of the impacts of doctoral training on the subsequent careers of PhDs in the Brazilian case.

### Methodology

Data and analysis presented in this manuscript are part of a more comprehensive research oriented towards an evaluation of scholarship programs of São Paulo Research Foundation (FAPESP), a Brazilian research agency that supports research in São Paulo State. The evaluation comprised the undergraduate research program, as well as the master and doctoral programs.

The data collection strategy used in the evaluation study consisted mainly of an online questionnaire completed by individuals who applied for one of the three scholarships programs from FAPESP in the period 1995-2009. This includes the awarded group as well as the rejected one.

The questionnaire was pre-completed with information from each respondent's Lattes Curriculum to facilitate completion and boost the response rate and was left on a specific website for 45 days in February and March 2012.

The response rate based on successfully sent invitations was 22%, corresponding to 8,682 complete questionnaires. From this total, 4,134 questionnaires were answered by individuals that had completed their doctoral education.

In order to answer the main research questions of the manuscript, the collected data about doctorate holders were analyzed regarding their professional trajectory, including labor market aspects – employment sector and region and dedication to teaching and research activities – and market value of PhDs – wages and premiums.

### Findings and discussion

Retaking the initial questions of this manuscript, it is possible to conclude that doctorate holders in Brazil are not being adequately absorbed by labor market, which brings important constraints in terms of generating economic and social impacts.

In summary, comparing the results presented in the previous sections to similar studies of developed countries, one can find analogous results: unbalance between PhDs supply and demand, prevalence of doctorate holders employment in higher education although with a decreasing trend in the last years, emergence of doctorate holders employment in other sectors, PhD premium wages and differences among fields of study and those coming from the time period since PhD completion.

Nevertheless, the gaps in the Brazilian situation are much more evident: the supply-demand mismatch is much higher than it is in other countries; the share of PhD employment in non-academic sectors is still much lower, particularly in the manufacturing sector; premium

wages are reasonable, but overall earnings are below expected considering qualifications of doctorate holders and don't evolve too much throughout time.

What does this mean in terms of impact of PhD holders in the country? On the one hand, Brazil achieved great success in improving its doctoral programs and creating new PhD in an unprecedented rate. This had obviously increased the 'pool of knowledge' in the country, which can be verified by recent achievements from Brazilian scientific production.

Teaching and learning effects of doctoral education can also be estimated, although it is difficult to have objective measures to do so. The great amount of PhDs absorbed by higher education and research organizations actually involved with teaching is for itself an evidence of this kind of effect.

Private returns can also be addressed as recognizable impacts, since wage premiums associated with having doctoral degrees are huge in the country. However, wages are not compatible with PhD's qualification and are below in real terms when compared to developed and developing countries.

In terms of creating innovative environments and fostering innovation in the country, impacts are very limited, which means that doctoral education in Brazil is being used much more for academic profession than for other means. If to some extent this can be result of not much industry-oriented skills of PhDs, the main reason is the innovative profile of Brazilian firms: restricted R&D efforts and few innovations to the country level (not to say to world's level).

In the Brazilian case - as it is the case of many less developed countries - this sort of unbalance might also be seen as a result of a historical trajectory where policies towards training high level students were much more effective than policies featured to absorb the trained personnel by fostering innovation and/or adequate links between public policy formulation and evaluation and research.

Brazil is not a case of a country that oversized the academic side beyond it should have been developed, but rather a case of a country that have not developed a STI system in a more balanced way. The same country that today is producing almost 3% of the total scientific publications in the Web of Science is filing less than 0,1% of the patents in the USPTO. Even considering these are quite narrow indicators, they do reveal characteristics from the Brazilian system of science, technology and innovation that are wholly consistent with the results showed in this manuscript.

For sure it is not the case of cutting investments of PhDs programs to equalize the situation. At the same time, it is not the case of artificially creating new job positions to hire PhDs, without effectively using their competences in daily tasks. To reduce the strong unbalance verified in Brazil and in other less developed countries is a matter of rethinking the whole STI system and start building true demand for high-qualified profiles.

In this perspective, one important recommendation for the near future would be the promotion of convergence among policies in a way they can co-evolve in terms of their synergic and integrated effect. As pointed out by Flanagan et al. (2011) there is a clear trend in many countries towards the promotion of mix of policies.

It is necessary to act in the demand side, which means conceiving and implementing effective innovation policies but also changing the actual parameters of public sector careers, mainly in higher education and research organizations, including functional differentiation and hiring flexibility parameters.

In addition, considering the particularities of Brazilian case, two complementary policies

have to be added in the policy mix in order to promote the real co-evolution of human capital formation and institutional research capacity building: the research decentralization in the country, which is already target of public policies in Brazil and the quality of private higher education institutions, which was a priority in the past but is no longer.

Only an effective policy mix could support new possibilities for doctorate holders in the country, since Brazilian problem is not much the lack of skills constraining economic growth, but the lack of incentives and effective ways to use these skills.

Finally, despite the evidence presented here about the supply-demand mismatch of PhDs in Brazil, further investigation on this subject is still needed. Implementing systematic studies to map doctoral graduates' careers in Brazil and also expanding investigations about the incentives of different economic sectors to hire PhDs seems to be a first step in this direction.

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***Common sense, common safety: the value of non-academic research institutes for public safety in the Netherlands***

**Abstract:** In the Netherlands, public, non-academic research institutes take up 17% of the total R&D-budget (figure 1). We define the public, non-academic research institutes as organizations that receive direct funding from a ministry and are not part of an academic setting (universities, academic medical centers, research councils, Academy of Science) Based on our definition we have identified 47 non-academic research institutes. Their size varies from 10 to 3500 employees. The oldest is the Royal Dutch Meteorological Institute (KNMI), which was established in 1854.

The aim of our paper is to understand the position of non academic research institutes in relation to issues of public safety and the related contract relation with the government. We analyse four institutes with missions related to weather and climate, food, health and forensic investigation respectively. Our analysis combines theories on the dynamics of regulatory sciences with theories on contract relations between government and research institutes.

To better understand the dynamics in their environment, we have developed a conceptual framework that places these knowledge institutes in the four domains of state, science, market and public. The framework provides insight in the way these institutes value their relations with respective domains, and vice versa are valued by their stakeholders.

**Non-academic institutes in transition**

For a long time, the position of non-academic institutes was undisputed and self-evident. In many countries though this has changed. New forms of market-like government funding, competition from both private labs and universities, public appreciation of issues related to institutes missions (climate change, vaccination, food safety, water floods) have made the institutes vulnerable.

A clear signal for the Netherlands is the expected decrease in government funding within the government budget forecasts. (figure 1) The decrease in funding is one of the signs of a change in governance and changing organization of these institutes. We also find that increasingly the programming, funding and accountability of such institutes is framed in market-like relationships and connected to national innovation policies.

Figuur 1 Funding of non-academic research institutes (source: Facts and figures: Totale Onderzoeksfinanciering ('TOF') 2013).

**Analysis**

We have investigated the changing governance and the consequences thereof, for four non-academic research institutes with a task in the field of public safety. The cases we have

studied are the Royal Netherlands Meteorological Institute (KNMI – Ministry of Infrastructure and the Environment), the Netherlands Forensic Institute (NFI – Ministry of Security and Justice), the Netherlands Vaccine Institute (NVI - Ministry of Health, Welfare and Sport) and RIKILT (an institute for food safety – Ministry of Economic Affairs). For each of the institutes we systematically map their relation with the state actors, with market actors (both competitors and customers), science actors and the public.

Our paper shows that since the nineties of the past century, the orientation of non-academic research institutes shifted from an orientation on government departments to an orientation on the market. In the context of this change in orientation, we identify two main trends.

The first trend involves the gradual change in the relation of these institutes with their traditional partners: government agencies/the funding ministry/department. Research institutes are put in a different relationship to the government department through which they are funded. In these new relationships, the institutes are stimulated to see their governing department and their traditional governmental partners, such as water management departments, as a customer. Thus financing is more and more linked to specific programs and questions. Institutes are evaluated based upon their output – how they perform as a market player, selling their knowledge.

Since qualitative assessment becomes less important, the capacity to be able to do so becomes also less of a necessity at government departments. An increased emphasis on output steering leads to a decrease of knowledge about the content of the institutes' work at the governing department. That entails that it becomes more difficult to monitor how these institutes perform their basic tasks in guaranteeing public safety.

The second trend is that the institutes are developing new relationships with market parties. This leads to new, more user-inspired research programs. Within this context, there is less room for strategic, long-term research. As a result of this move towards the market, the scientific independence of these institutes is challenged by the public, while private actors accuse the institutes of unfair competition. These accusations now largely define the political discussion on these institutes in the Netherlands.

### Conclusion

We conclude that the task these institutes fulfill in guaranteeing public safety disappears from the radar of policy makers, and sometimes of the radar of the institutes themselves as well, since:

- Steering on output becomes more important than assessing the quality of the basic tasks in safety, performed by the institutes.
- Government departments no longer have the knowledge to be able to monitor the way these institutes perform their public tasks, based on qualitative assessments.
- Institutes become vulnerable for accusations regarding their independence and disturbance of the market.

### Relevance

Based on our analysis we will develop a new governance framework for the public safety

function of non-academic research institutes. This framework will take into account the specificities of the public safety function as day to day routine as well as an assurance in times of crises. Moreover it will balance the need for stability of public functions and the dynamics of research, technology and the market.

Our results contribute to two topics in the call for proposals of EUSPRI: first “old actors, new roles” and secondly “state versus non-state actors”. The two trends we have described lead to changes in both the *modus operandi* and the roles of these research institutes, as well as their relation to other public and private entities. The non-academic research institutes have to develop a more businesslike attitude in order to survive (future) budget cuts. They are old actors developing a new role.

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***The role of indicators, scientific evidences and ideas in technology policy: Theoretical concepts and empirical evidences***

**Abstract:** 1. Introduction

The aim of this paper is to explore theoretically and empirically the concepts of indicators, scientific evidences and ideas in relation to the decision making process of technology policy. The work will first focus on reviewing the definitions of indicators and evidences existent in literature, establishing their role in evidence-based policy (and if possible along different areas such as sustainability, transport, health and development). After, the work will address empirically the difference between indicators, scientific evidence and ideas.

2. Theoretical concepts

2.1 Indicators

There are several definitions of indicators in the literature. In this work, a non-disciplinary quantified definition will be used to accommodate a broad interpretation of the word indicator, non-contingent to the topic and the final user. Consequently, an indicator is defined as a numerical sign that shows what something is like or how a situation is changing. This specific sign of a phenomenon under study is commonly, though disputably, defined within the boundaries of classic scientific disciplines, and assumed to be a scientifically objective measure beyond debate and a proxy of scientific knowledge. This work deals with indicators also as tools available to help people decide about technology, such as costs, technical characteristics, market share, Research & Development (R&D) expenditures, carbon emissions, number of cars in a fleet, etc.

According to Merry (2011), “indicators are a technology of not only knowledge production but also governance”. Furthermore, Feller-Länzlinger et al. (2010) described indicators as a “socially and culturally oriented technology” useful for reflexive processes. More closely related to technology policy making, Fred Gault (2013) described innovation indicators as a technology selected by consensus, produced by institutional or individual users and governed by a set of rules in manuals that guide the collection and interpretation of data for international comparisons. They exert considerable influence in decision making, since they are used to rank countries, compare sectors or regions, fund schools, etc. In this train of thought, the use of indicators in policy can be seen as an approach or a method used to bring additional awareness, efficiency and transparency at the different levels of complex decisions, by providing realistic and controllable evidence for studying, discussing and deciding.

This paper will also address problems related to the use of indicators to formulate policies. In fact, selecting indicators can entail activities that are neither neutral, trivial nor conscious, creating an implicit and sometimes controversial space for “indicator politics” in the exercise. The criteria to select indicators may be based on their policy relevance, utility, analytical soundness and measurability, as well as on other (sub)conscious factors.

Therefore, there is the need for a clear formulation of the initial problem, which will enable a transparent selection of indicators that describe the problem. The selection of indicators should also include space to reflect about the inclusion and the non-inclusion of certain indicators. In addition, the analysis phase should include a reflection about the selection of indicators, before technology options are suggested. Furthermore, the selection of most indicators present significant methodological problems, which can arise from lack of data, cost of information collection, superposition of indicators, reliability issues or time-pressure, among others. In addition, a choice of indicators produces constitutive effects that arise from their use, which can structure organizational activities, prescribe values and interpretations of reality entailed in the indicators, create new meanings to words and vocabulary, project incentives, sanctions, norms and regulations, etc. To conclude, despite being commonly used in technology policies, it is not yet clear how influential they are. The definition and selection of indicators is an important and sometimes hazardous procedure.

## 2.2 Scientific evidences

The process of policy making may include other elements from scientific research than just indicators. According to Weiss (1979), knowledge can reach the policy arena with concepts and theoretical perspectives permeating the policy-making process with generalisations and orientations, through informed public and coming to shape the way people think about social issues. However, policy making still relies mostly on quantitative studies to formulate evidence-based policies. In fact, although qualitative research has a consolidated tradition in social research, its use remains only auxiliary to quantitative studies. Nevertheless, according to Veltri, Lim, and Miller (2014) qualitative findings play a role in some circles of evidence-based policy, mostly due to the limitations and even failure of quantitative indicators to describe social and economic realities, particularly in controversial issues. According to Veltri, Lim, and Miller (2014), qualitative findings can contribute to evidence-based policy in different ways. First, qualitative research offers a commitment to observe and explain phenomena from the perspective of those being studied, providing them with a “voice”. Second, this type of research provides reflexive awareness and consideration of the researcher’s role and perspective. Third, the authors argued that qualitative research is not methodologically orthodox and can use flexible research strategies. Fourth, qualitative research offers a contextualization of the data collection and of its analysis. Fifth, qualitative research is thoughtful of emerging categories and theories rather than relying upon a priori concepts and ideas.

Therefore, evidence-based policy can rely on a broad scope of scientific evidences composed not only by indicators and other type of quantitative findings, but also by qualitative research. All these forms of knowledge permeate the policy arena contributing to the policy-making process of evidence-based policies with generalizations and orientations in the form of scientific evidences.

## 2.3 Ideas

In a political process the concept of evidence frequently assumes even a broader scope. In this scope there is space not just for indicators and other types of scientific evidences, but also for ideas. Some may be based on scientific knowledge and others in lay knowledge. This lay knowledge can include assumptions, thesis, ideologies, information, bargaining positions, etc. For example, in consensus building or negotiation activities, an idea about technology (e.g. the electric car) can be crucial to achieve a consensus, to negotiate or to



form coalitions. Together, they form a coherent rhetorical discourse that eventually will lead to a decision.

### 3. Empirical findings

The paper will also provide empirical findings for the three concepts in analysis. First, empirical data will be presented related to the influence of indicators in technology policies. The data was collected through questionnaires and interviews during a PhD project aimed to understand technology decisions and the role of indicators during innovation processes. The collection and analysis is now completed. Second, a case study on the settlement of the International Iberian Nanotechnology Laboratory (INL) is expected to provide data on the use of scientific evidences. All interviews are done and they will be analyzed in the following months. Third and last, more findings will be presented related to ideas based on a case study on electric mobility in Portugal. The case study describes the decision making process of a technology programme designed to implement public charging stations across the country. This case study is now complete.

### References

- Feller-Länzlinger, Ruth, Ueli Haefeli, Stefan Rieder, Martin Biebricher, and Karl Weber. 2010. *All Sized up - Counting, Calculating and Controlling in the Knowledge-Based Society*. TA Swiss. Bern: TA-SWISS. <http://www.ta-swiss.ch/en/projects/social-and-cultural-ta/indicators/>.
- Gault, Fred. 2013. "Innovation Indicators and Measurement an Overview." In *Innovation Indicators and Measurement*, edited by Fred Gault. Cheltenham, UK: Edward Elgar.
- Merry, Sally Engle. 2011. "Measuring the World Indicators, Human Rights, and Global Governance." *Current Anthropology* 52 (S3) (April): S83–S95. doi:10.1086/657241. <http://www.jstor.org/stable/info/10.1086/657241>.
- Tagscherer, Ulrike, and Rainer Frietsch. 2014. "E-Mobility in China: Chance or Daydream?" Karlsruhe. <http://www.econstor.eu/handle/10419/92410>.
- Veltri, Giuseppe a., Jasper Lim, and Robert Miller. 2014. "More than Meets the Eye: The Contribution of Qualitative Research to Evidence-Based Policy-Making." *Innovation: The European Journal of Social Science Research* 27 (1) (January 2): 1–4. doi:10.1080/13511610.2013.806211. <http://www.tandfonline.com/doi/abs/10.1080/13511610.2013.806211>.
- Weiss, Carol H. 1979. "The Many Meanings of Research Utilisations." *Public Administration Review* (Setember/October): 426–431.

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***Off-label use of drugs as user innovation***

**Abstract:** 1. Introduction

A major challenge for modern institutions is to determine when a positive balance between the benefits and risks of new techno-scientific products, such as pharmaceutical products, has been established and when this product can be made available to customers. The decision-making process is often associated with a high degree of uncertainty, complexity and ambiguity. One way to deal with this challenge is to link traditional institutions and regulation with institutions that are congruent to the problem at hand (Héritier, 2002). This so-called smart governance also involves tailor-made, bottom-up, user-driven initiatives (Meijer, et al., 2013).

One area in which this challenge is magnified is the innovative application of pharmaceutical products outside of their licensed ('labelled') indication. Before obtaining market access new drugs are tested in clinical trials. The therapeutic areas and patient populations that are used in these trials determine the scope of the granted license. However, once approved, pharmaceuticals are used by prescribers for different disease areas or patient populations. These practices are referred to as 'off-label use', which is defined as "the practice of prescribing or using a drug outside the scope of the drug's official approved label as designated by a regulatory agency concerning the treatment of a particular disease or condition" (PubMed).

Off-label drug use is associated with positive elements, such as access to therapies that are assumed to be safe and efficacious for an indication with a medical need and/or patient group (such as children) for which no evidence from clinical trials is available (Tabarrok, 2009; Liang and Mackay, 2010). Stafford (2008) mentions some negative consequences as well: off-label drugs could be unsafe and lack efficacy, be not cost-effective (leading to unwarranted increased healthcare costs), undermine incentives for rigorous studies, and discourage evidence-based practice.

These positive and negative risks are unequally distributed across the stakeholders in the healthcare system. This leads some actors, e.g. regulatory agencies, to press for stricter regulation (Stafford, 2008; Dresser, 2009; Ventola, 2009), whereas other scholars call for more lenient (Meadows, 2008; Todd, 2011) or reformed regulation (Ray et al., 2006). These distributed consequences of off-label use and differences of opinion on regulation indicates that off-label drug use is a typical governance challenge.

In this smart governance context, this paper focuses on off-label drug use as a product of bottom-up initiatives. In other words, we regard off-label use as an user innovation strategy, underlining the creative input from medical professionals and patients. Users are seen as 'post-implementation adapters', i.e. adapters after market introduction. In doing so, we build on work by DeMonaco, Ali and Von Hippel (2006) who found that practicing clinicians had been responsible for 59% (85/144) of new "off-label" applications in the group of medicines approved by the FDA in 1998. Only recently did they delve into the pathways through which clinicians diffuse their ideas about off-label use. They addressed the gap between possibilities and incentives to diffuse, which takes for example the form of 91% of

the clinicians deeming writing a scientific publication on a found off-label use as too costly. These findings led them to conclude that the lack of incentives to diffuse these ideas implies a 'market failure' (DeMonaco and Von Hippel, 2013).

Although DeMonaco and colleagues paid attention to users as ultimate sources of new off-label use, there is still a need for conceptualising and unravelling the diffusion pathways in the post-implementation phase (Bogers et al., 2010). In particular, we are interested in the role of and dynamics within user communities. The research question is, then: how do dynamics in user communities contribute to the diffusion of off-label drug use? Related to this: what determines the development of new ideas in user communities, how are these new ideas put into practice and how are these practices spread?

## 2. Theoretical background

From the late 1970s, the user innovation literature have dealt with the way in which users are engaged in improving separate products or services, especially focusing on industrial products (Von Hippel, 1976; 1988). Later, researchers in this school included studies on consumer products, such as outdoor sports products (Lüthje, 2004). Moreover, the attention shifted from users as single actors to users who work together on novel products and services in the context of communities. The growing popularity of and interest in open source software communities partially explained the widening of this scope (Von Hippel and Krogh, 2003; Dahlander and Magnusson, 2005). Franke and Shah (2003) took a next step by studying innovation within voluntary communities, explicitly taking scarce resources for user innovation and diffusion into account. They found that increased user-to-user assistance leads to higher-quality products and eventually to more diffusion.

As Franke and Shah showed, assistance from other members in the community provides resources that are beneficial to diffusion. Assistance can be supplemented with resources that the user-innovator brings to the table, e.g. driven by reputation-seeking, instrumental reasons or intrinsic motivations. Off-label use is an interesting example in this regard, because prime movers do not only need to gather sufficient resources. Their first moves into uncharted territory also mean that they run a high degree of risks, i.e. if their idea about alternative uses for a drug fails because of safety or efficacy issues, this might backfire to them as well.

Independent variables that are included related to the resources of the community members are: position of user in the community, assistance provided by fellow-community members, and the rewards the users receive for producing and distributing new ideas. In addition to the focus on the role of resources in user communities, we want to include knowledge development or learning as an aspect that conceptualises dynamics in these user communities. Learning is an important but also non-trivial exercise in the diffusion of user innovations, since these innovations originate in specific local niches (Geels and Raven, 2006). Apart from resources, the diffusion of these findings to the community in general is difficult due to cognitive translation of the findings. In some cases, information about off-label drug use is 'sticky' (Von Hippel, 1994) or 'tacit' (Polanyi, 1958) and is not easy to carry over to other localities or contexts. Moreover, literature on communities of practice (Brown and Daguid, 1991; Wenger, 1998) and technology communities (Garud and Rappa, 1994) emphasise the importance of 'sense of belonging' and 'community norms and values'. Learning-related independent variables are: available communication paths, degree of tacitness of knowledge to apply a drug off-label, the sense of belonging and community norms. As the dependent variable we take the diffusion of off-label usage of a specific drug.

### 3. Approach

The influence of resources and learning on the diffusion of off-label drug usage is investigated in two ways. First, a list of off-label used drugs, compiled by the Dutch National Institute for Health and Environment (2007), serves as a starting point. We selected all drugs that had been approved by the EMA and/or FDA since 1995. These drugs were then investigated, following a bibliometric research. Table 1 presents the indicators used.

Table 1: indicators used in bibliometric research off-label drugs.

Variable	Dimension(s)	Indicator(s)
Diffusion of off-label use	Degree of uptake (ordinal score 1-5)	level of acceptance by medical community
	part of medical guidelines	
	diffusion over different countries	
	diffusion over indication areas vs. patient populations	
Speed of uptake	time between first publication and codification in medical guidelines	
Position of originator	in community time in community (before/after 'key' publication)	
number of publication	(before/after 'key' publication)	
affiliation		
follow-up publications		
Assistance	number of co-authors	
type of co-authors		
Rewards	journal status (impact factor) of 'key' publication	
Characteristics of product	Time on market; degree of innovativeness; indication area	

Second, to investigate the factors that influence diffusion more in-depth, we selected four drugs that have extensively been applied off-label (as measured by number of recipes produced; RIVM, 2006). This in-depth investigation is primarily geared to uncover the influence of communication channels, degree of tacitness, sense of belonging and community norms and values. These variables are difficult to extract from bibliometric data. We conducted in-depth interviews with community members and document analyses in these four domains. The aim of the interviews was to uncover behavioural and attitudinal aspects of user innovations. The document analysis was done with the purpose of obtaining an overview of the context and content of the projects.

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***Tailoring research programs to grand challenges: principals, agents and ideographs***

**Abstract:**

Statement of relevance to the special session:

Increasingly, large societal goals, or grand challenges, are used in science policy. The idea is that when science is steered in this way, it will be more societally relevant. Grand challenges are however ambivalent orientation devices: even though they are themselves uncontested as abstract goals, without specification they do not provide straightforward lines of action. In this paper, we study empirically how grand challenges are articulated and used in tailoring a research program. To do so, we mobilize the insights from political science (Principal-Agent theory) and linguistics (ideographs). This paper, thus, brings new concepts to the study of challenge-oriented research and innovation policy, as well as detailed empirical data.

Tailoring research programs to grand challenges: principals, agents and ideographs  
Colette Bos, Alexander Peine and Harro van Lente

Keywords: science policy, grand challenges, nanotechnology, principal-agent theory, ideographs

**1. Introduction**

Large societal challenges increasingly enter the negotiations about the focus of scientific research agendas and policies. Science is steered to be more societally relevant and to provide 'solutions' for these large societal problems. This emerging form of steering towards broad and generic goals involves the use of 'big words', such as sustainability, the ageing society or responsible innovation. Many different articulations of arguments, beliefs, expectations, stories, money flows and technologies build connections to these 'big words'. In this context both 'top-down' (programming and steering of science) and 'bottom-up' (researchers positioning their research) dynamics are present. Furthermore, to provide solutions for these challenges high hopes are often attached to new and emerging technologies, like nanotechnology. This study looks at where grand challenges and the great expectations and promises of nanotechnology meet.

In this paper we study how societal grand challenges, like sustainability or the ageing society, are articulated within the establishment and execution of a large nanotechnology program in the Netherlands. The paper focusses specifically on the interplay between funders (government) and the researchers who took the lead in the efforts to get the program funded.

**2. Theory**

The relationship between policy ambitions and the directions of science is complex and intricate. Several papers (among others Braun and Guston, 2003; Guston 1996, 2003; Morris, 2003; Shove, 2003) have used principal-agent theory to analyze the relation between science and policy. The principal-agent theory describes situations where the principal – usually a government – has to decide and judge about situations where they have limited control and expertise about what the agent – researchers – does. (Guston, 1996)

This framework, however, has some limitations for describing ‘real’ processes: Shove (2003) concludes that “principal-agent theory fails to conceptualize the cumulative, social and institutional consequences of the relationships it describes.” Nonetheless, it is “useful in analyzing bounded research relationships and in characterizing national research systems.” (p. 381)

Shove (2003) describes situations where a research funding agency acts as an intermediary between the government and the researchers. She states that the funding agency here is both an agent in receiving funding from the government and a principal in deciding how this funding will be distributed among researchers. (Figure 1)

Figure 1 Principal-agent relations with research council as intermediary. From Shove (2003)

For this study the principal-agent framework is extended with a rhetorical analysis of the interaction between principal and agent. The grand challenges can be characterized as ‘ideographs’. This concept by McGee (1980) describes encompassing concepts, which itself are uncontested, but which allow for multiple interpretations and specifications. The ambiguity of the grand challenges doesn’t allow for a straightforward way of steering or coordination of research, which raises the question how this occurs in practice. On the one hand, an ‘ideal’ perspective from policy would be that use of grand challenges leads to clear directives for research agendas. A more cynical stance could be expected on the other hand: researchers performing ‘window dressing’, relating only to the big words for purposes of receiving funding but without substantially changing anything else. Naturally, the actual coordination will play out somewhere between these two extremes. Top-down steering will have its effect, although the bottom-up dynamics of researchers positioning themselves might countervail some of these ambitions.

Using the principal-agent framework to characterize the relations between the different actors and adding a rhetorical analysis to it using the ideographs, we will explore the dynamics of the tailoring of a large research program in the Netherlands.

### 3. Methods

This paper investigates the use of ‘big words’ at the science policy levels of a national nanotechnology program in the Netherlands. All Dutch universities and over a hundred companies participate in research in thematic areas of nanotechnology. This program was awarded directly by the Dutch government and parliament instead of the normal route, where science funding is awarded through a scientific research council as intermediary between the government and the researchers.

We interviewed actors responsible for the science policies and agendas or that took place in

the board of the nanotechnology program. The interviewees all came from university environments themselves. Some were still university professors; others now fulfilled policy advisory positions. The interview data was complemented with an analysis of documents, like research policy and research agendas that they contributed to.

Furthermore we constructed a timeline of the preparatory process before the granting of the research funding. We did this both by asking questions about this to the interviewees and we complemented this by analyzing public policy documents, like discussions in the Dutch parliament about nanotechnology. We searched in the Dutch database for parliamentary papers. In total we selected 68 parliamentary papers, in which we traced the discussions about nanotechnology and general opinions about science policy and societal relevance of science.

#### 4. Results: tailoring a research program

This case indeed revealed principal-agent dilemmas: the government did not have enough expertise on nanotechnology to judge which kind of research directions are the 'right' or valuable ones, so this was delegated to several leading scientists who wrote the Strategic Research Agenda Nanotechnology. (Netherlands Nano Initiative, 2008)

When asked about the 'grand challenges' in their research program, all interviewees readily referred to were good in reproducing the societal goals to which the nanotechnology program was said to contribute, similar to the rhetoric of the SRA. Grand challenges, like sustainability, energy provision, clean water, health care and the ageing society came up often. The normative notion of the ideographs was here used to gain legitimacy.

Interestingly, when asked about how they thought the researchers in the program took up these challenges, they were able to switch easily to the perspective of a researcher. They then noted that they knew that these challenges could be filled in many different ways and that it could sometimes be hard to relate to them as a researcher and that they knew that 'window dressing' to receive funding was an actual possibility.

This resembles the situation of which van der Meulen and Rip (1998) say that "principals must be schizophrenic to be effective." (p. 768) This also follows from Figure 1 (Shove, 2003) where research councils play double roles in order to accommodate both sides. Here, the researcher policy makers directly dealt with the government, which resulted in different situations. The interviewees actually had three different principal and agent roles: first of all, they were in agent in trying to receive money from the government for their program. Here they used the grand challenges as legitimizing strategy. Second, after the money was awarded, they acted as principals for selecting which proposals were accepted in the program and which were not and by participating in the board throughout the program. And thirdly, they were again agents by taking place in several research projects in the program. (Figure 2)

#### Figure 2 Principal-agent relations in Dutch nanotechnology program

When writing the SRA, the interviewees felt they had to use grand challenges in order to get the research funded. The legitimacy that the grand challenges gave suited their strategy to gather money for their research field and thus much attention is given to these positive



promises in the SRA. A part of the SRA was also devoted to the possible risks for human health and environment of nanotechnology. In the parliament, the risks issues turned out to be a much larger decider in whether or not the money would be spend on nanotechnology than all the positive promises about grand challenges that the SRA made. The positive grand challenges were accepted easily by the parliament and little questions were asked about how realistic these projections actually were. However, repeatedly questions were asked about the possible health and safety risks.

The principal (the parliament) in its turn decided to trust the positive expectations about nanotechnology, since it did not have the expertise to judge whether these were realistic and valid expectations. However, when human and environmental safety was concerned they questioned this very thoroughly, more than perhaps the writers of the SRA had anticipated. This could also be due to the absence of a funding agency acting as an intermediary. Morris (2003) writes that these research councils can help to build to trust, because they are able to communicate and translate between these parties.

This paper reflects on how these dynamics relate to principal-agent theory and ideographs. It will add to the understanding of principal-agent theory by analyzing a case where no research council was present as intermediary. Also, it will show how adding a rhetorical analysis is useful when considering the grand challenges in science policy, since in some places the legitimating power of the grand challenges is deemed very important, while in other places it only plays a subsidiary role.

## 5. References

- Braun, Dietmar, and David H. Guston. "Principal-agent theory and research policy: an introduction." *Science and Public Policy* 30.5 (2003): 302-308.
- Guston, David H. "Principal-agent theory and the structure of science policy." *Science and Public Policy* 23.4 (1996): 229-240.
- Guston, David H. "Principal-agent theory and the structure of science policy, revisited: 'Science in policy' and the US Report on Carcinogens." *Science and Public Policy* 30.5 (2003): 347-357.
- McGee, M.C. 1980. "The 'Ideograph': A link between Rhetoric and Ideology." *The Quarterly Journal of Speech* 66(1): 1-16.
- Van der Meulen, Barend, and Arie Rip. "Mediation in the Dutch science system." *Research Policy* 27.8 (1998): 757-769.
- Morris, Norma. "Academic researchers as 'agents' of science policy." *Science and Public Policy* 30.5 (2003): 359-370.
- Netherlands Nano Initiative, 2008. *Strategic Research Agenda Nanotechnology*.
- Shove, Elizabeth. "Principals, agents and research programmes." *Science and Public Policy* 30.5 (2003): 371-381.



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***Drivers of institutional change in transitional economies that lead to development of entrepreneurial university: case of Bosnia and Herzegovina***

**Abstract:** As the economies of the industrialized countries have become more knowledge-based, universities have become viewed as important players in regional economic development. In this context, entrepreneurial universities play an important role as both knowledge-producer and a disseminating institution. Development of successful connection and collaboration of university and industry as a precondition for entrepreneurial university development has been emerging as one of the key wheel of economic growth and base of knowledgeable and innovative economy. Policy-makers in a number of countries are promoting such developments by encouraging collaboration between universities and industry (Mowery and Nelson 2004).

Today's universities are increasingly being called upon to engage economic development; they are being required to live in the market (Clark 1995), to be innovative (van Vught 2000), and to be entrepreneurial (Clark 1998). Hence, universities are required to build relationships with their stakeholders in several ways. In the literature, theoretical models have tried to explain the phenomenon of entrepreneurial universities development (Clark 1998; Sporn 2001; Etzkowitz 2004; Kirby 2005; O'Shea et al. 2005, 2008; Rothaermel et al. 2007).

To achieve this objective in this paper an institutional perspective is adopted to analyze the factors associated with the environmental factors (formal and informal), following the idea of Burton Clark (1983, 1998, 2005).

However, body of literature that examines the notion of collaboration of industry and higher education innovation, including university entrepreneurialism and R&D, innovation in policy that regulates partnership across higher education systems and industrial clusters, informal and formal linkage of knowledge institutions and industry that continues to receive widespread attention is predicated upon industrial nations; therefore, questions arise whether or not the models and ideas about well-known research-intensive universities in highly industrial countries could be extrapolated to entirely different, developing economies, universities and regions.

What are the drivers of institutional change in transitional economies, like Bosnia and Herzegovina is, that lead to development of entrepreneurial university?

Moreover, questions arise whether or not the models and ideas about well-known research-intensive universities in highly industrial countries could be extrapolated to entirely different, developing economies, universities and regions.

The paper will explore if the current policy prescription for encouragement of partnership across higher education systems and industrial clusters, informal and formal linkage of knowledge institutions and industry fits within the Western Balkan countries, and in particular in Bosnia and Herzegovina. The paper is driven by hypothesis that one size

doesn't fit all and that current institutional infrastructure in Bosnia and Herzegovina does not support or motivate partnership across higher education systems and industrial clusters.

Before 1990 higher education system in Bosnia and Herzegovina was initially university dominated (following classification of Kyvik, 2004), and country kept the university and non-university research sectors essentially separated which can be named knowledge institutions of higher education. Following the reconstruction of its war-devastated economy, Bosnia and Herzegovina from 2000 embarked on the road of economic transformation. This process included privatisation of state-owned enterprises and private sector development and resulted in different stage of development of public companies, private companies and companies with dominant international capital. Bosnia and Herzegovina increased its competitiveness from 2011 to 2012 (based on Global competitiveness Index the country was on 100 place and it is now on 81 place on the scale of 141 countries) and as described in the Global competitiveness Index Bosnia and Herzegovina is at the "Efficiency-Driven Economies" stage (GCI, 2013) with major industry development is metal industry, oil refinery, electro distribution and mining and car production industry (Chamber of Commerce, 2013).

At the same time, during the last 20 years Bosnia and Herzegovina experienced differences in the timing and dynamics of the process of transition in general, has been faced with challenges of EU accession and started a long road of higher education reform. The process of Europeanisation of higher education, e.g. by way of the Bologna Process (Olsen, 2002), presented forces that shape the environment in which the interaction between system level authorities and institutions takes place.

Policies that regulate development of science and research have been adopted after 2008 but their implementation is negligible. Considering the extreme decentralisation of the country with 14 authority levels in education, some parts of the country (cantons) are leading in the science and research policy implementation some university departments developed and intensified cooperation with industry, while most of universities are lagging behind. Technology parks have been developed after the 2008.

Unfortunately, there are very few studies in Bosnia and Herzegovina dealing with education-industry, particularly on the process of developing social dialogue and partnership between them both at enterprise and state authority level and development of entrepreneurial university. There is no united incentive for such studies, and approaches have been partial (such as topical round-tables and occasional publications) (Eurofond, 2011). No study, however, has highlighted the interrelations among environmental and internal factors that conditioned the development of entrepreneurial universities with the teaching, research and entrepreneurial missions that they need to achieve.

Therefore, it is interesting to follow the research potentials and practice of universities and research institutes in their collaboration with industry and to analyse factors that led to development of entrepreneurial departments within university or university itself.

Economic and socio-cultural issues might suggest that a "one-size-fits-all" innovative approach does not fit the non-industrial (high-tech) regions. In light of an absence of empirical attention and systematic understanding of Bosnia and Herzegovina university – industry and industry – research institutes collaboration routines, the primary goal of the paper is to improve our understanding of development of entrepreneurial university in

Bosnia and Herzegovina.

This paper addresses the drivers of change in higher education institutions that led to development of the entrepreneurial university. The paper aims to contribute to a better understanding of these interrelations identifying the most critical factors that conditioned the development of entrepreneurial universities in Bosnia and Herzegovina. To be able to explore the alignment of initiatives and actions at various levels in the country, various data has been collected and analyzed. First, key policy documents describing ambitions and policy initiatives in the country have been collected. The lack of regional data on specific information (non-technological innovation, R&D, labor mobility, scientific research articles, etc.) was an indicator that forced me to utilize data from various publications from the geographical area covered in the study (i.e. national higher education policies, national reports for Bologna process), Tempus project WBC regional model of university-enterprise cooperation (2010), ERAWATCH country report (2013). Secondly, university's mission, but also specific organizational routines of universities in the country have been analyzed. The paper looked for university-enterprise cooperation such advance activities in which many universities in the industrial world have engaged (i.e., formal technology transfer activities, which have encompassed commercialized activities, spin offs, research parks etc.). In light of an absence of empirical attention and systematic understanding of Bosnia and Herzegovina university – industry and industry – research institutes collaboration routines, the primary goal of the paper is to improve our understanding of development of entrepreneurial university in Bosnia and Herzegovina.

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### ***Governing Fuel Cell Innovation in a Dynamic Network of Expectations***

**Abstract:** The emergence of new technologies is characterised by a broad array of inherent uncertainties. This holds all the more for technologies which bear the potential to trigger radical innovation. These technologies typically pose particular technological challenges and they allow new ways of application, which often require the adaptation of regulatory frameworks and affect established business models. In addition, new constellations of innovation actors have to be set up. In the face of these uncertainties, actors involved in innovation and governance processes have to rely on expectations rather than on robust knowledge for developing strategies and policies. Especially collective expectations, i.e. expectations that are part of a widely acknowledged social repertoire, have been shown to be particularly influential (Borup et al., 2006; Konrad, 2006; Raven et al., 2008). Collective expectations act as provisional, and in that sense tentative, but forceful assumptions on the future potential and requirements of an emerging technology, and thus constitute a core element in the governance of innovation processes (Borup et al., 2006). The important role of expectations is also acknowledged by approaches dedicated to governing radical innovation processes, such as transition management and strategic niche management (Geels et al., 2008; Raven et al., 2008; Sondejker et al., 2006). However, collective expectations often develop quite dynamically, up to sudden changes, due to developments within a technology field, as well as external developments in related sectors or competing technologies (Borup et al., 2006; Geels and Raven, 2006; Konrad, 2006; van Lente, 1993). The highly dynamic evolvement of expectations creates challenges for related governance processes, which have to deal with the dynamics and tentativeness of expectations, either ex-post when expectations have changed, or ex-ante, when possible future changes in expectations are taken into account in the set-up of governance measures. Thus, governance itself may become as de-facto tentative when flexibility is the outcome, or in a purposeful manner, when flexibility is actively sought.

Against this background, this article investigates how expectations on fuel cell technology developed in the German policy arena, taking into account expectations on the technology and its applications, as well as on further influential developments, e.g. related sectoral dynamics. Moreover we consider how these expectation dynamics affected the governance of the field and how governance processes and structures dealt with the uncertainty and changes in expectations.

We focus on Germany, one of the highly active countries in fuel cell innovation, in the time period 1994 to 2011. In this period fuel cell expectations were changing considerably: At the turn of the millennium many expected fuel cell technology to become widely implemented within a few years from then, for propulsion of vehicles, as combined heat and power systems at the household level (micro CHP), or as highly efficient replacements of conventional power stations. A number of companies announced the market introduction of fuel cells within the first half of the 2000s, and policy programmes to support the

technology were initiated around the globe. However, fuel cell technology did not live up to these optimistic expectations and the hype around fuel cell technology turned into disappointment. In the second half of the 2000s, expectations about battery electric vehicles became increasingly optimistic, putting additional pressure on fuel cell expectations. In Germany, actors with stakes in fuel cell technology managed to translate fuel cell expectations into stable support structures, which were maintained though adjusted – in times when battery electric vehicles were generally expected to be more promising. This is in contrast to other countries, e.g. the Netherlands or the US, where fuel cell technology rather disappeared on the policy agenda, or was at risk to receive considerably less funding after the hype (Bakker and Budde, 2010).

Conceptually, this paper draws on two bodies of literature: the sociology of expectations (Borup et al., 2006) and the multi-level perspective of transition studies (Geels, 2010; Geels, 2002). Both literatures have shown the importance to consider different levels of, on the one hand, expectations and, on the other, ‘real-world’ processes, to understand the complex dynamics of innovation, up to broader sectoral transition processes (Geels, 2002; van Lente, 1993). Building on this, we develop a conceptual framework for the analysis of interrelated visions and expectations – networks of expectations. Based on this framework, we analyze how visions and expectations related to different levels, such as a technology field, sectoral developments or broader societal trends, developed and influenced each other over time in the German policy discourse on fuel cell technology.

Empirically we draw on a discourse analysis of German policy documents from 1994 to 2011, complemented by expert interviews.

Thus, the main research question of this paper is: To what extent can the dynamics of fuel cell expectations and visions in the German policy discourse be explained by changes in the broader network of expectations and how have these dynamics affected policy support for fuel cell technology?

With this paper we want to (a) contribute to a better understanding of the dynamics of expectations, which takes into account the complex interactions – or co-evolution – of collective expectations, and (b) we want to explore how policy responds to these dynamics in more or less tentative manners.

Our analysis showed that collective expectations about fuel cell technology itself were an important reference point in the policy discourse. However, it became also clear that these expectations alone were not sufficient to trigger substantial policy measures, as exemplified by the fact that the hype around mobile fuel cell applications did not result in immediate policy action. Apparently, only once and as far as expectations about fuel cell technology linked up with visions and expectations at the regime and landscape level, they were able to facilitate the setup of supportive policy measures. In addition, but not surprisingly, linking to regime and landscape level expectations was only supportive, if these were widely shared and assessed positively across the policy spectrum, or the governing parties at the time. The types of links and interactions we observed within dynamic networks of expectations reflect the broad variety reported in the literature of strategic niche management and transition studies for ‘real-world’ processes. We identified more or less supportive links between niche and regime expectations, supportive linkages between niche and landscape expectations, and competing and complementary linkages between expectations

concerning different niche technologies. Niche expectations were related to multiple regime expectations and visions, both in the form of expectations referring to multiple systems a niche may relate to, such as visions regarding the electricity and the mobility system.

Furthermore niche expectations were related as well to competing visions about the future of a particular system, for instance visions about a hydrogen economy based on renewables or nuclear energy, or a mobility system based on fuel cell versus battery-electric vehicles or – in the case of battery electric vehicles - to an overarching vision of an electrification of transport. These linkages are not stable, but change over time. A further dynamic element is introduced due to changes in the assessment of linked visions, as in the case of the vision of a hydrogen economy, or the assessment of battery-electric vehicles.

Dynamics do not only include reshufflings of the network of expectations. In addition, we observed a successive articulation of expectations – mainly in the later periods, largely by way of dedicated expectation-building measures within working groups, which were initiated by actors of the “fuel cell community”, but joined by policy actors and became increasingly institutionalized.

Thinking beyond this paper, our framework could be further developed and inform a reflexive approach of dealing with the dynamics within networks of expectations. The multi-level analysis of expectations may serve to identify weak, latent or potential future relations and interactions of visions and expectations, which may affect future discourses and ultimately governance processes. Thus this paper emphasizes the importance of taking into account expectations and visions related to all three levels linking up to emerging discussions among experts in the German fuel cell community, that higher level expectations were not taken into account sufficiently in previous expectations work. Thus an analysis based on the insights of this paper could eventually contribute to a reflexive governance approach, which does not only respond ex post to shifts in expectations and expectation networks, but tries to anticipate to some extent possible future dynamics and reshufflings of expectations, for instance as a result of changes in related expectations or due to the intensification of so far weak or latent links.

#### Literature:

- Bakker, S., Budde, B. 2010. Technological Hype and Disappointment: Lessons from the Hydrogen and Fuel Cell Case. *Technology Analysis & Strategic Management* 24/6, 549-563
- Borup, M., Brown, N., Konrad, K., Van Lente, H., 2006. The sociology of expectations in science and technology. *Technology Analysis & Strategic Management* 18, 285-298.
- Geels, F., 2010. Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Research Policy* 39, 495-510.
- Geels, F., Hekkert, M., Jacobsson, S., 2008. The dynamics of sustainable innovation journeys. *Technology Analysis & Strategic Management* 20/5, 521-536.
- Geels, F., Raven, R., 2006. Non-linearity and Expectations in Niche-Development Trajectories: Ups and Downs in Dutch Biogas Development (1973–2003). *Technology Analysis & Strategic Management* 18, 375-392.
- Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research Policy* 31, 1257.
- Konrad, K., 2006. The Social Dynamics of Expectations: The Interaction of Collective and Actor-Specific Expectations on Electronic Commerce and Interactive Television. *Technology Analysis & Strategic Management* 18, 429-444.
- Raven, R.P.J.M., Heiskanen, E., Lovio, R., Hodson, M., Brohmann, B., 2008. The Contribution

of Local Experiments and Negotiation Processes to Field-Level Learning in Emerging (Niche) Technologies: Meta-Analysis of 27 New Energy Projects in Europe. *Bulletin of Science, Technology & Society* 28, 464-477.

Sondeijker, S., Geurts, J., Rotmans, J., Tukker, A., 2006. Imaging sustainability: the added value of transition scenarios in transition management. *Foresight - The journal of future studies, strategic thinking and policy* 8, 15-30.

van Lente, H., 1993. *Promising Technology: The Dynamics of Expectations in Technological Developments*, Faculteit Wijsbegeerte en Maatschappijwetenschappen. Universiteit Twente.



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***Competence Mismatches among PhD Graduates in Social Sciences and Humanities***

**Abstract:** Education represents more than an investment in human capital, because it allows individuals to learn and acquire skills that will fundamentally shape their behaviour, beliefs and role in society. Education also appears to be related to people's success in making many economic decisions. This is why more attention has been paid, in recent years, to the importance of various types of competences (kinds of knowledge, skills, values and attitudes) in the labour market (Heije et al., 2002; García-Aracil and Van der Velden, 2008). This paper focuses on the kinds of competences that are needed by PhD graduates for successful professional development and satisfying careers. A sound theoretical framework or empirical evidence base for the choice of relevant doctoral competences is lacking. Based on different lists of general undergraduate competences proposed by the empirical evidence of other studies (e.g. Rychen and Slagvik, 2003; NCEE, 2007; Reflex Project, 2007; ILO, 2012, OECD, 2012), we examine whether doctoral competences should be differentiated from competences acquired at other educational levels, and whether employers value the competences that doctoral graduates bring to work organisations. The list of doctoral competencies then proposed in this study is based on a review of the available literature regarding graduate and doctoral students' experiences (Buckley et al., 2009; NESTA, 2009).

The interview data used for this study was obtained under the framework of the FP7 POCARIM project (Mapping the Population, Careers, Mobilities and Impacts of Advanced Research Degree Graduates in the Social Sciences and Humanities, POCARIM 2013). This paper is focused on the analysis of the competences and social impacts of a sample of Spanish PhD holders who earned their doctoral degree during the period 2000-2012 in Social Sciences and Humanities. Participants were drawn from the five biggest public universities in Spain: Complutense University of Madrid, University of Barcelona, University of the Basque Country, University of Seville and University of Valencia. Scientific disciplines included were economics, geography, history, journalism, law, linguistics, management/business administration, political sciences and international relations. A total of 30 social science and humanities PhD holders were interviewed. Participants were selected on the basis of including as diverse a range of employing organisations as possible. Interviews were conducted with individuals working in a private university (one), public universities (eight), foreign universities (three), private firms (four), public sector research organisations (five) and other public organisations (one). In addition, interviews were conducted with self-employed (four), unemployed (three) and retired (one) doctorate holders.

The paper provides insights into which competences are more relevant to PhD graduates' professional success and how these competences should be generated, or may be better promoted, through higher education systems. It is far from easy to give a clear answer to these issues because of the heterogeneity and changing nature of productivity-enhancing characteristics of graduates. However, our preliminary results suggest that PhD graduates



working outside academia do value the professional benefits deriving from the competencies they acquired during their doctoral studies - even if they were not currently working in scientific research. However, a deficit of management competences also emerged, including in relation to the ability to negotiate effectively and the capability to propose and submit research projects to competitive grant calls.

This paper has implications for policies addressing the education and training of doctoral students and their study programmes. A good doctoral programme should not only prepare PhD graduates for high level performance upon entry into the labour market, but also ensure their employability in the longer-term including beyond academic organisations.

## References

- Buckley, F., Brogan, J., Flynn, J., Monks, K., Hogan, T. and Alexopoulos, A. (2009). Doctoral Competencies and Graduate Research Education: Focus and Fit with the Knowledge Economy? LINK Working Paper Series, WP 01-09, DCU Business School, Ireland.
- García-Aracil, A. & Van der Velden, R. (2008). Competencies for young European higher education graduates: Labor market mismatches and their payoffs. *Higher Education*, 55 (2), 219-239.
- Heijke, H., Meng, C. & Ramaekers, G. (2002): An Investigation into the Role of Human Capital Competences and Their Pay-Off, Research Memorandum, ROA, Maastricht.
- ILO (2012). Global Employment trends for youth 2012, [[http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/documents/publication/wcms\\_180976.pdf](http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/documents/publication/wcms_180976.pdf)]
- NESTA (2009). The identification and measurement of innovative characteristics of young people. Development of the Youth Innovation Skills Measurement Tool. Research Report, July 2009, Kingston University.
- NCEE, National Center on Education and the Economy (2007). Tough Choices, tough times. The report of the new commission on the skills of the American workforce, [[http://www.skillscommission.org/wp-content/uploads/2010/05/ToughChoices\\_EXECSUM.pdf](http://www.skillscommission.org/wp-content/uploads/2010/05/ToughChoices_EXECSUM.pdf)]
- OECD (2012). Better Skills, Better Jobs, Better Lives: A Strategic Approach to Skills Policies. Paris, OECD Publishing.
- POCARIM (2013). Mapping the population, careers, mobilities and impacts of advanced research degree graduates in the social sciences and humanities. European Commission, 7FP.
- Reflex Project – Allen, J. and Van der Velden, R. (eds) (2007). The Flexible Professional in the Knowledge Society: General results of the REFLEX Project. <http://www.fdewb.unimaas.nl/roa/reflex/>
- Rychen, D. S. and Slagnik, L. H. (2003). Key Competencies for a successful life and a Well-Functioning Society, Gottingen, Hogrefe and Huber.

**Javier Castro Spila, Alfonso Unceta and Mercedes Oleaga.**

**Sinnergiak Social Innovation Centre. Spain.**

***Relational University and Social Innovation: Lessons from the Basque Country***

**Abstract:**

The article explores the Relational University concept which refers to a new model of University, which is connected to different social and cultural local problems and regional stakeholders. This article provides the results of the Regional Social Innovation Index (RESINDEX) a conceptual and empirical model that explores indicators of social innovation at regional level, related to University relations, social innovation projects development and its impact over the Basque Country (Spain) context. The article presents the main results and lessons learned.

**Chris Caswill.**

**Manchester Business School, University of Manchester, UK.**

***Working together, staying singular: Ups and downs of research council co-operation across national boundaries***

**Abstract:**

This paper is concerned with international policy innovation and the movement (or otherwise) of research policy ideas and instruments across organisations and national boundaries. It seeks to connect the arena of research (science) policy with the longstanding interest of political scientists in change and continuity in public policy. It draws on the author's observations of the creation, development and current state of the thirteen-country NORFACE ERA-NET research council network in the social sciences, originally funded within the EU Sixth Framework Programme (FP6). It begins with a review of the key events and characteristics of this innovation in transnational organisation. It goes on to illustrate the internal dynamics of research council collaboration across national boundaries by reference to two contrasting NORFACE initiatives – the establishment of transnational research programmes and the attempt to examine and share best practice in the engagement of policy and practice actors ('users') in the research process. These illustrate the extent, nature and limitations of policy learning across organisations and national systems. It is a story of the ups and downs of international co-operation, knowledge sharing and transnational policy development. It seeks to go beyond an informed account of events to find explanations of the outcomes in the literature of policy learning and change. It concludes with an assessment of what has changed, what has remained constant, and the implications for our understanding of national research funding agencies and practices.

**David Charles.**

**University of Strathclyde, UK.**

***The rural university campus and rural innovation – conflicts around specialisation and expectations***

**Abstract:**

Much of the research on university contribution to regional innovation, at least in the UK and other large countries, focuses on larger metropolitan based universities, often those that are research intensive. Emphasis is placed on excellent universities located in relatively well endowed regions, in which regional innovation systems are well developed. The opposite case is of regions that are mainly rural in nature, often highly peripheral and with very limited university provision, perhaps in the form of a small university in the main town, or even just in the form of a small satellite campus to a university based in a city. Such cases are rarely the subject of study, other than perhaps as one-off impact studies used in the lobbying for resources. Yet these small university campuses are the subject of keen political interest in their regions, as local interests lobby hard for university investment in order to support their local economies. The difficulties are great however and such campuses are subject to wide-ranging demands from a small asset base. This paper examines the experience of campuses in six rural locations in the UK, with a particular focus on the contributions they are able to make to local innovation capacities.

The literature on universities and regional innovation typically draws upon some form of regional or local innovation system perspective, in which the university is a source of knowledge or resources which constitutes a significant actor within an innovation system. The scale and complexity of a university is such that it often performs a number of different roles within its innovation system, as a source of human capital, as a source of specialist knowledge, an incubator of firms perhaps, and potentially many other roles. Urban regions also often have several universities, with perhaps some specialised on particular roles or sectors, and each adding to the thickness of the institutional capacity. Successful regions also typically exhibit some form of agglomeration and hence specialisation, which perhaps co-evolves with the areas of specialisation of the universities. So even looking beyond the much cited examples from California and Massachusetts, there are regions with specialist clusters where the university has closely related specialisations – oil and gas in Aberdeen, or materials in Sheffield for example.

In more rural regions though the challenge for universities and for regional innovation policy is much greater, with usually a more diverse and diffuse economic base, a predominance of small and micro-businesses, and with weak knowledge institutions, often with an absence of universities. In response in more recent years there has been active lobbying by rural regions for a university presence, and with some investment in new campuses and universities. The UK has seen a number of such developments, as have other countries in Europe and beyond. Often the rationale is the same: regions want a university to help retain young talented people, to provide local study opportunities and to support local business and the wider community. Rarely do such regions gain a large full-range university, sometimes an existing small college might become part of a university based elsewhere, a

few new small universities have been established, or perhaps a new satellite campus is set up. The extent to which such developments have successfully supported local innovation systems has not been fully assessed however.

This paper examines university campus developments in six rural regions in Scotland and the North of England. All of the case studies emerged as universities or university campuses in the last twenty years, although by varying processes. Three involve new universities, each evolving from a different set of precursor institutions, whilst the other three are satellite campuses either acquired or newly established by urban-based universities. All were underpinned by a strong local desire to see a university presence in the area, but whilst there are some parallels each is also distinctive.

In Scotland the three case studies cover the main rural areas outside of the central urbanised belt. In the North the University of the Highlands and Islands operates a decentralised model with campuses distributed across the Highlands and Islands from Argyll in the South to Shetland and the Western Isles. To the South west of the central belt the Crichton Campus of the small town of Dumfries hosts satellite campuses for both the University of Glasgow and the University of Western Scotland. In the eastern borders the former Scottish College of Textiles in Galashiels became a campus of Heriot-Watt University in Edinburgh.

In the English North West a University of Cumbria was established headquartered in Carlisle though with several other campuses assembled from a merger of institutions and previous satellites. In Yorkshire Hull took over a college in Scarborough. To the south the University of Humberside established a campus in Lincoln into which it then moved all of its provision, closing down campuses in Hull and Grimsby.

In each case interviews were held with senior managers or enterprise engagement staff in the university campus as well as local partners in local authorities, enterprise agencies or chambers of commerce.

A number of common or shared narratives emerged from these case studies. Central to this was the tension between meeting local educational interests which tended to be generic and encourage a teaching focused model, and the development of areas of specialisation linked with local industry and with a research base. The relatively small scale of institutions meant that it was difficult to adopt both strategies at the same time, so the campuses were almost bound to fail to meet expectations on either education or collaboration with local industry, and in some cases on both. Local partners had started to be more realistic on expectations, especially when in several cases there was a threat of complete closure which occurred on four of the sites, three of which so far saw reinvestment and reorientation after local campaigns.

The limitations of the campuses meant that business links tended to be in relatively narrow niches, although the needs of these rural areas were quite diverse, in most cases with relatively high proportions of manufacturing activity, and certainly much higher than the large cities where most university research is based. Despite the presence of new universities in the regions, partners were still looking to universities elsewhere to meet the needs of local SMEs, even whilst trying to build the capacity of the new rural campuses. However there was greater success in building productive relationships with the Further Education sector in shaping the human resource capacity of the region.

The paper concludes that whilst these new campuses have been able to add to the regional innovation systems of these rural areas, they struggle with economies of scale and scope, especially facing the reality of rural business which is not always the mix of agriculture and

tourism that is the stereotype. Where specialisation has been the strategy, potential exists for niche clusters to develop, although in most cases the campus requires a longer development period to reach its full potential. The limited scale of resources restricts the potential for significant spin off development, but attempts are emerging to promote graduate entrepreneurship. Overall though policies to enhance rural innovation through new university campuses must be seen to be very long term strategies and not necessarily congruent with strategies to increase HE participation and retain young people through local degree provision.

**Nidhi Chaudhary.**

**University of Cambridge.**

***Pathways to Innovation: Micro underpinnings of the growth of Indian software sector***

**Abstract:** This paper focuses on understanding the key micro-underpinnings which have enabled software firms in India to build dynamic capabilities which have facilitated innovation and growth of the Indian software sector given the institutional infrastructure and other market structure constraints of an emerging innovation system. In particular, the paper looks at the diversity of mechanisms by which Indian indigenous firms have leveraged transnational corporations (TNCs) assets and their founder's experience in overcoming these institutional infrastructure constraints resulting in the evolution of Indian indigenous firms' capabilities.

The innovation system literature highlights the presence of an emerging innovation system in developing countries where the networks and interactions are in a formative stage with some missing actors and institutions, which are normally present in well developed innovation system (Chaminade and Vang, 2008; Metcalfe and Ramlogan, 2005; Lundvall et al., 2009). Firms in an emerging innovation system might lack even the minimum capabilities to engage in learning and innovation and rather are more likely to be in the process of accumulating competencies and capabilities which are needed to enable engagement for interactive learning and innovation. Malerba and Nelson (2012) define this process of capability building in emergent innovation system in developing countries as "catch-up". The capabilities that are needed to catch up include those required to access complementary assets, absorptive capabilities, and innovation capabilities. One of the most important factors for catch up and progressing from an emergent to mature innovation system is access to foreign knowledge. This could take place through a variety of different mechanisms including networks with suppliers and users; local networks; collaborative partnerships and global value chain participation for outsourcing. Current research on innovation systems in developing countries highlights that the most important networks for 'catch-up' for indigenous firms are with MNCs and their subsidiaries; with service users and those between university and industry (Lundvall et al., 2009; Padilla-Perez' et al., 2009; Pietrobelli and Rabellotti, 2010; Marin and Arza, 2010; Malerba and Nelson, 2012).

The Indian software industry is the world's largest exporter of ICT services starting with \$.02 billion in 1985 to \$52.7 billion by 2012 with the world's highest growth rates within an industry (Arora and Gambardella, 2004). Furthermore, the revenues of the Indian software industry have grown from US\$81 million in 1985-86 to \$67.5 billion in 2011-12 (Unctad, 2012; Nasscom, 2012). Despite the multi-fold growth in the empirical literature on Indian software industry (Arora et. al., 1999, 2001; Athreye, 2003, 2005, 2010; Parthasarathy, 2004a, b; Parthasarathy & Aoyama, 2006; Kumar, 2001; Kumar and Joseph, 2006; Basant and Mani, 2012; Parthasarathy, & Ranganathan, 2011; Ilavarasan & Parthasarathy, 2012; Chaminade & Plechero, 2012) which explores the growth of Indian software firms' capabilities, relatively little attention has been paid to how TNCs have contributed to the evolutionary capability building process in indigenous firms and their movement upwards in

the value chain at the micro-level (Vang and Chaminade, 2006; Chaminade and Vang, 2008; Lema, 2010). Further, despite the existence of cross-country research exploring the role of Indian Diaspora (Saxenian, 2006), there are few micro-level studies which explore the diversity of mechanisms by which the firms in the Indian software sector leverage TNC assets and their founder's educational capability and work experience.

New evidence and analysis presented in this paper seeks to address this dearth of research by focusing on how Indian software firms at different stages in their evolution have successfully competed and grown in the global knowledge economy, given the institutional and other constraints confronted in the emerging innovation system. A second important question addressed here is what is the role played by transnational corporations (TNCs) in the evolving competences of Indian software firms and their upgrading in the value chain over time? A third question addressed here focuses on understanding how the founders in Indian start-ups leverage their educational and work experience in the in the US to catalyse the Indian software sector?

To address these questions, three case studies of Indian firms are presented which demonstrate how entrepreneurs deploying different business and innovation based strategic approaches have successfully innovated, moved up the value chain and raised their share of the global software market. The three case studies selected here have been selected from a larger dataset established as part of research for a PhD . These case studies are an illustration of the potential diversity in the way different firms develop, adapt and shape their business and innovation strategy in the context of institutional constraints in case of developing countries. These case studies are embedded in an in-depth literature review of the software sector in India which provided a comprehensive evaluation of the background of the software sector; its institutional context; its performance and its innovation ecology. The literature review also enabled a deeper understanding of how the formal and informal interactions between firms and non-firms organisations have evolved with time; how the industry's boundaries and characteristics have evolved with the changing technologies and institutional context; and how the capabilities of firms in the software sector have changed in response to the external social, economic, and political climate.

Firm A is a soft start-up which was setup by an ex-Microsoft employee in 1994 who identified an unexploited business opportunity to provide post-product support services to Microsoft. The capability enhancing innovation in firm A's evolution has been largely dependent on leveraging Microsoft as a customer, as a channel for new knowledge and new networks in the global value chain and as a platform. Firm B is a hard start-up model which came into genesis in 2004 with the founders' conviction that a pure technology play and innovation-based firm could be based out of India. With Silicon Valley venture funding and 24 patents, it was firm B which invented and delivered the world's first comprehensive and fully automated wireless intrusion prevention system (WIPS) and provided the first WIPS solution on cloud globally. Firm B has evolved and deepened its technological capabilities through its customer partnerships in various stages of evolution. Firm C is a hard start-up set up by four academics in 2001 and is the first public university spin-off in India. The firm has evolved to become a global leader in computational biology products with 30% of global share in the market. The learning and evolution of firm C's capabilities has come



through its evolving partnerships with its global competitors as well as local and global academic and research institutions, who have become partners in new technology products. The founders of all the three firms had been educated in top US universities and worked in the US before returning to India to start new firms in India.

The research findings highlight different mechanisms by which strategic coupling occurred between TNCs and indigenous Indian firms. The analysis charts the development of their capabilities and movement up the value chain. This evolution of Indian software firms' capabilities was achieved through close interactions between the TNCs and the indigenous Indian firms which supported the development of trust based relationships. This helped the case study firms gain a deep knowledge of the business processes of their clients which was aided by their ability to recruit a highly talented and motivated team in India. The case studies also illustrate the evolving role of human capital in providing 'bridges of innovation' through their educational and work experience in Silicon Valley and elsewhere in the US. The founders' education and experience helped in reducing the institutional distance between the US and India thus overcoming the uncertainty and transaction costs of opening up new markets in an uncertain environment. These collaborations and partnerships were integral to the evolution of the capability of indigenous firms. The case studies also highlight the emerging nature of the Indian software sector innovation system. The presence of path dependency in the evolution of firms, leading to different growth trajectories within the software sector also points to the need to adopt a flexible and accommodating policy framework which can address the different problems that different types of firms face as they evolve.

**Diego Chavarro.**

**PRU - University of Sussex, UK.**

***Journal Indexing Systems in Latin America: their role in science as perceived by researchers and their influence on publication decisions***

**Abstract:** Introduction

Journal Indexing Systems (JIS) are services that select and make available valuable information about scientific journals. They are widely used by researchers and policy makers not only to search for literature, but also to rank and assess scientific production through publication indicators.

Arguably, the most widely known JIS is Web of Science (WoS). It provides information and indicators for a set of selected journals from all over the world, and the company advertises to implement objective and unbiased processes to offer only the best quality journals<sup>1</sup>.

Yet there is an emergence of regional JIS (called alternative JIS in this work), which are gaining recognition by national research evaluation systems. Specifically, in Latin America there are three big initiatives: Latindex, RedALyC, and Scielo. These are multidisciplinary JIS that cover journals produced in Latin America, the Caribbean, Portugal, Spain and other territories such as South Africa. In China there is the Chinese Citation Index, and in some countries, such as Japan, India, and Russia<sup>2</sup> there are new developments to create bibliographic and citation indexes too.

Although the importance of alternative JIS has been supported from a macro perspective: the importance of open access, the need to give visibility to Latin American Science, and the editorial quality improvement of Latin American journals, we still know little about researchers' perceptions and uses of these systems. there is a need to understand the perception of researchers about JIS as related to their publication practices. Researchers are, in the end, the ones who shape JIS through their decisions to publish papers in the journals indexed by them. Therefore, my research question is:

How do researchers respond in terms of publications to available Journal Indexing Systems?

**Methodology**

This paper uses a case study as a way to get in depth answers to the research question. A set of 30 Colombian<sup>3</sup> researchers from agriculture, Chemistry, and Business and Management were interviewed in order to get their opinions on their publication pattern and its relationship with Journal Indexing Systems. There were 10 researchers from each discipline. The questions were on the following subjects:

Motivations to publish.

Explanation of their publication pattern and its relationship with JIS.

Use of JIS in their research

Valuation of alternative JIS both through direct questioning and through a ranking of their papers.

The future of JIS, recommendations, comments.

Researchers were identified using CvLAC, a Curriculum Vitae database managed by Colciencias, which is a public organisation in charge of science and technology policy in Colombia. The criteria used were participating in a research group endorsed by an institution in Colciencias database, and with an individual production of at least three papers in the last 10 years. In practice most of them have 5 or more papers. As not all of them replied my invitation for an interview, I also used snowballing to complete my sample. Respondents were working for either private or public organizations at the time of the interview, and vary in terms of experience and research topics. The aim of this design is to have a diverse sample that helps in looking at JIS from a variety of views.

The methodology for the interview consisted of analysing, previous to the interview, the publication patterns of each researcher in terms of number of papers produced in journals indexed by RedALyC, Scielo, Latindex, Scopus, and WoS. This formed the basis for my interview. I followed a topic guideline that will be explained during the presentation. The interviews were then studied and codified, using a thematic analysis approach. Thematic analysis aims at finding recurring or interesting patterns in the interviews, serving as a way to classify, aggregate, and compare sets (Braun and Clarke, 2008, p. 87). The results of this analysis will be contrasted with the publication patterns of researchers, not only to triangulate the answers, but to enrich the empirical analysis.

#### Analytical perspective

I will focus mainly on the concept of universalism in science, which has been debated by Robert Merton (Merton, 1973a; Merton, 1973b) and other institutionalist (Whitley, 2000) and constructivist (Knorr-Cetina, 1982; Gyerin, 1983;) approaches. Universalism means not only that science results are valid globally, but also that contributions to science should be reviewed equally regardless of gender, race, nationality, or any other non-scientific criterion. Particularism is the opposite.

Given the assumption of universalism by WoS, and based on a literature review about different coverage biases of this database on the grounds of language and geography of the journals covered, I investigate my research question building on the wider discussion about universalism and particularism in science.

My hypothesis is that alternative JIS arise from a debate on the role of developing countries in science, which has been thought of as a conflicting relationship between the Centre and the Periphery of science. Alleged claims of universalism by WoS would be contested by the emergence of different indexing systems, which would see in WoS not a universalistic but a particularistic device that would favour countries belonging to the Centre. By giving visibility to what is not indexed by WoS, they would try to contribute to universalism. To summarize, what WoS presents as a universalistic coverage of science is questioned by those who feel excluded on the grounds of particularism. The analysis of the interviews and their contrast with publication patterns will shed light on this from the researchers' point of view.

#### Bibliography

Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 3, 77–101. doi:10.1191/1478088706qp063oa

Merton, R., 1973a. The perspectives of insiders and outsiders (1972), in: *The Sociology of Science*. The University of Chicago Press, Chicago and London, pp. 99–136.

Merton, R., 1973b. The normative structure of science, in: *The Sociology of Science*. The

University of Chicago Press, Chicago and London, pp. 267–278.

Whitley, R.D., 2000. *The Intellectual and Social Organization of the Sciences*, (2nd ed. with a new introduction). ed. Oxford University Press, Oxford.

Gieryn, T.F., 1983. Boundary-work and the demarcation of science from non-science: Strains and interests in professional ideologies of scientists. *American sociological review* 781–795.

Knorr-Cetina, K.D., 1982. Scientific Communities or Transdisciplinary Arenas of Research? A Critique of Quasi-Economic Models of Science. *Social Studies of Science* 12, 101–130.

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**Valeria Cirillo.**

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***Innovation, Skills, Wages***

**Abstract:** The aim of this piece of work is to shed light on the relationship between innovation and employment at sectoral level considering professions and technologies. We improve the existent empirical literature on two major points. First, we consider the role of skills in terms of professions enriching the existent framework relying on the skill-biased technological change (SBTC) hypothesis; second, drawing from innovation studies, we consider different typology of technologies.

Economists have focused on the composition of skills change and on the wage structure giving emphasis to the skill-biased technological change (SBTC) hypothesis, suitable for explaining inequality trends during 80s, leaving a gap of explanation for inequality trends during 90s. The skill-biased technological change has been replaced by the task-based framework giving emphasis to polarization (Acemoglu and Autor, 2011). The task-based framework born to improve the shortcomings of the canonical model relates wage and employment dynamics mostly ignoring important elements such as labor market institutions and globalization. Some authors as Di Nardo (1996) and Lemieux (2006) have focused on institutional elements but they still do not differentiate between typology of pattern of innovations as Croci Angeli et al. (2009) do.

Given this rich debate in the literature, we aim to study the relation employment-innovation by professional category avoiding the simplistic dichotomy skilled/unskilled workers.

Building on Nascia, L. and Pianta, M. (2009), we analyze the polarization thesis applying a better definition of skills, using professional groups according to the ISCO classification at one digit (Managers, Clerks, Craft Workers, Manual Workers) focusing on the determinants of employment growth by professional category. The main hypothesis to test is the existence of different determinants of employment change by professional group in terms of wage elasticity, demand, typology of technology and institutional patterns.

Furthermore, we aim to enrich the analysis considering at least two typology of technologies at sectoral level: one aiming to open up new markets and potentially leading to new jobs; the other aiming to reduce labor costs in order to compete on international and local markets. This differentiation between technologies usually applied in Innovation studies haven't received much attention in labor economics. With this work we aim to fill this gap between different streams of research: from one side, labor economics literature more interested in employment dynamics; from the other side Innovation studies focused on technological change and innovations.

**Methodology**

In terms of methodology, the analysis is carried out at two steps. Firstly, we detect employment dynamics through a descriptive analysis of changes in skills. In this phase we applied a shift share analysis in order to detect changes in skills at sectoral level related to employment shifts from one sector to another and skill changes in the same sector. At the end of the analysis we are able to distinguish within from between movements, separating a pure upskilling/downskilling phenomenon from a technological change process based on

employment shift at intersectoral level.

Secondly, through an econometric strategy we investigate the determinants of job changes in total employment and in each skill group. We use industry-level data from the Urbino Sectoral Database (USD) developed at the University of Urbino. It combines data on innovation, drawn from the fourth (2002-2004) and eighth (2006-2008) Eurostat Community Innovation Survey (CIS) with the 2010 OECD Structural Analysis (STAN) database and Labor Forces Survey (LFS) on employment. Countries included in the analysis are Germany, France, Italy, Spain and the United Kingdom. The dataset covers 21 manufacturing sectors and 15 service sectors. The model introduces specific country effects in order to account for differences in country characteristics and sector specificities. We estimate a general model for all professional categories and specific model for each profession. The baseline model can be estimated consistently with OLS, it is adjusted for heteroschedasticity and intra-group correlation at the industry level, checking for intra-sectoral heterogeneity.

#### Expected results

Given our research questions, we provided evidence on two major points: polarization trends and determinants of job growth by professional categories.

From the descriptive analysis, we get an important difference in employment trends between manufacturing and services over the period 1999-2011. We have analyzed the broad trend of employment for each professional group giving emphasis to employment change within and between sectors in terms of structural change. The picture of employment dynamics over the period 1999-2011 can be summarized as follow: overall upskilling (manufacturing + services); job polarization in services mostly due to between-sector shifts; relative upskilling in manufacturing due to negative structural change and contraction of low-skill occupations; middle-skill occupations decrease within sectors. In terms of determinants of employment change by skill group, we learnt the existence of different relations for each professional group. Managers appear to be less sensitive to labor compensation variation compared to Manual workers; also innovation strategies are various at sectoral level impacting differently on job creation. Product innovation positively impact on job growth for all professional categories and particularly for Managers. On the contrary, process innovation leads to job destruction mainly for Manual workers being substituted by machines.

**Wim Cofino, Nadja Dokter, Sylvia Jahn, Totti Konnola, Johan van der Poel, José Manuel Leceta, Caroline Vandenplas, Endika Bengoetxea and Mathea Fammels.**

**European Institute of Innovation and Technology (EIT), Hungary.**

***Strengthening Knowledge Triangle Integration in Europe***

**Abstract:** The European Institute of Innovation and Technology (EIT) is an independent body of the EU established in 2008 to increase European sustainable growth and competitiveness and to reinforce the innovation capacity of the EU Member States and the Union.

To achieve these objectives, the EIT implements so-called Knowledge and Innovation Communities (KICs) to tackle major societal challenges. KICs implement the concept of entrepreneurship driven Knowledge Triangle integration in order to address the situation whereby excellent academics, businesses and entrepreneurs work in isolation from each other. This fragmentation presents unfavourable conditions to spur innovation and entrepreneurship and thus hampers Europe's global competitiveness.

By bringing together partners from leading higher education institutions, research centres and companies across Europe in highly integrated and innovative partnerships, KICs develop and implement activities that integrate the Knowledge Triangle (higher education, research and business) to effectively transmit and share knowledge, information and skills for joint exploitation. KICs generate new and innovative products, services and business models, new ventures, and train a new generation of change agents with an entrepreneurial mind-set.

The concept of Knowledge Triangle integration acts as a boundary object and is the subject of increasing attention in national and European policies though it is to date not well defined in literature. The EIT pursues a more thorough elaboration and description of the said integration as the basis for the set-up and development of its KICs and for the sharing of good practices with its stakeholder community.

To this end, the EIT is conducting a study in which Knowledge Triangle integration will be explored in a broad context. Similarities and differences with concepts described in literature will be examined and attention will be paid inter alia to concepts such as the triple helix, third generation universities, as well as practices that facilitate the co-operation between higher education institutions and industry. In addition, the different dimensions of integration will be investigated.

At the EU-SPRI conference, the intermediate results of the study will be reported. The final findings will be presented in a scientific publication and a report planned for the end of 2014.

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### ***The Skill-Content of Green Technologies***

#### **Abstract:**

In the wide spectrum of expected impacts of the transition towards environmentally sustainable economies, those that affect employment are among the most relevant due to their societal importance. This is due to the opportunities and the threats that job creation, destruction and reconfiguration pose to modern society, especially in turbulent times of crisis. In contrast with the traditional wisdom that environmental protection harms economic growth and job creation, recent evidence suggests that the technological transition towards a greener and low carbon economy engenders opportunities that can exert positive effects on employment (Bazdek et al., 2008). A staple of these studies is that the adoption of environmental innovations is associated with positive employment effects. Further elements emerging from this literature are mostly concerned with the uneven impact of different types of environmental innovation, e.g. end-of-pipe versus cleaner production technologies (e.g. Horbach and Rennings 2013; Licht and Peters, 2013). We believe that the persistent lack of detailed analyses on the skill content of the jobs created, modified (or destructed) by 'green technological change' is a significant shortcoming of this literature that, ultimately, limits the capacity to define problems and identify possible solutions for the educational and training system.

The present paper seeks to fill this gap by proposing a framework that analyses in detail the task- and skill-content of green occupations. In the framework adopted here skills are individual abilities necessary for performing work and tasks activities in a certain occupation (Autor et al, 2003; Levy and Murnane, 2004). The skill-content of an occupation usually reflects the knowledge mix that is relevant in a particular industrial sector at a specific moment. By the same token, as industry needs change over time, occupations evolve and so do the tasks and the relevant skill mix. The emergence of novel configurations in the skill mix primarily reflects technological changes that redistribute tasks and responsibilities across heterogeneous workers.

The case of green technologies represents an interesting application for this approach. Not only green technologies are the most direct way to address climate change problems and resource scarcity, but they also involve fundamental changes in the way products are designed, processed and disposed off. We hence expect the skills required in jobs more exposed to green technologies to differ considerably from the ones in twin jobs not exposed to green technologies.

To test whether skill content of jobs differs depending on the exposure to green technical change, we develop a new and original dataset merging together data on skills and patents. For the skill part, we rely on the Occupational Information Network (O\*NET) electronic database of the U.S. Department of Labour (DOL). O\*NET collects information on job



characteristics for 900 detailed occupations (8-digit), assigning importance scores to a common set of 98 tasks used at the workplace. We use statistical techniques as principal component analysis to build four skill indicators. The first is an indicator of skill specificity to capture the fact that green jobs usually require technical and vocational qualifications. The second is the indicator of routinization, usually employed in the literature (Autor et al. 2003), while the third is an indicator of job offshorability, which is crucial to assess the effective employment impact of green technologies. The fourth is an indicator of skill diversity that captures the fact that green technologies recombine knowledge from different domains; hence, occupations more exposed to green technologies are likely to require a broader skill mix compared to non-green occupations.

O\*NET dataset has three main advantages. First, it allows us to distinguish between green and non-green jobs as it includes a list of green occupations (see Dierdorff et al., 2009). Second, the skill content of each occupation is continuously revised over time reflecting task reconfiguration within each occupation. Third, O\*NET uses the Standard Occupational Classification (SOC) system and can hence be matched with other sources of occupational information such as the US Bureau of Labor Statistics (BLS). This allowed us to merge O\*NET data with BLS employment shares by occupation and 6-digit NAICS sectors. The sectoral dimension is crucial to build our proxies of technology exposure, measured with patents. We attribute USPTO patents to NAICS sectors using the concordance between IPC classes and economic activities proposed by Lybbert and Zolas (2014). The concordance, based on an 'algorithmic link with probabilities' (ALP), reflects the relevant knowledge available to the sector rather than the actual knowledge creation, making it more suitable for our purposes than other concordances aimed at measure knowledge creation. Furthermore, we are also able to identify patent applications related to environmental technology fields (based on IPC classes), which are expected to capture the 'green side' of technological change. Additional information on structural features of US manufacturing sectors has been retrieved from the NBER-CES Manufacturing Industry Database, mainly: ICT capital intensity, trade exposure, energy and material input (and costs).

Given the scant of literature on green skills, the main goal of our empirical analysis is to identify the skill profile of green occupation and, as a second step, to explain differences in the skill content using our measure of technology exposure. More in detail, our empirical strategy is designed to compare green and non-green occupations along the four skill dimensions defined above. A key aspect of this comparison is to identify the right control group for the comparison. In the first exploratory part, we rely in the classification of green occupation proposed by O\*NET and test whether the group of green differs from the group of non-green in any of the four skill indicators. Second, we use our continuous measure of exposure to green and non-green technology to test whether significant skill differences, if any, are explained by technology exposure. Finally, we redefine our control group of non-green occupations keeping only those occupations similar in terms of broad occupational characteristics, i.e. engineers or technicians, and carry out a standard difference-in-difference estimator, also exploiting the time variability of our data. This last step seeks to identify causal effect of green technology exposure on the skill composition of the workforce.

JEL: O33; Q55; J21

## REFERENCES

- Autor, D. H., Levy, F. and R.J. Murnane (2003) "The skill content of recent technological change: An empirical exploration". *Quarterly Journal of Economics* 118 (4), 1279-1333.
- Bezdek, R. H., Wendling, R. M., and DiPerna, P. (2008) "Environmental protection, the economy, and jobs: National and regional analyses". *Journal of Environmental Management*, 86 (1), 63-79.
- Dierdorff, E.C., Norton, J.J., Drewes, D.W., Kroustalis, C.M., Rivkin, D. and Lewis, P. (2009) *Greening of the World of Work: Implications for O\*NET-SOC and New and Emerging Occupations*, The National Center for O\*NET Development ([http://www.onetcenter.org/dl\\_files/Green.pdf](http://www.onetcenter.org/dl_files/Green.pdf))
- Horbach, J. and Rennings, K. (2013) "Environmental innovation and employment dynamics in different technology fields – an analysis based on the German Community Innovation Survey". *Journal of Cleaner Production*, 57, 158-165.
- Levy, F., and R.J. Murnane (2004) *The new division of labor: How computers are creating the next job market*. Princeton University Press.
- Lybbert, T. J., and Zolas, N. J. (2013) "Getting patents and economic data to speak to each other: An 'algorithmic links with probabilities' approach for joint analyses of patenting and economic activity". *Research Policy*, 43 (3), 530-542 .
- Licht, G., and Peters, B. (2013) "The Impact of Green Innovation on Employment Growth in Europe" Working Paper N. 50. WWWforEurope.

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***The participation and adaptation of universities to the emerging role of the European research Council (ERC)***

**Abstract:** Aim of the paper

The objective of the paper is to empirically assess and to compare the strategies and institutional responses that universities in Spain develop regarding the impact that the launching and regular functioning of the European Research Council and its funding is producing. The paper aims to address the issue of the potential impact of European funding instruments in the institutional changes at the level of traditional research organisations, in this case, public universities.

**Research Questions**

We aim to address several research questions: a) is there a distinctive profile of universities hosting a significant number of ERC grantees, in terms of their scientific quality and visibility at the outset of the ERC programmes? b) has participation in the programme been associated with a reinforcement of already existing scientific excellence conditions (top research universities) through positive feedbacks effects? c) can we find differences across higher education institutions in their adaptive behaviour towards this European policy?, d) under which institutional conditions is the ERC's objective to support the move of research organisations to excellence more likely to be implemented? Here, and drawing upon our own previous research, we pay special attention to two organisational attributes: external autonomy and internal authority.

More specifically, we want to shed light on the question of whether and how the universities have implemented some strategies, policies and measures to attract this kind of resources, either through incentives or mechanisms to promote that their academics and researchers get such grants, or through the recruitment of external researchers, already funded and coming from other institutions.

**Analytical framework**

The overall theoretical premise of institutional analysis is that institutions affect the incentives confronting individuals and their resulting behaviour (Ostrom, 2005); for organisational institutionalists they also define the context within which organisations interact with each other, and organisations change in response to pressures and values imposed on them by powerful actors in their environment (Campbell, 2004). The paper is based on the institutional analysis of organisations literature and explores the organisational strategic responses (Oliver, 1991) to the changes produced at EU level. The paper relates to recent findings coming from evaluations carried out (e.g. EURECIA project) on the transformative impact of the setting up of the ERC in different countries. We believe the focus on research organisations is relevant not only because impact on universities and research institutes is an explicit part of ERC's overall mission, but also because research organisations provide the organisational conditions for researchers to perform and thus are likely to change as a result of powerful signals by funding instruments.

### Methodology

The period of the analysis covers from 2007, year in which the ERC began its work to 2012-2013, a time period in which the agency granted aid funding to a total of 200 scientific research projects linked to some higher education institution and/or research center in Spain. Methodologically, we combine quantitative and qualitative techniques; the paper first provides basic information on the applications and grants obtained by researchers aiming to base their research at Spanish institutions.. Secondly, the paper presents a positional analysis of the institutions' scientific productivity patterns in term of publications results and indicators of visibility and quality. For this we have used as reference the data of scientific publications collected by Scimago Lab (2006-2010); a total of 18 public universities were selected, most of them -15 - geographically distributed between each of three Spanish regions with the highest volume of scientific production (considering the total number of scientific articles produced between 2006 and 2010) - and the remaining in different regions that only have a single university in its territory For the final selection of the universities under study, the main criterion was the research performance of those universities, taking as reference the Spanish universities ranking by normalised impact of scientific publications (covering the years 2006-2010), and eventually selecting five universities. The logic used for selecting cases was to control the possible effect that the research quality of universities variable could have (as a possible initial advantage) on the success or failure in the participation of their researchers in highly competitive funding processes as well as consideration of the regional environment variable in the phenomenon under study.. Next based on qualitative interviews, the paper explores the organisational strategies and initiatives followed by the different universities at different managerial levels to promote the application to ERC grants and to attract, recruit and retain talent through potential ERC grantees. In this qualitative part, we aim to explore also the impact that the presence of ERC grantees has in term of strategic capabilities and more concretely those related the changes of human resources practices within the organisation.

### Relevance and expected results

We expect the findings of the paper will contribute to the theoretical debates that the Workshop aims to advance, with a particular focus on “instruments” and “institutions” and their interactions. The questions we address in the paper are relevant for the debates around organisational diversity and change in the HE and research domains, and about whether European policy is promoting organisational convergence towards excellence or growing differentiation/stratification in the European research area. This piece of work is also more broadly related to policy implementation and the role of organisational conditions in the process.

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***Implementing challenge-orientation in the non-hierarchical setting of R&I policy: Old wine in new bottles or real transformation?***

**Abstract:** This proposal fits well with the conference objectives and the outline of the special session on challenge-oriented Research and Innovation (R&I) policy, as it addresses the complexity of implementing challenge-oriented policies.

This contribution is about implementing challenge-oriented R&I policies in the non-hierarchical setting of innovation systems (IS). It is a conceptual contribution bridging the IS literature with governance and policy implementation literature. At the same time, it features new empirical material from scenario work on the European Research Area (see VERA project at <http://eravisions.eu>) as well as insights from a comparative study on the formulation and implementation of the national innovation policy strategies of Sweden, Germany and the UK.

**Rationale:**

In recent years the traditional rationales of R&I policies like fostering competitiveness and innovation capability have been complemented. Nowadays we can observe the establishment of large scale national innovation policy strategies to foster innovation that addresses the “grand challenges of our time” as proposed in the Lund Declaration in 2009: “[...] challenges must turn into sustainable solutions in areas such as global warming, tightening supplies of energy, water and food, ageing societies, public health, pandemics and security. [...] Responses to Grand Challenges should take the form of broad areas of issue-oriented research in relevant fields” (Lund Declaration 2009). The derived paradigm is referred to as the new mission-orientation of R&I policy.

This “normative turn” implies changes in the requirements of its instruments such as addressing the challenges in a problem-oriented manner without merely focussing on a certain technology or industrial sector. The conceptual and empirical question which appears at this point is whether we observe this shift in the strategy and priorities of R&I policy being implemented in a transformative sense. This would mean that the intended impact can be realized at the performance level of research and that behavioural additionalities take place instead of short-termed adaptive behavior and inconsequential rhetoric.

Conceptually, this means that we want to discuss how the prominent model of R&I activities and the governance structures for the R&I landscape – the IS model – allows for the inclusion of strategic orientation. This task will be pursued by an empirical stocktaking on how strategic policy-making according to the systems approach is being implemented in selected cases with a view to

- the formulation of policy objectives and their “translation” into policy instruments according to the challenge orientation

- the coordination between the entities responsible for the implementation of these policies and
- the adaption of strategic capacity of the involved policy actors and the research community.

We will elaborate on these aspects by assessing the growing trickiness of addressing the grand challenges for policy makers and researchers alike by presenting empirical evidence on the challenges of formulating adequate support measures (policy makers) as well as establishing interdisciplinary research projects asking “the right cross-cutting questions and delivering future-complaint feasible answers” (research community).

In the literature on the policies of R&I the innovation system has been assigned certain functional levels. Most recently, for example, Barré et al (2013) have referred to orientation, programming (and funding) and research performance (ibid. p. 190). The connections between the levels are outlined in theoretical perspective using the principal-agent-approach (see Barré et al. 2013, p. 190). According to this understanding, there are two agency relationships: the government acts as a principal for the agencies and research councils and the agencies act as principals for the researchers. The delegation does not take place in a hierarchical setting. Moreover the informational asymmetries observable in many principal-agent-relationships are also very likely to exist here, and to put the performing level in a situation where it can pursue its own agenda to a large extent instead of the “task” delegated to her by the principals.

We argue, that challenge-orientation is not foreseen in the IS concept, and that in the implementation phase, an “orientation failure” might materialize. Therefore we would like to interlink the theoretical frameworks with our empirical insights to facilitate an incorporation of this notion into the IS heuristic. In previous work, we pointed out (2012: 170ff): “A reflection on the now well established innovation system approach underlines that this heuristic concept focuses on the well-functioning of the system, but does not provide for a strategic or normative orientation. [...] Despite all the refined understanding of innovation systems, the instruments derived from the innovation system approach are mainly directed at enhancing the innovation ecosystem in order to strengthen innovation capability. So far, there is no attempt to build on the innovation system heuristic in order to modulate innovation journeys towards certain desirable objectives. So whereas system failure appears to be addressed, “orientation failure” has largely not been tackled. The question is whether systemic policy instruments, which are designed to address the capability of innovation systems, are also suited to address new requirements of research and innovation activities implied by the normative turn of innovation policy.”

We build our argument on the fact that the setting of R&I policy is a non-hierarchical one. Looking at examples of IS in modern democracies we find that R&I policy is one of the fields where the steering power of the government over the activities performed (in the research landscape) is limited. There are two reasons for this:

- Due to the diverse nature of stakeholders in the field and the delegation of public tasks (programming and funding) to various agencies, the regulatory setting can be described as “multi-actor and multi-level governance”, rather than “government”.
- Excellent research, creativity and innovativeness can only appear in a free, less regulated environment. Consequentially, the available toolbox of policy instruments is directed to

setting incentives, while regulations as “sticks” of a top-down nature are rarely used.

So, the question is how a strategic orientation can be implemented.

Barré et al. (2013) argue that the dyadic delegation from government to the agencies and from the agencies to the researchers work more or less without disturbances. It is assumed that the agencies implement the orientation set by the government in their programming and funding priorities. Further, there is the assumption that researchers adapt their research according to the available funding options. However, the inherent top-down logic in this model might rather cause short-term adaptive behavior and “presenting old wine in new bottles” rather than a transformative change of behavior at the level of performing and programming.

In our previous work we have analyzed whether systemic instruments can be complemented in such a manner to take on board a challenge-orientation. In this context we have discussed foresight and participatory evaluation and found that participatory elements and bottom-up governance elements in these instruments have a potential to strengthen the intended policy impact, i.e. to implement challenge-orientation of R&I policy also at the level of programming and partly at the level of performing (Daimer et al 2012).

#### Approach:

In this contribution, we seek to widen the understanding of implementing challenge-orientation in R&I policies by analyzing the potential of different governance structures. We do so by presenting and discussing new empirical material. We seek to show how the orientation function can be filled out in an IS avoiding top-down government processes and instead building on governance structures which include bottom-up elements which allow for co-creation of priorities by the other function levels. As mentioned before scenarios of the European Research Area created by the VERA project (<http://eravisions.eu>) and examples from three selected national cases will help to illustrate the potential effects of different governance structures on the interplay between orientation, programming and performing

#### Expected outcomes:

While the challenge-orientation of R&I policy starts to materialize more and more in innovation strategies and large research programmes such as the European “Horizon 2020” framework, the question remains whether this normative turn remains at the level of narration or whether this is followed by transformative changes at the programming and performing levels of the systems. With this contribution we want to expand the conceptual knowledge on how challenge-orientation can be implemented, starting from our initial claim that IS in principle might suffer from an “orientation failure” which hampers the implementation of policy objectives other than knowledge production and innovativeness. We seek to contribute to the empirical evidence available by discussing our two applications with a view to contribute to the scientific discussion as well as to practical policy-making



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***Institutionalization of the academic third mission: what is to be gained?***

**Abstract:** Introduction

Society increasingly expects academic research to contribute to society. The EU and a number of European countries have included knowledge transfer as a task of universities in their legislation (Kitagawa, 2013). As a result, the conditions under which academic research is supported have changed (Hessels et al., 2009). To give a few examples: in Horizon 2020, collaboration with societal partners is a requirement for funding; in the US, the UK, Switzerland and The Netherlands research councils have introduced the societal impact criterion in funding procedures (European Commission, 2013; Dance, 2013; NWO, 2013), and in the UK and The Netherlands, societal impact is a criterion in research assessments (REF, 2014; VSNU, KNAW, NWO, 2009).

However, this emphasis on what is also referred to as the Third Mission (TM) creates a struggle for many researchers (Lok, 2010, Owens, 2013, D'Este, Tang et al., 2013). We aim to study where the TM struggle originates from and how it can be overcome. This aim relates to the conference topics of 'old actors, new roles' and 'open science, impact agenda's and public engagement', because of the focus on how academic researchers take up their new role of impact and public engagement. Our research question is: how can the TM not only be formally implemented, but also in everyday academic practice? We define the TM as all contributions to other audiences than scientific peers, that aim to result in a change in acting or thinking of this audience.

**Theory**

Receiving reputation is crucial for researchers to develop an academic career, as it provides access to funding and research positions (Van Arensbergen et al., 2013). Traditionally, for most researchers reputation is not based on their TM activities, but on publications and citations (Merton, 1957). The work of Whitley (2000) shows that the ways researchers can develop their reputation differ across scientific fields. Among other factors, it depends on the internal organization of their field and the audience structure of their field.

The processes of developing reputation is regulated by institutions, which can originate from within social communities and formal organizations. Together, they determine the boundaries of the behavior of scientists (Laudel & Glaser, 1998). Institutions in social communities, such as a scientific field, are those implicit behavioral rules that are agreed upon within the community. In the case of TM, these rules can be about whether TM is considered to be equal to research and education and what activities are considered to be appropriate TM activities. Institutions set on the level of formal organizations are those rules that explicitly regulate behavior. In the case of TM, these rules are for example about which TM activities are recognized in research assessments and whether TM activities are part of job descriptions.

Social and formal institutions related to the TM are not necessarily both present or aligned.



This can create a struggle for scientists. For example, scientists encounter the TM criterion in funding procedures, but don't know how to include and evaluate it in research proposals (Lok, 2010). In research assessments, scientists are increasingly requested to address the TM, yet they fear this will decrease scientific quality, through which reputation is traditionally gathered (Owens, 2013; Merton, 1957).

Additionally, the misalignment might be stronger in some fields than others. The formal institutionalization of the TM is strongly biased towards patenting, licensing and spin-off companies (Geuna & Muscio, 2009; Rothaermel et al. 2007). Even in the natural and life sciences, these activities are an exception (Balconi et al, 2004, Agrawal & Henderson), but especially in the social sciences and humanities focus on commercialization of research results is rather low. Nevertheless, many researchers in these fields are investing in the TM (Olmos-Peñuela, Molas-Gallart et al, 2013).

From this follows our hypothesis: if the social institutions in a research community and formal institutions concerning the TM applied to this community are both present and in line with each other, the TM will not cause problems in the development of scientists' reputation in this research community.

#### Methodology: Case selection

To test our hypothesis, we have selected three different types of fields in the Netherlands: the social sciences and humanities; physics, and interdisciplinary fields, such as climate sciences and artificial intelligence. By selecting these three types we cover the entire spectrum of diversity within types of academic fields identified by Whitley (2000). The Netherlands is a good case to study our research question, since all elements of formal institutionalization of the TM are present: it is included in the law on higher education; it is a core mission of science policy; it is a criterion in funding procedures and research assessments; universities included it in performance agreements with the Ministry of Science, and nearly all universities have a technology transfer office.

#### Method

We collect our data through focus groups (Merton, 1987) which allows us to gather data on attitudes and opinions of participants in a dynamic social context (Sim, 1998). In contrast to a regular interview, focus group participants have both to explain themselves to and query other participants (Morgan, 1996). By studying the TM in a social context, we aim to capture how the social institutions concerning the TM are discussed in a research community and how the community relates it to formal institutions concerning the TM and reputation. The composition of participant groups demands a balance between homogeneity to allow for mutual understanding and speaking freely (Morgan, 1996) and heterogeneity to have different inputs and prevent polarization (Sim, 1998; Kitzinger, 1995). We have selected scientists with TM experience, so these experiences can serve as input for discussions. This type of participant selection is referred to as segmentation (Morgan, 1996). There are 8-12 participants per group and two groups per type of field.

The interview guide is constructed based on a priori analysis (Kidd & Marshall, 2000), which consists of previous research and dissemination activities including giving lectures, consultancy activities and organizing workshops. The guide consists of three main topics: 1) example participants' TM activities 2) the ideal future of the TM in five years' time 3)

important knowledge to facilitate further development of the TM. Discussions were audio recorded and noted on flip-over sheets. Both will be analyzed using Atlas.ti.

### Preliminary results

At this moment, we have conducted the social sciences and humanities (SSH) focus groups. The other four groups are scheduled in April 2014. A first preliminary analysis has been performed. Our first findings are that invited researchers regularly did not understand why we invited them to discuss TM activities: 'We don't make money out of our scientific results.' Yet, this researcher and his colleagues collaborate with numerous organizations from civic society.

Participants in both groups described many different TM activities, ranging from television interviews to action research. Patents, licenses and spin-off companies were not mentioned and commercial activities were a rare exception. Regularly, participants had never thought of activities mentioned by others as TM activities and sometimes they did not even think of their own as such. Yet, through discussing them, they were all recognized as appropriate TM activities in SSH.

For the near future, participants would like to see the TM as an obligation for science. They believe it should be a group effort, in which some researchers are more active in doing research and others in doing TM activities. This can only happen if TM activities become an acknowledged source of recognition. The TM should be fully integrated in human resource policies and research assessments, having the same value as education and research tasks. Some participants experienced TM activities hampered them in their career or that their TM activities were not recognized in research assessments.

To facilitate this transition, the TM should be more discussed between researchers, so that the attitude towards it becomes more positive and that a clear vision can be developed. The need for this is exemplified by one of the participants: 'this afternoon is the first time I feel appreciated for my TM activities. Yes, really!' It should also be facilitated through practical organizational support and training.

The three main questions participants think should be answered to facilitate this change, are: 1) how can we create the preconditions to improve the TM? 2) How can we organize TM activities on a practical level? And 3) How can we assess TM activities?

### Preliminary conclusion

The fact that TM activities were not necessarily recognized at first sight, suggests that the TM in the SSH research community is poorly institutionalized or that it is differently institutionalized in different sub fields. The TM seems to be accepted as a task by the participants, and as such it could be thought of as socially institutionalized. However, it is far from institutionalized in practice. There is a lack of recognition by peers and in formal assessments, which creates a struggle for researchers within their own field and within their institutions. This is directly to accepting, although we can only confirm or reject it after completing our study.

### References

Agrawal, A and R Henderson 2002 'Putting patents in context: exploring knowledge transfer from MIT'. *Management Science*, 48(1): 44–60.

- Balconi, M, S Breschi and F Lissoni 2004. 'Networks of inventors and the role of academia: an exploration of Italian patent data.' *Research Policy*, 33: 127–145.
- Dance, A., 2013. 'Pack a punch.' *Nature*, 502: 397.
- D'Este, P., P. Tang, S. Mahdi, A. Neely and M-Sánchez-Barrioluengo, 2013. 'The pursuit of academic excellence and business engagement: is it irreconcilable?.' *Scientometrics* 95: 481-502.
- European Commission (2013), 'Horizon 2020: Work Programme 2014 – 2015.' (European Commission Decision C (2013) 8631 of 10 December 2013)'.
- Geuna, A. and Muscio, A. (2009) 'The Governance of University Knowledge Transfer: A Critical Review of Literature.' *Minerva* 47: 93–114.
- Hessels, L.K., H. van Lente, R.E.H.M. Smits, 2009. 'In search of relevance: the changing contract between science and society.' *Science and Public Policy* 36 (5): 387-401.
- Kidd, P.S. and M.B. Parshall. 'Getting the focus and the group: enhancing analytical rigor in focus group research.' *Qualitative Health Research* 19(3): 293–308.
- Kitagawa, F. and C. Lightowler, 2013. Knowledge exchange: A comparison of policies, strategies, and funding incentives in English and Scottish higher education. *Research Evaluation* 22: 1-14
- Kitzinger, J., 1995. 'Introducing focus groups.' *British Medical Journal* 311: 299–302.
- Laudel, G. and J. Gläser, 1998. 'What are institutional boundaries and how can they be overcome? Germany's collaborative research centres as boundary-spanning networks.' *Veröffentlichungsreihe der Arbeitsgruppe Wissenschaftstransformation des Wissenschaftszentrums Berlin für Sozialforschung (WZB)*, No. P 98-401.
- Lok, C., 2010. 'Science for the masses.' *Nature* 465: 416-418.
- Merton, R.K., 1957. 'Priorities in scientific discovery – A chapter in the sociology of science.' *American sociological review* 22(6): 635-659.
- Merton, R.K., 1987. 'The focused interview and focus groups – Continuities and discontinuities.' *Public Opinion Quarterly* 51(4): 550-566.
- Morgan, D.L., 1996. 'Focus Groups.' *Annual Review of Sociology* 22: 129-152.
- NWO, 2013. *Handreiking Kennisbenutting Vernieuwingsimpuls 2014*. Den Haag: NWO.
- Olmos-Peñuela, J., J. Molas-Gallart, E. Castro-Martinez, 2013. 'Informal collaborations between social sciences and humanities researchers and non-academic partners.' *Science and Public Policy* first published online October 17, 2013.
- Owens, B., 2013. 'Judgement day.' *Nature* 502: 288-290.
- REF, 2014, 'Research Excellence Framework.' <http://www.ref.ac.uk/> (website visited 12-2-2014)
- Rothaermel, F.T., A.D. Agung and L. Jiang, 2007. 'University entrepreneurship: a taxonomy of the literature. *Industrial and corporate change* 16(4): 691-791.
- Sim, J., 1998. 'Collecting and analyzing qualitative data: issues raised by the focus group.' *Journal of Advanced Nursing* 28(2): 345-352.
- Van Arensbergen, P., L.K. Hessels and B. van der Meulen. *Talent Centraal*. Den Haag: Rathenau Instituut
- VNSU, KNAW, NWO, 2009. 'Standard Evaluation Protocol.' [www.knaw.nl/sep](http://www.knaw.nl/sep) (website visited 12-2-2014)
- Whitley, R., 2000. 'The intellectual and social organization of the sciences.' (2nd edition). Oxford: Oxford University Press

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***What are the loci for the creation or evolution market infrastructures? Are they new and specific structures? A focus on organisational issues of market infrastructures creation or evolution***

**Abstract:** This paper focuses on the loci for the creation or evolution of innovation and market infrastructures. In two previous papers that are forthcoming (Delemarle and Larédo, forthcoming a and b), we have proposed the notion of “market infrastructures” to characterize the framing of markets for radical innovations. Market infrastructures are defined as a set of rules, norms and values that are a pre-requisite for markets to exist in the future. This links with work by Courtney et al. (1997) in management about “market shaping activities”. Indeed, rules, norms or values can be shaped in different ways by different types of strategic actors (Delemarle and Larédo, forthcoming b). The activity of defining the term “nanomaterial”, or the setting up of material specifications are elements of the market infrastructure for nanotechnology-based markets. Indeed, they are essential for markets to exist in the future: without a formal agreed definition on what a nanomaterial is, or without material specifications so that buyers and sellers agree on what they sell or buy, no market will ever exist. This notion of market infrastructures also links with governance work (Kuhlmann, 2002; Borrás and Edler, 2012; Bonneuil et al., 2008). Indeed, market infrastructures are central to govern S&T systems in a process of change. The study of arenas, of their internal dynamics and inter arenas dynamics is essential to understand the shaping of market infrastructures and thus of markets (Delemarle and Larédo, forthcoming a). It requires a political work (Fligstein, 1996) to organise the consensus on a piece of market infrastructures between the different actors (to punctualise it (Vinck, 2010)) and even more when it happens at a global scale.

We were struck in our work by the fact that market infrastructures were essentially created within arenas within the boundaries of existing organisations. We showed that existing organisations are used and adapted by strategic actors to shape market infrastructures for radical innovations. This was a surprise because we expected that specific new organisations developed on purpose to support the development of new market infrastructures would be more relevant: the rationales would be that new organisations would be very targeted and thus more efficient to discuss needs for radical innovations. This was not the case. In the case of nanotechnologies, OECD and ISO, two generic and long standing organisations were leading in the structuring of markets for nanotechnology based products, while ad-hoc organisations such as the International Council on Nanotechnology failed to play a role. We pushed forward two hypotheses to explain this result: the first is a legitimacy issue. Existing structures have an existing legitimacy, which among other things rely on their process and procedures. For instance, ISO has transparent rules of functioning, various steps need to be followed in the writing of a standard document, rules of consensus and votes are known etc. The second is an organisational issue. Both ISO and the OECD rely on internal structures based on dedicated secretaries and standard member bodies. They have employees, means

of implementation, mechanisms to develop activities etc.

In this paper, we propose to deepen our understanding of such loci for the creation or evolution of market infrastructures. We thus propose to study another well-known locus for the framing of markets: the International Roadmap for Semiconductors (ITRS) which has been organising the microelectronics market since the end of the nineties (Kahane et al., 2010). The ITRS has been the central coordination tool to align actors within this highly interdependent B-to-B industry. Moore's law has been dictating the pace of innovations. It is an underlying driver of the ITRS as it defines technological targets to reach. The ITRS constitutes a large networked organisation with working groups meeting on a regular basis to produce updates of the roadmap every two years and a new document every four years. Today, the semiconductor industry faces new challenges: for the first time since the ITRS was set up, technological targets could not be met. Moore's law is questioned (it started in the second half of the 2000's) and some actors develop alternative thinking. They aim at setting up a different paradigm, which is labelled "more than Moore" rather than deepening the existing paradigm ("more Moore"). Instead of basing the roadmap on technological targets dictated by Moore's law, they propose to start from the needed functionalities and to develop, using other technologies (i.e. "More than Moore" based-technologies), solutions to fill the needs. This is a radical change, because as for now, users were not directly included in the writing of the roadmap. How do actors tackle the change? Do actors need to develop other roadmaps or will they do it within the existing ITRS? Based on the nanotechnology case study, we would argue that because of legitimacy issues and because of the organisational strength of the ITRS, actors would aim at changing the paradigm within the existing structure.

Based on a series of interviews, we draw a map of existing and developing arenas that aim at changing the existing market infrastructure (i.e. the ITRS). We analyse them by focusing on the four criteria that we identified in the nanotechnology case study.

- (1) The degree of specificity. Is the arena a generic one (here the ITRS) or is it a dedicated one?
- (2) The degree of openness. How easily can actors join an arena? What are the cognitive prerequisites to participate in debates? To what extent the participation in the arena is conditioned by an expertise.
- (3) The level of transparency. Transparency relies on the existence of rules of functioning, on the ways the working process is formalised.
- (4) The organisational features. Are the activities developed in the existence of stabilised processes that enable to organise the work?

The discussion builds on the result from the case study and deepens what we consider a challenge in science and innovation policy: the organisational dimensions to support S&T change.

Main references:

Bonneuil, C., Joly PB. and C. Marris, Disentrenching Experiment: The Construction of GM Crop Field Trials As a Social Problem, *Science Technology Human Values* 2008; 33; 201

Borrás, S. and J. Edler, The Governance of Change in Socio-Technical and Innovation Systems: Some Pillars for Theory-Building

Deleamarle, A. and P. Larédo, forthcoming a " Governing markets for radical products by designing market infrastructure. Market infrastructures – towards a market paradigm?", 4S-EASST Conference 2012, Copenhagen Business School, Denmark. October 2012.  
Forthcoming in Borrás and Edler (eds), book on governance of S&T change.

Deleamarle, A. and P. Larédo, forthcoming b, Tentative governance for new markets by creating market infrastructures, special issue Research Policy on tentative Governance, ed. Kuhlman S et al.

Fligstein N, 1996 "Markets as politics: a political-cultural approach to market institutions", American Sociological Review, Vol. 61 (August: 656-673).

Kahane , B., Deleamarle, A and P. Larédo, 2010, Coordination and Collective Long Range Planning in an Open Innovation System: Shaping the semiconductor industry through "filières" and roadmaps nanofiliere, LATTs

Kuhlmann S., 2007, Rationales and evolution of public "knowledge policies" in the context of their evaluation. Presentation at the Seminario Internacional CGEE, Rio de Janeiro, December 3-5 2007

Vinck, Dominique, 2010. The sociology of scientific work, Cheltenham, Edward Elgar, p245

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***Cold numbers. Superconducting supercomputers: a failed revolution?***

**Abstract:**

In 1980 IBM announced a revolution in computer technology which was based on superconducting materials as opposed to semiconductors. The outcome of the heavily R&D dependent, largely subsidised by public funding, project will be illustrated in this paper. The case of superconducting computers is extremely interesting as in it one sees the interaction between big science, technological domains, innovation and the role of policy. In fact, superconductivity represents a case of a paradigm change that concerned the most important private player of the time, i.e. IBM, government agencies and other parties such as universities and other strategic suppliers. Put in another way, this "case" provides the prospect to study the opportunity, or even the necessity, and the effectiveness of a Science, Technology and Innovation (STI) policy aimed at creating a new technological system, revolving around the new scientific principle of superconductivity since its discovery in 1911. The interest of governments and their active intervention in computer technology is a constant feature of the technology itself. The very birth of the field was characterised by heavy public investments in the technology and companies developing it: the history and realisation of the first monster computer built in the 1940s, ENIAC, under the very generous American government aegis, is widely known.

Today, as in the 1940s, many private and public interests, national security concerns and the willingness to retain international standing are part of the computer technology game: STI policy is central to the latter. The case at hand demonstrates how the Ss, Ts and Is of STI are inextricably intertwined and, after decades of research effort, the relevance of it in policy thinking is still paramount.

Let us hint at some features of the superconducting computer project and then go back to STI policy.

The superconducting revolution was based on superconductor materials which would substitute semiconductors. "Superconductivity" means that electricity finds no resistance when it flows through superconductors. However, selected materials, to become superconductors have to be cooled down to near absolute zero (-273 °C) temperatures. If successful, this radical innovation would have increased computing rates up to 100 times. IBM started working on this type of computer in the mid-1960s and by 1980 researchers at IBM felt confident enough to disclose the project. They thought that the technical difficulties had basically been overcome, so that technical feasibility and economic viability were within reach.

The resources invested in this new and promising technology were very large: between the mid-1960s and the early 1980s a research group made up of 100 to 120 researchers was employed in the best equipped laboratories of IBM, expenditure reaching US\$ 20 m per



year. The project, though, was dropped in 1983, as semiconductors were progressing too quickly.

However, this is not the end of the story. In fact the Japanese took over and produced a working superconducting microchip a few years later, while some successful work had taken place in the late years of the Soviet Union.

Despite the fact that binary superconducting computers were never produced beyond the superconducting microchip prototypes, thirty years later superconductivity emerges as a key component of quantum computers. In fact, the company D-Wave claims to have fabricated a quantum computer which is ultrafast, but can operate only at temperatures close to absolute zero. The latter artefact has gained worldwide attention through the cover of the weekly magazine "Time" of 17 February 2014 which refers to it as the "infinity machine" which "operates at 273° below zero".

Further technological achievements due to superconductors have been attained during the last thirty years: magnetic resonance imaging, magnetic levitating trains, highly sensitive measurement instrumentation and other devices would not exist without superconductors. Furthermore, some scientific achievements have also emerged: through the study of supercold materials the Bose-Einstein "condensate" – a state of matter predicted by the two scientists which cannot be observed in ordinary conditions – could be observed for the first time.

These scientific and technological results cannot be classified as by-products or serendipitous. They are intentional developments of the superconductivity research efforts which point to the non-linearity of the evolution of the relationships between science, technology, innovation and policy. Furthermore, there emerges a blurring of the border between a failed and a successful innovation.



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***A systematic review into the role of research management in institutional research processes.***

**Abstract:**

The introduction of competitive rankings and research assessment frameworks have necessitated that research organisations continually monitor their research strengths and weaknesses. Such monitoring is essential to be able to strategically respond in a competitive environment. There is little research on the role of research management in research organisations, including universities (Hockey & Allen-Collinson, 2009). However, there is an understanding that when implemented well, research management is an essential component of the research process (Whitchurch, 2004). Despite this, an evidence-based understanding of the strategies available for research management to employ is sadly lacking. In order for organisations to structure their research management strategies more efficiently, as well as to inform practitioners of the best way to deliver their service, an understanding of the evidence for successful research management strategies is needed. The aim of this article was to provide a systematic review to investigate the evidence base for successful research management strategies as part of a move towards evidence-informed policies and practice.

The review adopted a convergent-divergent systematic review approach that incorporated an empirically structured approach such as: developing a definition; exclusion and inclusion criteria; and drawing inferences from the literature; as well as provide a pragmatic appraisal framework based on the guidelines set out by Spencer et al (2003) and Pettigrew & Roberts (2006) systematic reviews of the social sciences. The following definition guided the selection of relevant literature for this review: "What are the successes of different models and structures of research management within research organisations?" An open, keyword-base topic search of Web of Science, combined with a manual search of relevant, non-indexed management journals was employed to identify relevant articles. A total of 4266 articles were identified through these means. Articles were then manually screened by the authors (GD & AN), in order to eliminate any irrelevant articles that were either (i) not relevant for research management/administration; (ii) not focused on research processes within universities or research organisations; and/or (iii) did not include an consideration of the structures and strategies of research management/administration. At the end of this process, a total of 99 articles were included in the final review. An analysis of the article characteristics (journal, authors and keywords) was included alongside a critical appraisal of the evidence presented, in line with Spencer et al (2003) and Pettigrew & Roberts (2006), as well as an investigation of the themes discussed across the article sample.

The results showed a difference in the methodological approaches and the quality of the evidence presented in articles published in the primarily academic (e.g. Research Policy and Technovation), compared to those in the professional literature (e.g. Journal of Research Administration). There were also a number of definitions of research management/administration used in the literature. In a large number of sample articles,

research management was regarded as a role that exists, and was important for research success, though its specific nature and the characteristics of the role as it is performed, was overlooked. A further analysis of the way research management is defined revealed that within the sample, the level that research management was regarded could be divided into those that, (i) directly considered the characteristics of research management and managers as a primary variable (Direct); and (ii) considered research management and managers as part of a larger, overarching variable such as organisational culture, institutional support; support services; and knowledge management (Indirect). As such, a difference was observed in the strength of the evidence supplied under these Direct (27% of the sample articles) and Indirect (71% of the sample articles) levels of defining research management. The majority of the literature that considered research management directly was based on case studies, or qualitative, survey-data with small sample sizes. This research provided evidence for particular strategies and structures for research management, but the small sample sizes and individual case study approaches made it difficult to draw any inferences on a population scale of successful research management strategies. Conversely, the consideration of research management indirectly, affected the applicability of the evidence supplied, as well as overlooked the potential role research management plays in influencing research outcomes in strategically desired directions. Further, the top-level, undefined nature of research management as a variable included amid larger, overarching variables such as “organisational climate”, meant that any practical applications discussed in the results, were lost. Future research will need to consider research management directly, in order to provide much needed evidence of successful strategies available for research organisations.

Across the literature considering research management both directly and indirectly, a number of potential strategies were identified. These included the use of incentives (Indirect and Direct), flexible organisational policies (Indirect), and the individual characteristics of research management staff (Direct). The incentives investigated were both financial and non-financial, with financial incentive structures being the more popular strategy investigated. No strong evidence was provided for either, the level of where financial incentives are most effective, or for the characteristics of non-financial incentives that were influential. Promoting flexible organisational policies was also a strategy extensively discussed in the literature. However, as with the incentives, no empirical analysis, nor cross university comparison of restrictive policies and their effect on research processes were included in the sample. This is despite administrative flexibility being identified as an important component of entrepreneurial universities, and good organisational structure (Boardman, 2009; McAdam et al, 2005; Edgar & Geare, 2013). Finally, a number of individual qualities for research administrators/managers were identified. Identification of these characteristics was primarily achieved surveying researchers about their opinions of effective research management (Sapienza, 2005); or by surveying research managers about what characteristics they felt were essential (Hockey & Allen-Collinson, 2009). Salient characteristics such as promoting shared values (Drummond, 2003) and shared communication (Mom et al, 2012) were identified, along with more specialised strategies and skills, such as building contingency plans for working with researchers (Cole, 2007; Rutherford & Langley, 2007) and commercial knowledge (Mom et al, 2012). An area that both researchers and research administrators indicated where guidance from research management was more useful was in the financial preparation of grants (pre-award) and management (post-award) of successful grants (Mason & Learned,

2006; Cole, 2007). However, no indication was given regarding the time where research managers had the most influence (pre- or post-award). Although within the direct and indirect sample of articles, strategies such as incentives and bureaucratic free policies were suggested, they were never tested empirically. Therefore there is currently a lack of evidence about the extent, and how, such strategies are successful. More specifically, the literature overlooks the types of incentives (financial and non-financial) are effective, and at what point the financial incentives are most, and least effective. Likewise, the concept of bureaucratic policies is currently binary and completely depended on subjective views of users. Further definition of "bureaucratic policies" is required so that any improvements can be tested, and for organisations to be able to identify policies that are potentially harmful. Further research that considers research management directly, with a strong empirical methodological design is needed to inform a reliable evidence base for successful research management practice.

## References

- Boardman, P.C., Ponomarev, B.L. (2009) University researchers working with private companies. *Technovation*, 29(2): 142-153.
- Cole, S. S. (2007). "Research Administration as a Living System." *Journal of Research Administration* 38(2): 14-27,18
- Drummond, C. N. (2003). "Strategic Planning for Research Administration." *Journal of Research Administration* 34(2): 4-10.
- Edgar, F., Geare, A. (2013) Factors influencing university research performance. *Studies in Higher Education*, 38(5): 774-792.
- Hockey, J., Allen-Collinson, Jacquelyn (2009). "Occupational Knowledge and Practice amongst UK University Research Administrators." *Higher Education Quarterly* 63(2): 141-159.
- Kirkland, J. (2008) University research management: an emerging profession in the developing world. *Technology Analysis & Strategy*, 20(6):717-726.
- Mason, E., Learned, L. (2006). "The Role of "Development" in a Research Administration Office." *Journal of Research Administration* 37(1/2): 23-34,29-10.
- McAdam, R., Keogh, W., Galbraith, B., Laurie, D. (2005) Defining and improving technology transfer business and management processes in university innovation centres. *Technovation*, 25(12):1418-1429.
- Mom, T.J.M., Oshri, I., Volberda, H.W. (2012) The skills base of technology transfer professionals. *Technology Analysis and Strategic Management*, 24(9):871-891.
- Petticrew M, Roberts H (2006) *Systematic Reviews in the Social Sciences: A practical guide*. Oxford: Blackwell Publishing.
- Rutherford, S., Langley, D. (2007). "Implementation of Systems to Support the Management of Research: Commentary from a UK University Perspective." *Journal of Research Administration* 38(1): 49-60,13.
- Sapienza, A.M. (2005) From the inside: scientists' own experience of good (and bad) management. *R&D Management*, 35(5):473-482.
- Spencer L, Ritchie J, Lewis J, Dillon L (2003) *Quality in Qualitative Evaluation: A framework for assessing research evidence*. London: Cabinet Office.
- Whitchurch, C. (2004). *Administrative Managers – A Critical Link*. *Higher Education Quarterly* 58(4): 280-298.

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**A Tale of Two Frameworks: 'Grand Challenges' and the emergence of responsible innovation policy in the EU and the UK**

Keywords: responsible innovation, innovation policy, grand challenges

**Extended abstract**

In 1900, the mathematician David Hilbert published a list of 23 unsolved problems, which came to be known as the 'grand challenges' of mathematics, some of which are unsolved to this day. The term became widely used in computer science, engineering, mathematics and physics in the 1990s, and has now become Grand Challenges, writ large and used in fields as diverse as medicine and archaeology to describe intellectual problems or lacunae which the discipline is urged to put its collective energy towards overcoming. The term eventually found its way into research policy, where it did similar work in directing funding streams towards particular themes, and acquired a competitive edge in engineering, particularly in the emerging field of robotics. Most recently, however, it has acquired a different meaning, where it no longer describes challenges to formal knowledge or technological innovation, but to the planet and to society as a whole. The formulation of 'Grand Challenges', therefore, has considerable implications for the rapidly-developing discourse(s) of Responsible (Research and) Innovation as a policy framework which is meant to produce better governance of new technologies, and direct innovation towards the creation of public good.

This paper discusses work carried out through the Leverhulme Trust research programme, *Making Science Public*, as part of a project investigating constructions of R(R)I amongst scientists, funders and users developing innovations for the 'Grand Challenge' of aging populations. It uses a discursive analytic framework to examine how and to what extent external pressures and institutional norms have shaped and been (re)shaped by five 'Grand Challenge' frames during the process of creating policy aimed at delivering socially-beneficial innovation systems, probing the distinction between the EU's Six Keys of RRI (EC 2012) and RCUK's policy on responsible innovation. This exploration of points of divergence, as well as points of symmetry, through a comparison of two contexts of emergence, will enable a more nuanced understanding of the overall rise in this form of mission-oriented discourse in the policy community, and the ways in which the concept of 'Grand Challenges' is employed.

## Methodology

Research for this paper was carried out in two phases. In the first phase, sampling was based on a scoping study approach (Arksey and O'Malley 2005), using a title-based search for 'grand + challenge?' in the academic literature on Web of Knowledge (as of February 2014). While different search portals might return different numbers of documents, the purpose here was not a metrical or systematic review, but to gain a general overview of what meanings the main stakeholder group for research policy, research academics, were attaching to the term. The search returned 598 relevant documents, which were then categorised thematically through constant comparison until saturation was reached (Martin 1986), revealing that the concept of 'Grand Challenges' is framed, or used as an organizer of meaning (Goffman 1974), across the disciplines in five different ways. In order of first appearance in the dataset, these are defined herein as:

- 1) **Academic**: the largest category; theoretical, methodological or technical problems, usually considered to be obstructing the discipline's ability to advance in a particular direction;
- 2) **Catastrophic**: global threats to society/life/environment, increasingly expressed as impending doom requiring an immediate response;
- 3) **Competitive**: 'incentivised competitions' (Frey 2012) outside normal funding calls, where the best ideas or prototypes win large monetary prizes or lucrative (usually military or private) contracts;
- 4) **Programmatic**: thematic research programmes, or broad-based, multi-national, multi-disciplinary initiatives which seek new technical solutions or new pathways toward solving specific, pre-identified problems (Altevogt, Hanson, and Leshner 2008);
- 5) **Disruptive**: emergent/convergent technologies or ideas which are projected to reconfigure existing socio-economic relations and/or policy and governance (Haegeman, Weber, and Könnölä 2012)

It should be noted that some of these categories may have contextually fuzzy borders - a competition (3), for example, may be part of a larger research programme (4) devised to address an area where a field has been stuck for some time (1). However, there are also subtle differences. For example, while the Academic frame describes challenges as longstanding puzzles, within the Programmatic frame problems which have already been the focus of scientific activity are often excluded as this is seen as making the need for a 'challenge'

redundant (see Varmus et al. 2003). Similarly, in the Competitive frame 'challenge' has more the character of a dare than a puzzle.

These five frames were then used in the second phase as the basis for an approach derived from interpretive policy analysis, which considers how and by whom symbolic meanings are constructed in the process of policy creation and implementation (Yanow 1993), and applied to policy documents issued by the European Union (EU) and Research Councils UK (RCUK) in order to reveal the way(s) in which the term 'grand challenge' functions on both overt and symbolic levels within these policy structures to operationalise (a) specific vision(s) of mission-oriented scientific research.

### **Background: The evolution of 'grand challenges'**

Although this paper focuses on Europe and the UK, it is perhaps first necessary to note that use of the term in connection with Big Science-style funding programmes appears to originate with policy decisions emanating from the US, in particular the High Performance Computing Act of 1991. Drawing from a similarly-named report from the Office of Science and Technology (Committee 1991), the Act defines a Grand Challenge as 'a fundamental problem in science or engineering, with broad economic and scientific impact, whose solution will require the application of high-performance computing resources' (Sec.4(2)). In 2003, a \$200m call issued by the Bill and Melinda Gates Foundation in collaboration with the National Institutes of Health, for a 'specific scientific or technological innovation that would remove a critical barrier to solving an important health problem...with a high likelihood of global impact' or at the very least, a 'breakthrough that would be expected to overcome one or more bottlenecks in an imagined path towards a solution' (Varmus et al. 2003). Here, the list of topics had been determined by a group of scientists in the context of a substantial injection of research funds to stimulate a competitive bidding process under a particular theme. Shortly thereafter, the US Department of Defense's Advanced Research Projects Agency (DARPA) issued a Grand Challenge which took the Programmatic frame one step further, into a highly-publicised festival-style competition, in which teams of researchers present prototypes which sometimes compete directly against each other, for prizes as high as \$2m (see Fulton and Pransky 2004, also the DARPA Robotics Challenge at <http://www.theroboticschallenge.org/>).

Therefore, while the chicken-and-egg question is beyond the scope of this paper, it is clear that each of these initiatives correlates with an upsurge of those particular frames – Academic, Programmatic and Competitive -- in peer-reviewed literature, which quickly moves beyond the discipline to which the funding stream is initially directed. However, while the first use of a similar term to describe direct threats to the survival of humanity and/or the



planet, appears concurrently with a projected \$1 billion boost to the National Science Foundation for research into eight 'grand' environmental challenges (Schoen 2001, it was not until after the financial crisis that this form of catastrophic framing began to appear regularly in both academic and policy documents, and in Europe and the UK as well as the US. This paper will concentrate largely upon that shift, and its implications for science, technology and innovation (STI) policy.

### **'Grand Challenges' in STI policy**

Academia is a global enterprise, and so the 'travelling' of concepts from one national context to another, or across disciplines, is no surprise, nor is the ability of concepts to travel between researchers and policymakers. Thematic research programmes are often drawn up in consultation with scientists themselves, who have increasingly expressed a desire to make their findings more useful to policymakers, while policymakers have become increasingly called upon to provide an evidence basis to legitimise their decisions, particularly in areas which are highly politically charged. *When* concepts travel, however, may be more dependent upon external pressures, than on a kind of intellectual convergence.

#### The EU context

Within the European Union, the larger policy objectives of the Commission are furthered through the Framework Programmes (FP) which are the instrument for funding European research. FP6 (2002-2006) had been explicitly directed towards creating a common knowledge market, the European Research Area (ERA,) and towards research for implementation of the Lisbon strategy. The European Foresight Monitoring Network did use the term once in this period, as Programmatic, describing the UK Cognitive Systems Project which had identified four grand challenge areas for research promising 'revolutionary advance' (EC 2008), otherwise, it had not been common parlance in FP6. In its ex-post assessment of FP6, two years into FP7 (Arnold 2009), 'Grand Challenges' had shifted firmly to the Programmatic, now envisioned as large, co-operative, problem-driven programmes on topics chosen by the Commission to fill its own goals, and designed to attract more industry funding towards European R&D. This top-down approach would be complimented by bottom-up, 'Great Ideas' generated by individually mobile researchers in direct competition, to be managed through a new organisation independent of the Commission, the European Research Council. At the same time, the Lund Declaration (2009) placed 'Grand Challenges' securely in the Catastrophic frame, as 'rapid and simultaneous' global threats which required an urgent move away from thematic priorities to concentrate on 'sustainable solutions' to global warming, energy, water, food, security, health and aging.

The interim report for FP7 (EC 2010) suggested that these objectives should first be implemented as small strategic shifts, paving the way for the more comprehensive restructuring which has ultimately been set out as Horizon 2020 (EC 2013). However, at this time, there were also discussions which suggested that the Directorate for Science, Economy and Society, which is part of the European Commission's Directorate-General for Research, would be undergoing a restructuring for Horizon 2020. In particular, the small Unit which directs the Science in Society (SIS) Work Programme, having barely survived the restructuring between FP6 and FP7, was now expecting to have its functions mainstreamed and be dissolved (Dratwa and Laurent 2013). As Dratwa & Laurent argue, this threat made it imperative to show the necessity of not only retaining this Unit, but of increasing, rather than decreasing the overall research budget by devising a framework within which the two key ethical components of Grand Challenges in the Catastrophic frame – that publicly funded research should be addressed towards pressing public needs, and that these needs should be in at least part determined by a closer engagement with the public on issues of science and technology – could be productively linked with other legal obligations under the Lisbon Treaty, which came into force in 2009. The eventual framework for Responsible Research and Innovation which emerged from the formative high-level workshop held at the European Commission in May of 2011 (EC 2011) was a way of bridging these two policy regimes, through the formulation of Six Keys of RRI (EC 2012) which spoke to both.

### Grand Challenges in the UK

In the UK, the Engineering and Physical Sciences Research Council (EPSRC) had already adopted the idea of grand challenges in the Programmatic frame, as a means of creating greater international impact and making the UK 'the most dynamic and stimulating environment in which to engage in research and innovation' (EPSRC 2006). These topics would be decided in partnership with other stakeholders, including a greater integration of industry to stimulate investment in R&D, continuing a policy agenda which had begun years prior with the re-assigning of the administration of universities away from the Department of Education to the Department for Business, Skills and Innovation.

According to Owen (2014: 114), by 2009 the EPSRC was beginning to conceive of its role as more of a 'sponsor' or 'shaper', rather than a mere funder of research, opening up the question of responsibility for the technologies it chose to fund. To some extent, this is rooted in a still-linear model of innovation and historical division of labour, where the EPSRC funds ideas through to prototype, at which point the Technology Strategy Board (TSB) takes over to scale up the prototype for the market. Therefore, it was argued that the most effective way to integrate public engagement into the upstream, or beginning stages, of the process would be through the EPSRC, as there was a danger of lock-in by the time a technology was considered ready for application to the TSB.



At this point, the term 'Grand Challenge' was not applied to climate change itself, but was shifting from a Programmatic (see EPSRC 2006) to a Competitive frame, informing a sandbox during which researchers were meant to come up with a project to address climate change through geoengineering. The responsible innovation framework had been developed through a process where applicants themselves were also research subjects, asked to create risk registers for their proposed nanotechnology projects, and then interviewed about the process. Most had interpreted 'risk' as being to the researcher; few considered environmental risks and none considered any potential impact on society as a whole (Owen and Goldberg 2010: 1702).

Overall, however, the response from the researchers was positive, leading the ESRC to determine that all proposals for development of emergent technologies should contain provisions for multidisciplinary engagement of social scientists and ethics scholars. At this time, this was felt to be best applied to the development of the 'Grand Challenges', which was used in the Programmatic frame to describe thematic funding streams, rather than as a requirement for individual applicants. This fledgling governance framework was then subsequently tested on the Stratospheric Particle Injection for Climate Engineering (SPICE) project, a programme to develop sulphur particles to reflect heat away from the planet, which was piloting a test run of the equipment using only water. Although it passed the first EPSRC review, the announcement of the project caused a huge public outcry, and the stage-gate panel eventually cancelled the test on the basis of inadequate public consultation, and a lack of ability to describe or incorporate mitigation for potential global impacts (Macnaghten and Owen 2011). Thus, although SPICE may be considered a failure, this EPSRC version of RI – or, as its proponents have called it, the ARIR framework of anticipation, reflection, inclusion and responsiveness (Owen et al. 2013) -- did prove that a reflexive, ethical, stage-gated process could function to halt the trajectory of a technology based on public concern, before it became locked-in.

Thus, the RI framework created for the EPSRC can be said to differ from RRI first by *not* being anchored to European policy processes and reference to European values' (see von Schomberg 2013), and second from already having a clear implementation framework which has evolved from field application. Where the framework devised for RCUK was focused on more responsive forms of public engagement, the Six Keys also explicitly includes gender equality, access to data, and better science education in addition to a commitment to ethics, inclusive engagement and devising new forms of governance. Thus, the Catastrophic frame is also gilded with promises of opportunity. That this was at least partially successful is evident in the eventual €70bn budget for Horizon 2020 which was approved by the European Parliament in June of 2013.

In a similar manner, by 2010, the new coalition government had also accepted the Catastrophic frame, indicating that Research Councils UK were 'where the UK can make an internationally competitive contribution in terms of new knowledge and understanding to

address major societal challenges' (BIS 2010: 5). However, here it was in the context of a complete restructuring of university financing, which made research-intensive universities more reliant upon income from competitive sources, visible in the EPSRC's subsequent strategic plan for 2011-2015 which reflects multiple and uncertain framings (EPSRC 2010).

## Discussion

To some extent, all five framings reflect a form of mission-oriented research, whether it is to solve the unsolvable problems of a discipline, or the effects of a longstanding imbalance between consumption and conservation of resources. However, former Big Science programmes were largely aimed at a difficult, but singular and ultimately solvable problem such as creating a nuclear weapon or unravelling the human genome. In this sense, while they were large scale research programmes, they lacked the kind of interdisciplinarity which is now the hallmark of the Programmatic frame, particularly as R(R)I now demands greater integration of social scientists and humanities scholars in formerly siloed areas of hard science. Another main difference is that Catastrophic-framed Grand Challenges, unlike Hilbert's 23 mathematics problems, are not solvable, nor are they framed as seeking a solution to the problem itself. These challenges are largely addressed at *fait accompli* – the population *is* aging, climate *is* changing, peak oil *has* passed. As such they are not about solutions, so much as adaptations which provide opportunities for innovation. In that sense, the Catastrophic frame is market-oriented, rather than about disaster mitigation or avoidance, while at the same time the same frame has been used in other policy areas to justify – very successfully, and some might argue mostly unnecessarily, in the case of the UK – deep cuts to the public purse.

Foray *et al.* (2012) also point out that the previous 'user' of former large-scale mission-based programmes modelled on the Manhattan Project was the government. One of the reasons that the Catastrophic frame has proved extremely useful as a policy object is that the projected 'user' is society itself. This has dovetailed well with the long-developing discourse of greater involvement of the public in both scientific and political governance, and provided a fertile ground for discussions of moral responsibility for the future which is all but impossible to have in terms of growth-based economic models in other areas of public policy. However, it has also raised the question of whether it is in itself mission-oriented, as the Catastrophic frame has also provided the most fertile pathway for the continued promise that innovation will restore both the UK and the EU to 'prosperity'.

**References:**

- BIS. (2010) *Government Response to the House of Lords Science & Technology Select Committee Report “ Setting Priorities for Publicly Funded Research .”*
- DRATWA, J AND LAURENT, B. (2013) Europe’s Collective Experiment with Research and Ethics as a Construction of Responsibility. In *Devices of Responsibility*,.
- EC. (2010) *Interim Evaluation of the Seventh Framework Programme: Report of the Expert Group*.
- EC. (2011) Newsletter. *DG Research workshop on Responsible Research & Innovation in Europe, 16-17 May*.
- EC. (2012) Responsible Research and Innovation: Europe’s Ability to Respond to Societal Challenges. Available at: [http://ec.europa.eu/research/science-society/document\\_library/pdf\\_06/responsible-research-and-innovation-leaflet\\_en.pdf](http://ec.europa.eu/research/science-society/document_library/pdf_06/responsible-research-and-innovation-leaflet_en.pdf).
- EC. (2013) *The Grand Challenge: The Design and Societal Impact of Horizon 2020*. European Commission, Directorate-General for Research and Innovation. Available at: <https://bookshop.europa.eu/en/the-grand-challenge-pbKINA25271/>.
- EPSRC. (2010) *EPSRC Delivery Plan 2011-2015*. London.
- EPSRC. (2006) *Strategic Plan 2006: Towards a Shared Vision of Tomorrow’s Challenges*. Available at: <http://www.epsrc.ac.uk/newsevents/pubs/corporate/deliverystrategic/Pages/plans.aspx>.
- FORAY, D, MOWERY, DC, AND NELSON, RR. (2012) Public R&D and Social Challenges: What Lessons from Mission R&D Programs? *Research Policy* 41(10): 1697–1702. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0048733312002193>. (Accessed February 5, 2014).
- GOFFMAN, E. (1974) *Frame Analysis: An Essay on the Organisation of Experience*. Harmondsworth: Penguin Books.
- MACNAGHTEN, P AND OWEN, R. (2011) Good Governance for Geoengineering. *Nature* 479: 293.
- OWEN, R. (2014) The UK Engineering and Physical Sciences Research Council’s Commitment to a Framework for Responsible Innovation. *Journal of Responsible Innovation* 1(1): 113–117. Available at: <http://www.tandfonline.com/doi/abs/10.1080/23299460.2014.882065>. (Accessed January 22, 2014).
- OWEN, R AND GOLDBERG, N. (2010) Responsible Innovation: A Pilot Study with the U.K. Engineering and Physical Sciences Research Council. *Risk analysis* 30(11): 1699–1707. Available at: <http://onlinelibrary.wiley.com/doi/10.1111/j.1539-6924.2010.01517.x/abstract>. (Accessed January 27, 2014).

- OWEN, R, STILGOE, J, MACNAGHTEN, P, GORMAN, M, FISHER, E, AND GUSTON, DH. (2013) A Framework for Responsible Innovation. In *Responsible Innovation*, edited by Richard Owen, J Bessant, and M Heintz. London: John Wiley & Sons.
- VON SCHOMBERG, R. (2013) A Vision of Responsible Innovation. In *Responsible Innovation*, edited by Richard Owen, M Heintz, and J Bessant. London: John Wiley.
- VARMUS, H, KLAUSNER, R, ZERHOUNI, E, ACHARYA, T, DAAR, A, AND SINGER, P. (2003) Grand Challenges in Global Health. *Science* 302(5644): 398–399. Available at: <http://www.jstor.org/stable/3835313>. (Accessed February 26, 2014).

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***Brokerage roles and medical innovation: an empirical analysis***

**Abstract:** This article investigates how actors' position in a network influence their capacity to come up with new medical innovations. Our focus is on the relationships between biomedical scientists working in different institutions such as hospitals, universities and public research centers. We use survey data to analyze the different brokerage roles that biomedical scientists can play, as well as the distinctive effects that such positions exerts over the scientists' likelihood to participate in different medical innovation outputs. Our results shows that scientists that mediate between actors from different medical communities are more prone to innovate.

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***The impact of firm participation in EU R&D programmes on their R&D strategies: Lessons from an evaluation of the FP7 Transport Programme***

**Abstract:** Policy making related to the support of RTDI is built upon a number of key principles:

1. Industry knows better than anyone else how to invest to increase its income
2. Public money can orient research towards specific topics which are not or insufficiently tackled by industry ("market failures" due in particular to externalities)
3. Public actors are coordinated in order to avoid overlap on the one hand and to maximize the use of public money on the other.

In this paper, we assess the extent to which public money actually orients private research towards specific topics or, in other words, the extent to which public money impacts on the allocation of private money to topics selected by the policymakers.

To reply to this question, we propose to focus on R&D activities related to surface transport. Our paper is based on two sets of data that we have collected during two projects: the mid-term evaluation of the FP7 Transport Programme (2011) and the evaluation of the French Transport research programme – PREDIT (2013). In the context of the mid-term evaluation of the Transport programme, we carried out interviews with 110 participants in 75 projects.

Our paper comprises the following sections:

- A presentation of the economic literature on the impact of public funding on the research carried out by private companies;
- The influence of industry on the topics addressed and funded by the EC funding and the impact of the EC funding on private investment in R&D.

**Lessons from the literature**

Literature shows the financial impact of public incentives on R&D on private companies is generally positive but depends on various linked factors, such as the size and activities of companies and the type and intensity of public incentives. Public support for R&D is justified by the existence of important market failures linked to firms' R&D activities. The incomplete return on R&D investment (lower than its social return) made by firms due mostly to knowledge dissemination outside the firm discourage them to invest more in R&D activities. The R&D investment made by firms in a competitive framework is likely to be below the socially optimal level (Arrow, 1962).

Literature shows that direct government funding for R&D performed by firms and tax incentives have a clear positive effect on business financed R&D. Nevertheless, publicly produced knowledge (by universities or public research organisations) may be used by

private firms but without any leverage effect in terms of R&D expenditures.

Direct public funding and tax credits are substitutes. The effectiveness of each type of policy tool depends of the use of the others: an increased intensity of one reduces the effect of the other on business R&D. (Guellec et van Pottelsberghe, 2000).

Regarding the most appropriate funding rate for direct public incentives for R&D, it appears that offering too much or too little financial support has a weak impact on R&D private expenditures. Over 25% R&D funding rate, additional public money is likely to substitute private money with a decreasing leverage effect (Guellec et van Pottelsberghe, 2003a). EU collaborative R&D programmes have an impact on firms' R&D spending in general (Fisher et al, 2009) but participation strategies can drastically differ according to the size of the companies. Leverage effects can be important for small and medium enterprise and relatively weak for the largest companies with high R&D expenditures and a mix of various public incentives.

R&D activities in the transport sector: some facts

The stated objective of the Cooperation specific programme of the FP7 was to "support all types of research activities carried out by different research bodies in trans-national cooperation and aims to gain or consolidate leadership in key scientific and technology areas". (REF to EC)

Even if not explicitly mentioned, the EC support is in line with the general idea that public support is associated with applied R&D, that is to say downstream research. Our interviewees acknowledged this for the FP7 Transport Programme, with half of them claiming that their projects dealt with applied research (see Table below).

Table 1 Type of research carried out by projects

Aeronautics	Surface	Transport	Cross-cutting activities	Total
Applied research	27	17	8	52
Dissemination of information	1	1	2	
Experimentation	6	-	-	6
Fundamental research	2	4	-	6
Policy-oriented research	-	7	8	15
Production of prototype	-	4	-	4
Socio-economic research	2	1	5	8
Technological development	7	4	-	11
Total	45	37	22	104

Fisher, Polt and Vonortas (2009) demonstrated that "compared to 'normal' R&D projects, FP 4 projects differ from FP5 ones little in terms of costs and commercial risks. On the other hand, they do differ in the following respects:

- They have higher scientific and technological risks,
- They have a higher scientific and technical complexity,
- They are more long-term oriented, and
- They belong more often to the firm's core technological area".

The expert group conducting the Ex-post Evaluation of the Sixth Framework Programmes

had similar and contradictory conclusions. It noted that “Compared with projects that the companies funded internally, FP projects tended to involve less commercial risk, and have longer term RTD horizons, more interest in the non-core technologies of participants, a focus on exploration (rather than exploitation), a lower degree of flexibility and higher administrative burdens”.

Based on Spanish data, Busom and Fernandez-Ribas (2008) have shown that public support increases the likelihood of manufacturing industry to cooperate with public research institutions, which is the target of the policymakers.

The comparison of the actors that participate in the European Commission’s research programmes with those that participate in national or regional programmes is always very informative. This enables understanding of how the actors behave vis-à-vis these different programmes.

As far as the FP7 Transport programme and the French Transport Programme are concerned, this analysis shows that more than 900 French actors only participated in the French programme, around 100 actors only participated in the FP and around 50 participated in both.

These 50 common participants accounted for one quarter of French participation in the FP (for an average of 2.5 projects). On the other hand, the participants in the French programme only have 1.5 projects on average while half of them have a single project (meaning the other half has two projects on average).

Participants in the FP only have 1.4 projects on average but few of them have more than one project.

Our conclusions based on the analysis of each participant are as follows:

1. Large actors (both from the public research or large companies) participated in both programmes.
2. Participants in one programme only very often are small players with little participation. From that perspective, the national programme supports SMEs which are not very familiar with R&D projects and supports research on topics which are considered as important for the country.

The impact of the EC funding on the private investment in R&D

The budget for the FP7 Transport Programme was €4,2b for seven years that is to say less than €600m per year on average. Even if one adds up the national budgets aimed at supporting private R&D, private companies support more than 90% of the R&D total effort (Condeço et al. (2012)).

We proposed here to focus on the type of research that is carried out with the support of the FP. We believe this work is complementary to quantitative analyses and can provide a good insight into the “black box”.

Our analysis of the industrial behaviours of European companies towards the FP7 Transport Programme led us to the following conclusions:

1. Firstly, the FP supports the coverage of thematic areas or topics by companies that would not be covered without the FP.

Participants explained that the budget received from the EC corresponds to a small share of the total budget of their organisation dedicated to R&D. They also highlighted very often that the EC money was not considered as a part of this budget but had a different role within the organisation. Projects funded by the EC (or by national programmes) aimed at



carrying out projects that are too complex and risky to be funded without public support. More importantly, public money often funds research projects on topics that are not necessarily considered as a priority by the companies at the time the proposal is drafted. Without public support, those projects often would not have been started. Public money has an impact on the lobbying capacity of the research units (could be research teams, labs, research centres) which can justify towards their direction to carry out research activities on topics that would not be supported otherwise.

From that perspective, the FP is a major tool for the companies to fund research on those topics they would not consider without EC money. Even if the EC money represents a very small share of the total R&D expenditures, it has a leverage effect on the topics on which the industry will devote resources.

2. Secondly, the European policymaking has an impact on the research agenda of the large companies.

Large European companies are worldwide competitors and are huge investors in R&D. They participate in the European Technology Platforms. Their weight is important in terms of turn-over, of market shares or of R&D investments, so that their point of view on research needs logically influences the research agenda of their sector. The collective research agendas elaborated by the European Technology Platforms are by nature the result of a collective process that implies that research agendas of the European Technology Platforms express the view of the whole sector. In the end, it is a natural process to see convergence between the individual research strategies for the future of the largest players and what is decided by the industry on the research strategy for the future. To sum up, the Strategic Research Agendas drafted by the European Technology Platforms are notably shaped by the research strategy of the big players in the sector. However, these big players also adapt their own research strategy to the sectoral research strategy identified by the European Technology Platforms. This in turn impacts the design of the Work programmes

For the smallest players, the impact of the FP and of the Strategic Research Agendas on their own research agenda is certainly much more complex. For SMEs, the participation in a FP project is often linked to a specific technological knowledge or to the embedment of the companies in the value chain of a major player. For these companies, it would be surprising to see an impact of the FP on their research strategy that are much short-term than long-term. This would be even unlikely for SMEs which have participated in a single FP project or which are currently involved in their first FP project.

#### Conclusion

The literature on the effect of public money on the R&D efforts of the companies has a long tradition. Numerous quantitative analyses were carried out to precisely assess the leverage effect of the public money on the private efforts. Numerous projects were also aimed at identifying what kind of research was carried out when it was funded by public money. Our paper shows that in addition to providing resources for research, public money also impacts on the topics that are tackled by private companies. We have shown that the EC FP7 Transport Programme and the French Research Transport Programme have the capability to fund projects on topics that would not been covered otherwise. Provided that the topics identified by the EC and the French Research Transport Programme are conjointly identified by the companies, the public research organisations, the Universities and the public authorities, that means that the public programmes do influence the research agenda of the small companies.

We believe this issue should be further investigated in the future to better understand how the public funding impacts on the R&D strategies of companies.

## References

Arrow, (1962), "The economic implications of learning by doing", Review of Economic Studies, 29(2), pp. 155-173

Busom and Fernandes-Ribas (2008), "The impact of firm participation in R&D programmes on R&D partnerships", Research Policy, vol. 37, pp. 240-257

Condeco, Vieira, Krail, Reichenbach and Schippl (2012), The European innovation systems in transport and the current state of the competitiveness of the EU transport sector, FP7 project, Deliverable D.2.1.

European Commission (2003), Raising EU R&D intensity – Improving the effectiveness of public support mechanisms for private sector research and development – Fiscal measures, Report to the European Commission by an Independent Expert Group, EUR 20714, 38 p

Eparvier, Larrue and Doussineau (2011), Interim evaluation of EU FP7 Transport research notably within Theme 7 of the cooperation programme "Transport (including aeronautics)", report for the EC.

Eparvier, Roulstone (2013), Ex post evaluation of the French National Transport Programme, report for the Ministry of Transport

Expert Group (2009), Ex-post Evaluation of the Sixth Framework Programmes.

R. Fisher, W. Polt and N. Vonortas (2009), The impact of publicly funded research on innovation: An analysis of European Framework Programmes for Research and Development, PRO INNO Europe paper N°7 for European Commission-DG Enterprise and industry.

D. Guellec and B. van Pottelsberghe de la Potterie (2000), "The Impact of Public R&D Expenditure on Business R&D", OECD Science, Technology and Industry Working Papers, 2000/04, OECD Publishing.

B. Van Pottelsberghe, Les politiques de science et technologie et l'objectif de Lisbonne, Reflets et perspectives de la vie économique 2004/1 (Tome XLIII), pp. 69-86

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***Competing technological innovation systems as a new challenge for mission-oriented STI governance***

**Abstract:** Attention has been given to the question on how science, technology and innovation (STI) policy organizes its innovation activities and sets overall funding priorities. Developments in most of the Organisation for Economic Co-operation and Development (OECD) countries show a dominance of STI programs that contribute to specific government and societal missions (Mowery, 2009; OECD 2010). Gassler et al. (2008) therefore characterize a paradigm shift towards “a new mission orientation”, in which priority setting is thematically oriented around the development of technological trajectories to serve the specific economic and societal challenges in health, energy, security or environmental issues. This strategic shift from traditional technology based and systemic approaches to a broader concept of mission orientation raises new challenges for the policy decision making process. Former technology-specific policy programs required selection decisions within an existing technological innovation system (TIS) (e.g. formation of a dominant design). Furthermore, systemic-oriented policy approaches emphasized the importance of optimization processes of functional aspects like institutional arrangements and proper interactions within a national (regional) innovation system. In particular the vertical coordination between different territorial levels (supranational, national and regional) was stressed in the public and scientific debate.

With the mission-oriented turn of STI policy obviously a horizontal coordination between competing TIS is necessary, but currently not discussed. The mission orientation raises questions regarding how to react on developments between competing technological innovation systems at different stages of maturity and the governance of different, but interdependent innovation systems and subsystems. In other words: Instead of variety and competition between technological solutions within a technological innovation system, the mission orientation leads to a new type of competition for policy attention and funding support between different technological innovation systems. These competing technological innovation systems are typically in different development stages and thus, old/established technological innovation systems compete with new systems, which are in earlier phases of the formation process.

The German “Energy Turnaround” (Energiewende) is one current example of a national policy for pushing power generation from fossil to renewable energy sources by creating financial incentives for the development of different renewable technological trajectories. Due to competition and different technological developments in the respective technological innovation systems some technologies like wind energy have economically become more promising than others like photovoltaic conversion. This, however, highlights possible tensions between competing TIS and provokes responses from political decision makers in the context of mission-oriented policy strategies. On the vertical level, the effects of interdependent framework conditions like the German “Renewable Energy Act” and the “EU Emissions Trading system” as well as its impact and interplay on competing TIS needs to

be analyzed. Depending on the respective policy goal, this analysis would allow to reveal possible coordination needs and adjustment possibilities in order to improve future policy strategies.

The public and scientific debate about STI policy still suffers from a too static perspective on innovation systems and its interactions. Especially measures, such as temporary limited instruments and its time-specific implementation modalities or time strategies are rarely discussed. The focus on coordination and common adjustments already in the formation process of a TIS is problematic, because consensual decision making complicates and slows down necessary adaption of the innovation system. In particular, the new mission-oriented STI policy needs flexible instruments and measures in order to support the economic selection process towards the best technological solution for the mission. A sufficient level of “strategic intelligence” (Kuhlmann et al., 1999) is required as a basis for policy decisions and reforms in this process. Thus, the technological innovation systems and its interactions should be reformed according to plausible tools such as the conventional technology evaluation, foresight and assessment.

This paper attempts to review critically the literature on mission-oriented innovation policy strategies and its implications for the policy decision making processes. In addition, a wide strand of literature on competing technologies and the functional dynamics of technological innovation systems (e.g. Musiolik, 2012; Dewald & Truffer, 2011 or Bergek et al., 2008) needs to be analyzed against the background of these new challenges of mission-oriented policy strategies. At this point, two dependent analytical problems emerge: (1) The measurement of dynamics and heterogeneity of technological innovation systems and (2) the identification of relevant coordination needs of technological innovation systems at different stages of maturity. The second point refers to questions on how far this development should be left to the free play of market forces or, if coordination is necessary and desired, what coordination mechanisms are required? As a first step, a technology and system dynamic approach will be introduced using the Science and Technology Cycle. In technologically broader studies by Dreher et al. (2005) and Jochem (ed.) (2009) different energy and manufacturing technologies were analyzed using the Science and Technology Cycle. These results and its policy implications will be critically discussed in the context of the mission-oriented turn in STI policy. It is expected that the recognition of a technology and system dynamic approach will bring new insights about effects and trade-offs of policy measures and strategies.

A new mission-oriented innovation policy requires arrangements and measures, which are designed from a dynamic perspective considering the different phases of the innovation process (Meyer-Krahmer, Dreher 2004). After the discovery and the exploration (phase 1) new technological solutions are developed, are spread to problems in other disciplines and are also applied to transdisciplinary problems. In the following a broad research community emerges characterized by an euphoric optimism because of the new research opportunities (phase 2). However, during the research process several options are considered to be not realizable, so that research activities have to be limited (phase 3). Therefore, the community becomes more insecure and only the researchers and developers with the highest motivation or most innovative ideas will remain, so that the technological development re-orientes (phase 4). These first movers achieve first industrial breakthroughs. The technologies, which survive the market process, also determine the dominant design within the whole market in the future (phase 5). In the last phase of diffusion other application opportunities emerge, because due to economies of scale solutions become cheaper and

make an application on other problems and sectors possible.

Depending on the development stage, different behaviour patterns of firms and other actors within the technological innovation system can be observed. Firms, who treat a technology at the beginning of the innovation process, show a much opener perspective considering the international level as well as other possible applications. Furthermore, in early phases the quality of cooperation between firms and public R&D institutes reach a high level, whereas public institutes are not accepted to hesitate in the later process of market diffusion in order to protect important information at the firm level. Thus, structural and functional dynamics of technological innovation systems imply that political decision makers shall consider the maturing process and its specific requirements at different development stages. For this, new assessment and analysis tools like the Science and Technology Cycle can be a helpful method to engage system dynamics in order to improve STI strategies.

## References

- Bergek, A., Jacobsson, S., Sandén, B. (2008): 'Legitimation' and 'development of positive externalities': two key processes in the formation phase of technological innovation systems, in: *Technology Analysis & Strategic Management*, 20, 5, pp. 575-592.
- Dewald, U., Truffer, B. (2011): Market Formation in Technological Innovation Systems – Diffusion of Photovoltaic Applications in Germany, in: *Industry and Innovation*, Vol. 18, No. 3, pp. 285-300.
- Dreher, C., Armbruster, H., Arilla, C. (2005): Manufacturing Visions – Integrating Diverse Perspectives into Pan-European Foresight (ManVis), ManVis Report.
- Gassler H., Polt, W., Rammer, C. (2008): Priority Setting in Technology Policy: Historical Developments and Recent Trends, in: Nauwelaers, C., Wintjes, R. (Eds.): *Innovation Policy In Europe. Measurement and Strategy*, Cheltenham: Edward Elgar.
- Jochem, E. (Ed.) (2009): *Improving the Efficiency of R&D and the Market Diffusion of Energy Technologies*, Physika-Verlag, Heidelberg.
- Kuhlmann, S., Boekholt, P., Georghiou, L., Guy, K., Héraud, J.-A., Laredo. Ph., Lemola, T., Loveridge, D., Luukkonen, T., Polt, W., Rip, A., Sanz-Menendez, L., Smits, R. (1999): *Improving Distributed Intelligence in Complex Innovation Systems*. Brussels/Luxembourg (Office for Official Publications of the European Communities).
- Meyer-Krahmer, F., Dreher, C. (2004): Neuere Betrachtungen zu Technikzyklen und Implikationen für die Fraunhofer-Gesellschaft, in: Spath, D. (Ed.): *Forschungs- und Technologiemanagement: Potenziale nutzen – Zukunft gestalten*, München, pp. 27-35.
- Mowery, D. C. (2009): What does economic theory tell us about mission-oriented R&D?, in: Foray, D. (ed.): *The New Economics of Technology Policy*, Cheltenham: Edward Elgar.
- Musiolik, J., Markard, J., Hekkert, M. (2012): Networks and network resources in technological innovation systems: Towards a conceptual framework for system building, in: *Technological Forecasting & Social Change*, 79, pp. 1032-1048.
- OECD (2010): *The OECD Innovation Strategy. Getting a head start on tomorrow*.
- Smits, R., Kuhlmann, S. (2004): The rise of systemic instruments in innovation policy, in: *International Journal of Foresight and Innovation Policy*, 1, (1/2), pp. 4-32.
- Wieczorec, A., Hekkert, M. (2012): Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars, in: *Science and Public Policy*, 39, pp. 74-87.

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### ***Multi-Layered Foresight: Lessons from Regional Foresight in Chile***

**Abstract:** Foresight is used in national, regional and organisational contexts to anticipate the changes in the environment and create responses to them (e.g. Georghiou and Keenan, 2006; Uotila et al., 2005; Rohrbeck, 2011). The stated benefits of foresight include improved communication, coordination, consensus, commitment and concentration of the long term (Irvine and Martin, 1984; Martin, 1995), and it also aids organisations in creating strategic change (Rohrbeck and Schwarz, 2013). As the domain in which foresight is applied has broadened from technology forecasting to societal challenges (Miles et al., 2008; Kuosa, 2012) and organisational futures (Rohrbeck, 2011), the definition and expected outcomes have become more ambiguous. At the same time foresight has become more embedded into policy processes and more contextual (Harper, 2013). This has led to a situation where the impacts and objectives of foresight are hard to assess and the management of a foresight process becomes challenging (Könnölä et al., 2009).

Foresight is seldom an end in itself, but rather a supporting and complementary process to other activities, such as policy making, strategic planning, priority setting or capacity building (Georghiou and Keenan, 2006; Miles, 2012). The evaluation of foresight is challenging due to the complexity of the context, difficulties in attribution and different understandings of foresight and its rationales. Foresight exercises often focus on complex problems, where the dynamics of the system are unknown, future developments are uncertain and there are conflicting views of the problem. Foresight is also often connected to some other processes, such as policy making or strategy creation, or there are parallel processes focused on the same problem, all of which leads to challenges in attributing the changes in the situation to the foresight exercise. Even though there are some stated goals for the foresight exercise, the funders, facilitators and stakeholders may have their own implicit goals against which they assess the exercise. In order to improve the planning and evaluation of foresight, these connections need to be analysed using a multi-faceted approach, which looks at the different rationales and functions of foresight in a systemic way (Harper, 2013).

While there is growing literature on the rationales on foresight, there is need for coherent conceptualisation of the contribution of foresight in different layers of innovation system. To this end we propose a concept of Multi-Layered Foresight in this paper. We describe foresight contributions on four layers: landscape, system, organisation and individual. A foresight exercise may have an emphasis on one of the layers, for example the organisation layer in the case of corporate foresight, or the system layer in national foresight program. Most of the existing literature on foresight contributions has focused on the system or organisation layer. While we suggest that foresight exercises could benefit from systematic consideration of different layers, we do not assume that they necessarily have equal importance.

For each layer we look at foresight objectives and contributions from three aspects:



capabilities, knowledge and relations. Foresight can enhance the anticipatory capabilities of individuals, organisation and even systems. Foresight also produces (explicit) knowledge about the landscape level developments, improves the understanding of the system and context, creates strategic knowledge for a company and increases the knowledge of an individual. The third aspect, networking, is the results of the aim to engage different stakeholders and include all the relevant actors in a foresight process. This can also be seen in all the layers from individual contacts, through organisational collaboration to interaction between different systems.

We illustrate our concept of multi-layered foresight with a case example from a foresight project done in Antofagasta, Chile. The illustration is based on practitioner and participant self-reflection on a foresight pilot project "Water in Antofagasta 2040" done in spring 2013 in Antofagasta, Chile. The exercise was one part of a joint project between VTT Technical Research Centre of Finland and Mining Technological and Scientific Research Centre CICITEM in Chile, which had an overall objective of enhancing innovation-driven and sustainable economic development of the Antofagasta region. The foresight pilot was carried out jointly by researchers from VTT and CICITEM to enable capacity building. Our data consists of observations of the workshops and meetings, documentation of the workshop outcomes, the results of the online survey conducted during the project (42 responses, response rate 40%), practitioner self-reflection based on notes written during the process and feedback collected from CICITEM after the project (in which the four layers were used as a structure).

Based on a case study, we look at the impact and influence of foresight on four levels and give examples for each outcome. Some of our results confirm the benefits or value contribution of foresight, but we also highlight some issues that have not gained that much attention, such as the reframing of the topic, the influence on the legitimacy of the participants, the influence on the social dynamics within an organisation or the learning of foresight related skills. In addition, we discuss the potential and mechanisms by which foresight can aid in creating regional transformation through building future orientation and foresight capacity.

There are implications from our research to the practitioners of foresight as well as the funders or customers. For practitioners designing and conducting foresight our results provide both a checklist and experiences on the impact and influence of foresight, and a rough frame on the levels which to consider. By taking into account all of the levels practitioners can better design foresight exercises that 1) are relevant and interesting to the individuals involved, 2) contribute to the capabilities of the organisation, 3) shape the system to enable the desired future and 4) create new knowledge on the topic.

For funders or customers of foresight our results systematically show that there are more to foresight than just the process and outcomes – that a successful foresight process might change the capacity of an organisation or a community to anticipate the future and through that even create a regional transformation.

## References

- Georghiou, L. & Keenan, M. 2006, "Evaluation of national foresight activities: Assessing rationale, process and impact", *Technological Forecasting and Social Change*, vol. 73, no. 7, pp. 761-777.
- Harper, J.C. 2013, *Impact of Technology Foresight. Compendium of Evidence on the*

Effectiveness of Innovation Policy Intervention., Manchester Institute of Innovation Research.

Irvine, J. & Martin, B.R. 1984, *Foresight in science: picking the winners*, Pinter London.

Könnölä, T., Ahlqvist, T., Eerola, A., Kivisaari, S. & Koivisto, R. 2009, "Management of foresight portfolio: analysis of modular foresight projects at contract research organisation 1", *Technology Analysis & Strategic Management*, vol. 21, no. 3, pp. 381-405.

Kuosa, T. 2012, *The evolution of strategic foresight: navigating public policy making*, Gower Publishing, Ltd.

Martin, B.R. 1995, "Foresight in science and technology", *Technology Analysis & Strategic Management*, vol. 7, no. 2, pp. 139-168.

Miles, I. 2012, "Dynamic foresight evaluation", *Foresight*, vol. 14, no. 1, pp. 69-81.

Miles, I., Harper, J.C., Georghiou, L., Keenan, M. & Popper, R. 2008, "The Many Faces of Foresight" in *The Handbook of Technology Foresight*, eds. L. Georghiou, J.C. Harper, M. Keenan, I. Miles & R. Popper, Edward Elgar Publishing Limited, Massachusetts, USA, pp. 3-43.

Rohrbeck, R. 2011, *Corporate Foresight*, Springer.

Uotila, T., Melkas, H. & Harmaakorpi, V. 2005, "Incorporating futures research into regional knowledge creation and management", *Futures*, vol. 37, no. 8, pp. 849-866.



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***Designing and Implementing Innovation Policy Instruments: Three types of lessons from existing evidence***

**Abstract:** Innovation – the process of making change – is increasingly the focus of policy and broader societal attention. Searching for innovative solutions has become a core feature of modern management and policy, and has emerged as the main means by which politicians and policy makers at all levels seek to address “Grand Challenges” (Kallerud, 2013, Kuhlmann and Rip, 2014) or want to achieve “missions” (Gassler et al., 2008).

While innovation is itself an old concept associated with transformative ideas, the notion of innovation policy is rather newer – coming into currency in the early 1970s, with a massive expansion of use in scholarly, management and policy spheres 1990s (Fagerberg, 2014).

Today, considerable policy hopes are placed in the promise of innovation policy – although there is also recognition that many policy efforts to foster innovation fail to meet aspirations.

Nonetheless, there seems to be a broadly shared view – growing and broadening over the last 20 years or so (Stewart 2012) – that with well-defined intervention rationales, intelligent policy design, appropriate instrumentation and effective implementation, public intervention can make a difference, and deliver on the ever broader list of innovation policy goals. At the same time, it is suggested, notwithstanding much conceptualization about policy design and implementation, that we continue to lack a consistent underpinning theory that can guide design and analysis (Fagerberg, 2014, Martin, 2014), and thus policy intervention and the analysis of its effects are based, at best – on partial economic, systemic (Dodgson et al., 2011, Klein Woolthuis et al., 2005) and societal intervention rationales .

Against the background of high and growing expectations and lack of a sound theoretical base for innovation policy, this paper contributes to a better understanding of the functionality and impact of innovation policy instruments and critically reflects on broader insights related to impact analysis and its limits. The paper focuses on the design and implementation of innovation policy (1) to synthesize what we know about the nature and effectiveness of innovation policy instruments, (2) to better understand the limits of and conditions for learning in innovation policy, and (3) to suggest ways forward for innovation policy analysis and conceptualisation.

**1) Synthesis of evidence**

To synthesise the knowledge on effectiveness of innovation policy instruments, the paper starts off with a discussion of the existing literature on rationales for and theoretical reflections on innovation policy and existing typologies. It then introduces its own typology of instruments which is conceptually based on the idea of multi layered instrumental goals. This starts with the two main first level goals of innovation policy economic growth and societal welfare, and branches out with a set of concrete operational intervention goals: improving innovation capabilities and access to expertise, raising R&D spent, increasing connectivity, enhancing innovation demand, setting favourable framework conditions and supporting discourse on innovation. On the basis of this typology, the paper synthesis the

findings of a meta-evaluation of 18 innovation policy instruments based on the Manchester COMPENDIUM (see below) in terms of their effectiveness and the underlying conditions for effectiveness.

## 2) Limitations of policy learning

With the existing evidence we have we will demonstrate the limitations inherent in the question: “what works in innovation policy”, the answer to which must be: it depends. We will show how what works depends on a raft of factors, including the meaning of context conditions, the application of different analytical lenses and methods used to analyse effects, and insufficient means to capture spill over, interaction and long term effects of innovation policy instruments. Only if we understand these learning limitations more thoroughly can we make best use of existing evidence for future policy design.

## 3) Ways forward in instrument design, implementation and analysis: a set of principles

This will lead to the final part of the paper, where we will reflect on the shortcomings both in policy practice and policy analysis that can be identified on the basis of the meta-evaluation. The paper will suggest ways forward and a set of concrete principles as for instrument design, implementation and analysis in innovation policy. This will not deliver an instrumental or analytical “tool box” for innovation policy. If anything, it seeks to make a contribution to more reflexivity and the set of basic principles for instrument design and analysis will have to be applied flexibly, taking into account systemic contexts and evolution over time and allowing for informed policy experimentation.

The paper draws on the broad and systematic meta evaluation of the existing evidence of impact of 18 innovation policy instrument types and a horizontal analysis across instruments undertaken in the COMPENDIUM study performed at Manchester (<http://innovation-policy.org.uk/>). This COMPENDIUM deliberately applied a very broad definition of innovation policy, defined at “all public interventions that seek to support the generation and diffusion of innovation”.

## References

- DODGSON, M., HUGHES, A., FOSTER, J. & METCALFE, S. 2011. Systems thinking, market failure, and the development of innovation policy: The case of Australia. *Research Policy*, 40, 1145-1156.
- FAGERBERG, J. 2014. Innovation policy. In search for a useful theory. Lundvall Symposium: Innovation Policy - can it work. Aalborg.
- GASSLER, H., POLT, W. & RAMMER, C. 2008. Priority setting in technology policy: Historical development and recent trends. In: CLAIRE NAUWELAERS & WINTJES, R. (eds.) *Innovation Policy in Europe. Measurement and Strategy*. Cheltenham, UK; Northampton, USA.
- KALLERUD, E., ET AL. 2013. Dimensions of research and innovation policies to address grand and global challenges; Eu-SPRI Forum Position Paper of the project “The emergence of challenge-driven priorities in research and innovation policy (CPRI)” [http://www.euspri-forum.eu/key\\_missions/CPRI\\_Position\\_paper.pdf](http://www.euspri-forum.eu/key_missions/CPRI_Position_paper.pdf).
- KLEIN WOOLTHUIS, R., LANKHUIZEN, M. & GILSING, V. 2005. A system failure framework for innovation policy design. *Technovation*, 25, 609-619.
- KUHLMANN, S. & RIP, A. 2014. The challenge of addressing Grand Challenges. Report to ERIAB. Brussels.

MARTIN, B. 2014. R&D policy instruments - a critical review of what we do and don't know. Lundvall Symposium: Innovation Policy - can it make a difference? Aalborg.

STEWART, F. 2014. Europe's challenge-led broad-based innovation policy revolution: a convoluted and contested transition. EU SPRI Annual Conference Karlsruhe, Germany

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***A scenario analysis on the future knowledge functions of universities***

**Abstract:**

Universities have a key role in knowledge societies. As a result stakeholders increasingly push universities to adjust performances to the their interest. In the past decades this has resulted in a growing set of expected performances of universities and a search for university concepts such as 'the entrepreneurial university' (Clark, 1998), 'the multiversity' (Krücken et al., 2007), 'the enterprise university' (Marginson and Considine, 2000) and the 'postmodern university' (Smith and Webster, 1997). The multitude of expectations and of possible responses, induces strategic uncertainties within universities, between universities and their stakeholders and at system level for policy makers.

In our paper we report about a scenario study that we run from February 2013 till June 2014, aiming at facilitating and improving the strategic dialogue between Dutch universities and their stakeholders. We describe the methodology of the scenario study and its theoretical assumptions, as well as the main results in terms of scenarios and strategic options. In our discussion and conclusion we will reflect upon the new perspectives for traditional research universities that emerge from the scenario study.

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***Why is a Holistic Innovation Policy not Pursued in the European Union? -or- Efficiency of Research and Innovation Systems for Economic Growth and Employment***

**Abstract:** The concept of a holistic innovation policy is defined in this paper, and it is discussed what it is, why it is relevant and how it can be implemented. One of the main conclusions is that the innovation policies in European countries are still linear (and not holistic), in spite of the fact that the linear view has been completely abandoned by innovation researchers – and replaced by a systemic view on innovation processes. Why innovation policy is still linear is also discussed. Further it is noted that a considerable number of EU Member States have created public organizations (Councils) for innovation and/or research policy placed above ministries and usually chaired by the Prime Minister. The role and character of these bodies is discussed. The empirical results are based on a questionnaire sent to 23 EU Member States, out of which 19 (83%) responded. The work with this report was carried out for the European Research and Innovation Area Committee (ERAC) of the European Commission (DG RTD).

The paper can be downloaded at: [http://swopec.hhs.se/lucirc/abs/lucirc2014\\_008.htm](http://swopec.hhs.se/lucirc/abs/lucirc2014_008.htm)

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***Innovation policy: In search of a useful theoretical framework***

**Abstract:** The term “innovation policy” started to penetrate the policy discourse a few decades ago but the phenomenon is arguably older. It may be high time to take stock of what is learnt and consider what the challenges for the theory and practice in this area are. Indeed, several attempt of doing so have already been made.

This paper contributes to this process by focusing on two interrelated questions. First what we (now) mean by innovation policy, and second to what extent we have a theoretical framework that is sufficiently helpful. The first question, considered in the second section of the paper, is motivated by the fact that there continues to be confusion about what the term “innovation policy” means. For example, it may be defined broadly as all policies that have an impact on innovation, or more narrowly as policies (or policy instruments) created with the intent to affect innovation. Both definitions may have their advantages and drawbacks. The latter, narrower definition clearly makes it easier for the researcher to identify the relevant policy instruments. However, it is argued that if we are interested in the impacts on innovation, the former, broader definition appears more appropriate.

Ultimately the choice of definitions depends on the theoretical framework, the topic considered in the paper’s third section. The merits of the traditional “market failure” approach, based on traditional economic reasoning, and the more holistic “national systems of innovation” approach that emerged around 1990, are both considered. The development of the latter, from the first contributions with their emphasis on actors, organisations and institutions, to the more recent literature concerned with processes and “blocking mechanisms”, is also examined as a step towards developing synthetic framework for the discussion of innovation policies (and instruments) and their effects.

An important conclusion from the discussion is that a distinction needs to be made between the characteristics – or “structure” – of a national innovation system and its dynamics. National innovation systems are historical constructs that have evolved through interaction between the economic and political system of a country. Since countries differ industrially, industries (or sectors) have different innovation dynamics (and requirements) and political systems differ in their origins and characteristics, national innovation systems may end up as looking rather different. Such differences are not necessarily a problem, however, as much policy-advice based on so-called “benchmarking” seems to take for granted. Arguably, an unsatisfactory state or “problem” cannot be revealed by studying a single component of a system. What is required is an analysis of the technological dynamics of the national innovation system as whole.

While the characteristics – or structures – of national innovation system may differ a lot,

there will still be common features related to the technological dynamics occurring within these systems. This has to do with the fact what goes on in these systems, e.g., innovation, diffusion etc., follow certain regularities, which are extensively analyzed and documented by innovation research. Guided by this knowledge and recent advances in innovation systems research a theoretical framework is presented in which technological dynamics of country is depicted as the result of interaction between a number of different processes that are in turn influenced by a range of policies and policy-actors, several of which do not carry the “innovation” label and primarily have other goals. It is argued, therefore, that an effective innovation policy requires close coordination of policies across a number of different domains, and the development of new forms of governance that makes this possible.

In recent years a lot of attention has been devoted to the evaluation of single innovation policy instruments in various countries. However, such evaluations are at best incomplete as long as interactions between different policies - as well as system-wide effects and feedbacks - are not properly taken into account. What is needed are system-level evaluations, and the OECD should be credited for attempting to develop their evaluations of national innovation policies in this direction, see for example the recent evaluation of Swedish innovation policy. There has been little discussion, though, about the methodologies for carrying out such analyses.

Another issue that deserves attention is who might profitably be involved at various stages of the evaluation process. For example, there appears to be a tendency for national policy makers to try keep the cards close to their chests for as long as possible, and for the OECD-secretariat and other involved parties (such as consultancy companies) to go along with this. It is highly questionable, however, if restricting information, discussion and broad participation is a good strategy for creating effective innovation policy in modern, knowledge-based societies. Indeed, Eric von Hippel has in another context argued that in such societies “democratic innovation”, i.e., involving the expertise of the broader public, is not only more democratic but also more effective.

Finally, lessons from the discussion as well as challenges with respect how to implement these lessons are considered, and the future research agenda in this area is discussed. Empirical evidence from the Nordic area is introduced at various points to illustrate the relevance of the arguments brought up during the discussion.

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***Responsible Research and Innovation and assessment of emerging science and technologies***

**Abstract:** An important motivation for the current focus on responsibility in research and innovation is to secure that such activities provide the desired societal benefits. Ideally, in a liberal society, one may envisage that researchers and innovators would ensure the societal benefits of innovation by following what are arguably (referring to diverse contributions such as European Commission 2013, Owen et al. 2014 and von Schomberg 2012) the main elements of an RRI approach:

In order to be responsible research and innovation needs to

1. address significant societal needs and challenges
2. engage a range of stakeholders for the purposes of mutual learning
3. anticipate potential problems, identify available alternatives, and reflect on underlying values, and
4. respond, act and adapt according to 1-3

Recognising that all innovators for different reasons do not do this themselves implies a need for an apparatus around research and innovation that contributes to shaping the development in line with societal values. The EST-Frame project on integrated assessment has studied the assessment apparatus around emerging science and technologies (EST) (see Forsberg et al. 2014). Such science and technologies are assessed in risk assessments, impact assessments, ethical assessments, foresights, economic assessments and parliamentary technology assessments, as well as in assessments produced outside the institutionalised advisory domains, for instance by academic societies, research consortia, industry organisations and consultants. Such assessment of technologies can be related to RRI in two distinguishable but related ways.

The first relates to the support that the assessment apparatus can provide for responsible development and governance of science and technologies (see also von Schomberg 2012). This can be done by providing extensive peer review of the scientific status in a field necessary for developing appropriate risk assessment and management guidelines; providing routinized quality control of documentation of impacts; providing modelling and synthesis of available data on economic indicators, trends, etc.; and providing information on other relevant issues, such as ethical concerns or public opinions. Such advice can assist in specific technology cases (such as specific biotechnology applications) and for the development of a technology field (such as synthetic biology). Moreover, advisory domains can engage citizens, stakeholders, technology developers, and policy makers in learning processes that are not primarily intended to inform policy makers, but are in themselves direct governance activities. Such assessment support is crucial for responsible technology development and innovation.

A main motivation for the EST-Frame project was to explore to what extent these sources of intelligence do work together to ensure responsible technology development and governance. Related to the RRI dimensions outlined above the EST-Frame research shows that:



1. Some assessments discuss technologies in light of societal needs and challenges, but these usually do not inform other assessments in the field.
2. Some assessments engage stakeholders in technology discussions, but these are a minority
3. Many assessments anticipate potential problems with the technologies, but few identify available alternatives to the technologies, and few reflect on the underlying values of such technology development

The second way assessments of emerging science and technologies may respond to RRI is by adopting the RRI principles. The EST-Frame research shows that though there is a certain variation across assessment communities and institutions, all the RRI dimensions are challenging for the advisory domains.

1. All domains address significant societal needs and challenges as all have a societal function. However, the scope of such treatment of societal needs and challenges depends on the mandate of the different advisory domains.
2. The advisory domains seem to a very limited extent to engage a range of stakeholders for the purposes of mutual learning. Advisory domains are expert based and develop their methodologies primarily in internal dialogues. Though they do organise events with stakeholders or the public this is rarely to discuss their own methodologies.
3. When it comes to the reflexivity of the domains it has been hard to identify the extent to which they anticipate potential problems with their assumptions, identify available alternatives to the methods they apply, and reflect on their underlying values. This does not mean that such reflection does not exist, but that it is usually not expressed explicitly in their advice.
4. All the domains engage in methodological development as a response to shifting environmental expectations, but not necessarily to RRI-related values.

Should we expect the same responsibility principles for the assessors as for the innovators? What is 'responsible assessment' in relation to 'responsible research and innovation'? Is assessment an inherent part of the innovation system? These issues need further discussion among assessment professionals, policy makers, stakeholders and scholars.

Studying integration in assessments, the EST-Frame research indicates that such integration requires a mild institutional reform in the sense of creating topic-specific learning spaces where advisory domains meet to discuss assumptions, framings and method choices in assessment, preferably with relevant policy makers, representatives from industry, and other stakeholders. Instead of leaving the integration of the evidence base till the end, when a diversity of assessments have already been produced, there should be an integrated and transparent reflection on assessment needs, framings and methods at the start. Such integration will also be conducive for RRI as in such trans-domain and transdisciplinary processes discussion of societal values and needs for anticipation will have a space that more disciplinary assessments may not allow for. Such trans-domain dialogue will necessarily create increased reflexivity and may anticipate the objections and controversies that assessments may incur. Though the concept and intention of such broad assessment reflection is not new the research shows that there still is a need to operationalise and institutionalise it.

#### References

European Commission (2013) Options for Strengthening Responsible Research and Innovation <http://ec.europa.eu/research/science->

society/document\_library/pdf\_06/options-for-strengthening\_en.pdf [Accessed 15.05.2013]

Forsberg, E-M., Thorstensen, E., Nielsen, R.Ø. and de Bakker, E. (2014) 'Assessments of emerging science and technologies: mapping the landscape', *Science and Public Policy*, doi:10.1093/scipol/scu025

Owen, R, Macnaghten, P. and Stilgoe, J. (2014) 'Responsible research and innovation: From science in society to science for society, with society', *Science and Public Policy*, 39/6: 751-760

Von Schomberg, René (2012) 'Prospects for technology assessment in a framework of responsible research and innovation'. In: *Technikfolgen Abschatzen Lehren*.

*Bildungspotenziale Transdisziplinärer Methoden* (Eds. Dusseldorp, M. and Beecroft, R.). Vs Verlag Fur Sozialwissenschaften, pp. 39–61.

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***Giving with one hand, burdening with the other: European funding and regulation of vaccine research for global health***

**Abstract:**

In biomedical research for global health, the impact of European Union policy reaches far beyond the continent. Science towards innovations to treat and control neglected diseases—which primarily affect the global south—is highly dependent on the support of institutions in the global north (Smith 2009), and the EU is a major player in this area. This paper draws on over 50 interviews with scientists and clinicians in the UK and sub-Saharan Africa to demonstrate that this is particularly the case in tuberculosis (TB) vaccine research.

While highlighting the importance of EU funding towards innovation for a new TB vaccine, this paper also reveals that the increasing administrative burdens imposed by EU regulatory policy create bureaucratic bottlenecks. These hamper research efforts and limit the impact of funding in a research field that relies primarily on public actors with scarce resources. In theory, streamlining EU research funding and regulatory policy is a simple idea. In practice, achieving the optimum innovation ‘policy mix’ is far more elusive (Flanagan et al 2011). Nevertheless, if the tensions highlighted in this paper were addressed, the EU stands to make a greater contribution to innovation for TB and other neglected diseases.

Tuberculosis is an airborne disease, transmitted via micro-droplets in the coughs, sneezes, speech and laughter of infected individuals. Scientists discovered the mycobacterium that causes TB more than a century ago. A diagnostic test was developed eight years later. In the 1920s, the only vaccine widely delivered in human populations, Bacille Calmette–Guerin (BCG), was first used to prevent the disease. Drugs to cure TB were available to clinics by the 1950s. Many thought the battle had been won. Yet today, the World Health Organisation (2012) estimates that one third of the world’s population is infected with latent—inactive—TB. Each year, an additional 30 million people are infected, 8 million develop the active disease and 1.4 million die (WHO 2012). Overwhelmingly, these infections and deaths occur in poverty-stricken areas or in otherwise vulnerable populations. Contemporary TB is predominantly a socially stratified disease.

Because of this, TB vaccine research had ground to a halt by the 1980s. Meanwhile, existing tools for TB management had become out-dated or inadequate to contain and eradicate the disease—BCG had lost efficacy and drug-resistant strains of the mycobacterium emerged. In today’s challenging global health environment, prevention remains one of the most important components of a long-term solution to this airborne pathogen. Yet the TB vaccine R&D pipeline is limited, particularly as innovation in this area does not offer profit incentives to the pharmaceutical industry. Therefore, much of the high-risk basic, translational and early clinical TB vaccine research takes place in academic and public contexts.

This was the case with the front-running vaccine since BCG, MVA85A, which was discovered and initially evaluated for clinical safety at the Jenner Institute, University of Oxford. In 2009, MVA85A became the first preventative vaccine candidate since BCG—and is still one of only three—to reach Phase IIb of human clinical trials. Such trials in TB vaccine R&D are major undertakings involving several thousand participants in TB endemic areas in the developing world, primarily in sub-Saharan Africa. When MVA85A reached Phase IIb in the pipeline, it therefore marked a major milestone for the TB vaccine research field. In February 2013, the results of the Phase IIb trial unfortunately indicated that the vaccine failed to offer statistically significant protection against TB infection (Tameris, Hatherill et al. 2013). While there is general acceptance among the TB vaccine field that several vaccines will need to be trialled before a successful candidate is found, this was a disappointing outcome. Yet there are lessons in MVA85A's story that can be used to improve policy to better support future research.

It was clear from interviews with senior scientists and clinicians, particularly in the UK and South Africa, that EU funding underpinned the MVA85A research program. One of the aims of the EU research funding Framework Programmes is to position Europe as a world leader in research and encourage collaboration across member nations to achieve this goal. Furthermore, EU policy also includes priorities for increasing research capacity in the developing world, and in particular Africa, as in the case of the European & Developing Countries Clinical Trials Partnership (EDCTP). Established in 2003 under FP6, the EDCTP funds projects with a special condition: they must all be “undertaken in partnership with sub-Saharan African (SSA) countries”, ensure “synergy and optimal use of resources” and create “a win-win situation for all parties involved” (EDCTP 2012). Recent literature suggests the EDCTP is influencing capacity building and supporting transformative research collaborations for the global south (for example, Mgone and Salami 2009). The findings from the TB vaccine field support this, illustrating that the EDCTP was integral to MVA85A progressing through the R&D pipeline.

Throughout this research, however, there was another EU policy area that overshadowed the EDCTP. Interviews revealed that one of the burdens shouldered by the MVA85A research group has been the introduction of the European Clinical Trials Directive (EUCTD). Intended to standardise clinical trial regulation across Europe, this has greatly increased the amount of paperwork required of all researchers undertaking human clinical trials in the EU. A positive aspect of this is “getting rid of the garbage trials” (Petryna 2011:967) designed to generate or sustain markets for drugs. Yet participants in this study felt that the EUCTD disadvantaged academic research compared with industry, given that university and public organisations tend to have far less support staff than large pharmaceutical companies. This resonates with claims in the literature that the EUCTD exerts a “stifling effect” (Webb 2012:874) on clinical research in public and academic contexts. A proposed review to the EUCTD has gone through public consultation (Kermani 2010), though it has been argued elsewhere (Kenter and Cohen 2012:1766) that the system should instead be completely overhauled, otherwise reform will only be an attempt to “fix the roof when the foundations are shaky”.

Researchers interviewed in this study were not troubled by strict codes of safety and quality for clinical trials, as this was the way in which they already operated before the EUCTD,

given the benchmarks set by the UK and South African governments and by university human ethics frameworks. However, informants who spoke about the EUCTD felt it duplicated these existing mechanisms and exerted greater pressure on the resources of academic institutions than on those of pharmaceutical companies, as the literature suggests. As one mid-career scientist remarked: "it's put a big burden onto the trials run by small academic units like us. It's added more hurdles. It's slowed down the processes". Yet interviewees tended to be skeptical of whether the harmonised EU regulatory system had improved ethical or safety outcomes.

Indeed, several interviewees expressed concerns that the EUCTD had been modelled on industry practices, and had been directly influenced by large pharmaceutical companies. They perceived this as an unnecessary, inappropriate and inequitable model. As a result, participants were concerned that the EUCTD was reducing the amount of translational and clinical research conducted in the academic sector, with one mid-career interviewee commenting: "it hasn't levelled the playing field, it's driven lots of academic groups out of doing translational work." They saw this as particularly problematic for research towards neglected diseases given that there is little economic imperative for industry to pursue these problems.

In conclusion, this paper illustrates two key areas in which EU funding and regulation both enabled and constrained research for the leading TB vaccine since the 1920s. On one hand, the EDCTP provided the funding to underpin successful collaborations between researchers in the UK and sub-Saharan Africa. On the other hand, the EUCTD placed an ever-increasing burden on the resources of academic and public groups, with participants concerned that this was threatening the capacity of universities to undertake research into the treatment and prevention of diseases of poverty. This paper therefore argues that funders and regulators must address these policy tensions if they are to better support innovation for neglected diseases such as TB. Though challenging, this will be an integral step to maximising the impact of EU investment in global health research and move beyond a policy mix that gives with one hand and burdens with the other.

#### References:

EDCTP. (2012). "The Organisation - EDCTP." Retrieved October 30th, 2013.

Flanagan, K., Uyarra, E. and Laranja, M. (2011) "Reconceptualising the 'policy mix' for innovation." *Research Policy*. 40: 702-713

Kenter, M. J. H. and A. F. Cohen (2012). "Re-engineering the European Union Clinical Trials Directive." *The Lancet* 379(9828): 1765-1267.

Kermani, F. (2010). "Change is in the air for the European clinical trials directive." *Pharmaceutical Technology Europe* 22(5).

Mgone, C. S. and W. Salami (2009). "EDCTP: a genuine north-south partnership." *Tropical Medicine & International Health* 14(11): 1327-1328.

Petryna, A. (2011). "The Competitive Logic of Global Clinical Trials." *Social Research* 78(3): 949-974.

Smith, J. (2009). *Science and Technology for Development*. London, Zed Books.

Tameris, M., M. Hatherill, et al. (2013). "Safety and efficacy of MVA85A, a new tuberculosis vaccine, in infants previously vaccinated with BCG: A randomised, placebo-controlled phase 2b trial." *The Lancet* 381(9871): 1021-1028.

Webb, D. J. (2012). "The roles of clinical pharmacologists in UK universities." *British Journal of Clinical Pharmacology* 73(6): 874-877.

World Health Organization. (2012). "Tuberculosis." Retrieved December 2nd, 2012, from <http://www.who.int/gho/tb/en/>

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***University rankings and its determinants: an analysis of the CWTS Leiden Ranking data***

**Abstract:** Introduction

Undeniably, there is a large heterogeneity of performance among universities. Accordingly, the logic of university ranking seems appropriate: rankings reveal the performance of a university relative to others. Indeed, university rankings are now proliferating. Apart from the most well-known such as the ARWU ("Shanghai") ranking, the THE ranking and QS ranking, there are at least 30 other rankings being used (Shin et al. 2011).

However, global university rankings tend to suggest, albeit implicitly, that there is a single 'global' university system. Such a viewpoint ignores strong specificities between disciplines, countries, and university missions. Hence, university rankings can be criticized for being misleading to its users, such as international students and policy makers (Kehm and Stensaker 2009; Shin et al. 2011; European Journal of Education 2014).

In our view, what is needed is an understanding, and a reflection hereon, of the determinants of university rankings. For example, rankings may be explained by national or disciplinary differences. Size and age are also commonly through to affect rankings.

An empirical analysis of the determinants of university rankings would provide us with insights into the structural differences between universities worldwide. From this, more specific – and more meaningful – peer groups can be constructed relevant for a comparison between universities.

The goal of our empirical study is to analyse the determinants of performance of universities? We do so by using regression analysis by means of which a university's rank can be explained from underlying structural variables.

**Methodology**

We limit ourselves to research performance as expressed in three variables: mean citation impact of scientific articles, the share of university-industry publications, and the share of international publications. All three variables are taken from the CWTS Leiden ranking database concerning the 500 largest research universities in the world.

As determinants we take into account, among other variables, university location (country) and specialization (medical, engineering). These variables capture national and disciplinary specificities highlighted by those critical of university rankings. We also look into size variables. Here, a methodological problem is how to assess the size of the university in the first place. Apart from this question, data availability also restricts the kind of size data one can construct.

## Results

The results show that country variables are most important suggesting that global university rankings should be used with care. Instead, a more meaningful comparison between universities is at the national level. A second result holds that no country seems to “excel” in all three indicators (mean citation impact, university-industry publications, international publications). This reinforces our conclusion that national systems are heterogeneous, not only regarding each performance dimension as such, but also in their “mission”, i.e., which performance dimension is regarded as most important. A third result highlights the specific performance of technical universities. A final result holds that size seems to matter a lot, especially regarding citation impact. This result is in line with another recent empirical finding (van Raan 2013).

## Discussion

The results suggest that a global ranking of universities indeed ignores some of the structural differences between them. For a more meaningful comparison, one may, instead, construct more specific peer groups. Our results suggest that such peer groups should be constructed nationally – or between similar countries – as well as on the basis of size and university type.

## References

European Journal of Education (2014) Special Issue: Global University Rankings. A Critical Assessment, 49, 1, Pages 1–158.

Kehm, B., Stensaker, B. (2009) (Eds.). University rankings, diversity, and the new landscape of higher education. Sense Publishers.

Shin, J.C., Toutkoushian, R.K., Teichler, U. (2011) (Eds.) University Rankings. Theoretical Basis, Methodology and Impacts on Global Higher Education. Berlin: Springer.

van Raan AFJ (2013) Universities Scale Like Cities. PLoS ONE 8(3): e59384.  
doi:10.1371/journal.pone.0059384



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***Heterogeneity among science parks as intermediaries of university-industry research collaborations***

**Abstract:**

Science parks are expected to act as a catalyst for university-industry knowledge transfer in regional innovation systems. Unlike previous studies that analyzed the efficiency of science parks as a whole, this study examined how heterogeneity among science parks affects their capabilities to encourage on-park firms to develop interactive university spillover channels. The intermediary function of science parks was defined, measured, and evaluated, centering on the role played by incubation managers as a gatekeeper. Estimation results that the number of university-industry research collaborations is positively correlated with the scope of incubation managers' professional experiences, but not with the number of incubation managers. The physical advantage of science parks, such as the geographical proximity to universities, is not conducive to cooperative research with universities. Policy implications of the results are discussed.

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***Open science, science 2.0, new science and the evolution of the scientific process: trends, stakeholders and policy implications***

**Abstract:** The institutional configuration for undertaking science has changed little throughout the 20th Century. More recently, the diffusion of Information and Communication Technologies (ICT) and new web-based tools have introduced social and cultural changes to all aspects of life including the practice of science. The means by which science is being undertaken is also evolving, creating new initiatives and a movement that is typically described as Science 2.0, Open Science or New/e-science. In this paper we consider the evolution of the scientific process from Science 1.0 to Science 2.0, the new trends emergent, the stakeholders involved and the possible policy implications that arise. We consider a framework for policy interventions that are required to accompany the developments from the open science movement that are affecting the system of science. The paper points towards the idea that policy intervention is essential if the full potential for open science is to be realised and suggests that the wider adoption of open science cannot rely on researchers' preferences alone and will eventually require a more responsible and flexible range of policy interventions. The policy rationale that emerges from consideration of the evolution of open science is complex and involves many levels of stakeholder interests and decentralised governance. The overall policy framework brought forward in this essay is that of reconciling the open science agenda to achieving coherence between the various elements of the system. In order to foster an open science environment, policy makers will need to adopt a systemic view of the scientific process and consider all the nuances involved in the progression towards open science.

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***Are internal and external sources of knowledge complementary? Focusing on the diversified firm***

**Abstract:** Whether external knowledge sourcing (EKS) and internal knowledge generation (IKG) occur simultaneously or not is still an unresolved question in innovation studies. According to transaction cost theory, external knowledge sourcing and in-house knowledge generation are usually considered as substitutes. The complementarity of EKS and IKG has been mainly supported from the absorptive capacity theory, which states that as firms generate internal knowledge there are higher probabilities for the firm to recognize and acquire external sources of knowledge. We expect that empirical contradictory results could be resolved by understanding what other factors could be affecting this relationship such as product firm's diversification. We believe that the application of more traditional strategy and management research topics (e.g. corporate diversification) to this research question can contribute to previous literature.

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***Use of Expert Knowledge in Policy Formation: the Case of Smart Grids***

**Abstract:** 1. Introduction

There is a consensus that advances in science and technology will help us solve some of our most critical social and environmental problems (The Royal Society, 2010). Our ever-increasing reliance on science and technology, however, raises a number of important questions. Is scientific and technical knowledge used to inform public policy decisions that are supposed to mitigate or solve a problem? If so, to what extent do decision-makers incorporate scientific and engineering knowledge into policy design and development and how do they do so?

The decarbonisation of the electricity sector is an area that has drawn the attention of governments and regulators in developed economies. As a result, policy makers have devised major technology policy programmes and experiments with the purported aim of facilitating the transition to a low-carbon economy and society. This study provides insights into the processes through which policy makers—along with other relevant actors—have incorporated the scientific and technical knowledge underpinning some of these interventions.

2. Analytical Framework

It has been argued that our current understanding of when, why, how and whether science is used in public policy making is still limited (NRC, 2012). Three arguments buttress this statement. First, typologies such as that of Weiss (1979) and Renn (1995), which aim to explain how science is used in policy, are difficult to apply empirically. Indeed, knowledge use is a complex and context-dependent process, shaped by several actors as well as by formal and informal structures (Nutley et al., 2007). Second, Caplan's 'Two-Communities' theory does not provide a systematic explanation of use. Caplan's theoretical model highlights the gap between policy makers and scientists resulting from differences in language, values, beliefs and incentives (Caplan, 1979). However, this construct does not help to clarify how those factors interact, or the extent to which each of them can contribute to explaining the use of science in policy (Bogensneider and Corbett, 2010; NRC, 2012). Third, the evidence-based policy and practice approach has provided few insights as to how science is used. This approach recommends that policy decisions should be based on the best available scientific evidence (Nutley et al., 2000). Its emphasis is on evidence of 'what works', leaving ideology and values out of policy choices (Cabinet Office, 1999). Although this approach has arguably helped centre attention on the supply side (i.e. knowledge production), it has not offered solid propositions about the conditions that enable the use of science in public policy making. All of this suggests that social science research has to address the issue of use in a different fashion.

In the light of these arguments, this study examines the role of expert advice in public policy making. In particular, it builds on two findings from the US National Research Council's review of the use of science as evidence (NRC, 2012). First, it contends that knowledge is used and interpreted in the world of politics: policy making will never be a value-free enterprise. As a result, knowledge utilisation should be looked at through the lens of policy argumentation. From this perspective, the policy argument uses expert knowledge—along with many other practical considerations—as a form of evidence to encourage a certain course of action. This paper therefore draws on the extant policy and knowledge utilisation research literature.

Second, it posits the need for increased utilisation of systems thinking in public policy. This study applies a particular form of systems thinking—the sectoral systems of innovation (SSI) framework (Malerba and Orsenigo, 1997; Malerba, 2002). This allows for examining the interactions of the different actors that produce knowledge for public policy in a specific industrial and technological setting. While the SSI framework and its more generic form, known as systems of innovation, have devoted much attention to analysing systems' components, the issue of how such systems emerge and evolve has been partly neglected in the literature (Edquist, 2011; Malerba, 2002). This paper addresses this gap by opening the 'black box' of public policy processes (Chung, 2013).

This study also broadens the scope of the National Research Council's findings: it explores how both scientific and expert knowledge are used in policy making. This broader definition of knowledge encompasses, for instance, research papers at one end of the spectrum, and more tacit and proprietary knowledge acquired as a result of the commercial activities of firms at the other.

### 3. Empirical Setting

In this paper, the sectoral system under study is the electricity sector and the chosen national government is that of the United Kingdom. For more than sixty years, the infrastructure that delivers electricity to UK households and businesses has remained largely unchanged. However, concerns about decarbonising the electricity sector have led to an increased interest, within the government, in modernising the electricity distribution infrastructure and altering the patterns of electricity consumption. These drivers, fostered by advances in information and communications technologies (ICT), have provided the UK government with an impetus to promote the deployment of a set of new technologies with the goal of achieving specific environmental and social goals. This impetus is reflected in a set of public policy interventions, hereafter referred to as smart grids.

The empirical setting in which this research takes place is therefore heavily influenced by engineering science. It is one where emerging technologies with different readiness levels—and uncertain benefits—need to be integrated with existing technologies, and tested and deployed at scale. The complexity of these interventions stimulates investigation of the availability, accessibility and quality of knowledge required to design such an undertaking. It is in this context that the UK government and its relevant bodies need to produce, collate, interpret and utilise scientific and expert knowledge to inform their decision-making processes.

#### 4. Methodology

The research design consists of a case study approach that investigates how the design and development of the UK smart grids policy framework has unfolded. The proposed case study employs two data collection methods: face-to-face interviews, and unstructured data from documentary sources. The core data collection method consists of 78 in-depth, semi-structured interviews with senior civil servants (21), industry executives (42), leading academics (9) and senior representatives from other organisations (6) involved in policy development. A large volume of unstructured data found in the grey literature, such as government reports, public consultations and industry documents, supplements the primary data collected in the interviews.

In contrast to policy evaluation studies, or indeed to studies exploring policy change over long periods of time (Sabatier, 2007), a central feature of this case study is its emphasis on policy formation in near 'real-time'. Indeed, the near real-time aspect of this research permits tapping into the various actors' experience, knowledge and perceptions about the use of scientific and expert advice in policy formation.

#### 5. Intended Contributions

Technical knowledge is essential to making public policy choices. This is often captured in the pursuit of evidence-based policy, a term used increasingly in both academic and practitioner discussions of policy design. This term represents an idealised notion of the world of policy making. However, the empirical analysis of the UK smart grids policy formation in the UK reveals a different picture.

On the one hand, the initial search for policy ideas shows the extent to which politics, and not evidence, have influenced decision-making within government. On the other hand, the stringent policy design and implementation requirements have led to the development of ad-hoc organisational arrangements, both within government and across government, industry and academia. These organisational arrangements have been instrumental in providing more effective ways to elicit and discuss expert advice in the context of a complex technology policy area. Thus, these findings contribute towards establishing the idea that studying organisational arrangements can help improve our understanding of the use of knowledge in public policy, perhaps even more than the different available policy making models.

Finally, this study argues that in the context of this sectoral analysis, Caplan's often-cited 'Two-Communities Theory' is a model that no longer holds: firms are today's most important repositories of applied, practical knowledge. As such, governments are more prone to tap into their expertise in order to assist the policy development process. This, in turn, raises major challenges in the design of organisational arrangements that seek to integrate expert advice. These must be able to identify and manage potential conflicts arising from commercial interests while at the same time maintaining democratic accountability.

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***Science, Technology and Innovation Policy Evaluation: An Isolated Academic and Practice Field***

**Abstract:** Introduction

Evaluation has long been an important component of the policy process and is the concern of a broad area of academic enquiry. Academic researchers on evaluation are very close to practitioners and, together, have established a number of national and international associations, conferences and academic journals. As any other research community it revolves around a core set of generalist evaluation theory and methods, around which more specialised schools have developed around specific methodologies and approaches, or particular policy fields (education, health, social and development policy, etc.). Evaluation is also a topic typically covered in introductory textbooks on public policy, policy analysis, public administrations and the policy sciences. The result is an active community with different internal “schools” and a lively internal debate. An expression of this diversity is the annual conference organised by the American Evaluation Association (AEA) which draws thousands of practitioners and researchers from a wide variety of policy areas. This broad community encompasses a variety of schools, evaluation methods and different ways of understanding the role of evaluation in the policy process. From instrumental views of evaluation revolving around measurement-led, experimental research techniques, to outlooks like “Fourth Generation Evaluation” that sees evaluation as part of a process of building shared understandings of challenges and solutions among all policy stakeholders.

The evaluation of Science, Technology and Innovation Policies (STIP evaluation) appear to be one constituent component of this broader community. STIP evaluation started to become commonplace long after the core evaluation literature had developed. References to this literature can be found in some STIP evaluation reports and academics working in the field were active in the broader evaluation community. Currently “Research, Technology, and Development Evaluation” is one of the many “Topical Interest Groups” in the annual AEA evaluation conferences. STIP evaluation has its “own” academic journal (Research Evaluation), like many other policy fields (mention some examples). STIP evaluation seems to draw from and contribute to the overall policy evaluation community.

Yet, a more detailed analysis of the profile of STIP evaluation suggests a very different and surprising situation. Evidence indicates that STIP has developed on the margins of the other evaluation communities and has seldom drawn from the insights, approaches and practices they have developed. Instead STIP evaluation is characterised by its own dominant research approaches, technical developments on indicators, and a conviction that STIP evaluation is somehow essentially different from evaluation in other policy fields. STIP evaluation is not alone in having developed a somewhat distinct approach from the mainstream evaluation community and literature (e.g. development policy evaluation), but the extent to which STIP

appears isolated from mainstream evaluation is, as we will argue below, unparalleled. This paper presents evidence supporting this view through a bibliometric study. We also explore the reasons for the divide between STIP evaluation and generalist and other sectoral evaluation communities and literature. Finally, we present a roadmap to widen the scope for STIP evaluation to learn from and contribute to the core evaluation literature and practice.

## Data and Method

In this paper, we employ a mixed methods research design. On the quantitative side, we conduct a bibliometric analysis of the evaluation literature and of social media references to evaluation. We constructed a database consisting of over 20,000 publications related to policy evaluation. The database includes all articles published in 13 generalist and sector-specialist evaluation journals as well as evaluation related articles published in non-evaluation journals identified through a bespoke search strategy.

We conduct cluster analysis of the STIP evaluation literature, generalist evaluation literature and other sectoral evaluation literatures on the basis of their abstracts, their references, and other articles that cite them. We also use science overlay maps.

Social media references to evaluation are analysed using Twitter. Social media has increasingly been used to explore communities around professions and practices. Twitter data will help in studying the relationship between STIP evaluation practice and other sectoral evaluation practices. We have starting accumulating tweets related to policy evaluation in different sectors and we aim to analyse a total of 30,000 tweets. Twitter data will also be utilised in a topic modelling exercise to be able to locate the STIP evaluation practice within the evaluation practice community.

On the qualitative side, we conduct a systematic review of the concepts, frameworks and tools in STI evaluation and compare it with the trends in other policy areas and core evaluation literature.

## The Isolation of STIP Evaluation: Preliminary Results from the Bibliometric Exercise

The preliminary results from the analysis of the bibliometric data show that STI policy evaluation is very distinct from the core evaluation literature. Analyses on the basis of the abstract topic modelling, cited references networks and articles citing the dataset all corroborate this preliminary finding. Health, Social and Educational policy evaluation literatures are very close to the generalist core around, while development policy evaluation is relatively more distinct. STI evaluation, however, is very distinct from this network. The paper will present the results in detail; yet, some of the anecdotal evidence is already quite telling. For instance, there are only 21 citations from Research Evaluation to the American Journal of Evaluation, and most of these cited papers are STIP related anyway.

Twitter analysis shows a very similar picture. Health, Social, Educational Policy practices are very closely linked, while development policy is less related to this core and STIP is almost completely distinct from it.

## An interpretation of the evidence: roots and consequences



The preliminary bibliometric evidence presented above suggest some possible reasons for the separation of STIP evaluation. A substantial share of STIP evaluation revolves around indicators that are unique to this sector and, which have developed very actively over the past three decades. The importance of bibliometric indicators and associated research techniques has generated a specialised field with several associated journals (Scientometrics, JASIST, Technometrics, and others), conferences and associations (ENID, RICYT). STIP evaluation has become closely associated with these communities as shown by the data to be presented in our analysis of bibliometric evidence.

Additionally, it is common in STIP evaluation to refer to the uniqueness of the problems faced by this task. It is often emphasized that the effects of scientific research over the economy and society are often long term and unexpected; the result of complex interactions among different actors along protracted periods of time. In this context, the problem of attributing observed socio-economic “effects” to their original causes in scientific research is particularly daunting. In fact some of the initial seminal evaluations of the effect of basic and applied research developed specific techniques to identify such effects and measure their influence (projects TRACES and HINDSIGHT). Whether STIP evaluation faces exceptional problems is debatable. There are other areas of public policy where social-economic impacts are long-term and difficult to attribute. The belief in exceptionality may reinforce the isolationist tendencies prompted by the existence of a vast dataset and associated powerful research techniques.

We can identify two main problems generated by the isolation of STIP evaluation. First, there is a tendency in STIP evaluation to reinvent the wheel: issues emerge in the STIP evaluation literature as if they were novel when they have already been addressed in other fields of evaluation. For instance, “systemic evaluation” has long been implicit in general evaluation theory, but its introduction in STIP evaluation is relatively new and has generated substantial interests: a 2005 article in *Research Evaluation* has become the most cited paper in this journal.

Second, and perhaps more important STIP evaluation has gravitated towards a particular approach in policy evaluation: the use of measurements to provide instrumental answers within the context of summative evaluations. Other traditions in policy evaluation (Fourth Generation, participative evaluation, usefulness focused evaluation, etc.) have not found much audience in the STIP evaluation and practice, even when their close relatives in the broader policy environment (participative policy processes, etc) have been widely used in many STIP areas (like for instance energy and sustainability research). There is therefore a need to link STIP evaluation theory and practice both to the mainstream evaluation theories and practice.

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***Using a Conjoint Analysis approach to evaluate the preferences of incentives to innovation of manufacturing and service firms of the Dominican Republic***

**Abstract:** Introduction

This research is about preferences of incentives to innovation of manufacturing and service firms of the Dominican Republic. The main objective is to analyze the structure of preferences about certain combinations of stimuli to innovation, as well as identifying how certain core characteristics of firms such as size, market, technological level of products and location, influence these preferences. The analysis of preferences was carried out using the method of Conjoint Analysis (CA), which is part of the family of stated preferences methods. The Dominican Republic is a country located in the Caribbean Region and occupy 2/3 of the Hispaniola Island, which is shared with the Republic of Haiti. It has a population of around 10 million of inhabitants and a surface of aprox. 49,000 square kilometers. According to the World Bank, it is the biggest economy of Central America and the Caribbean, with a GDP of US\$59 billion in 2012. Until 2010, the country experienced one of the highest growth rates in Latin America and the Caribbean. In terms of human development it is considered as a middle income country with distortions in income distribution and inequalities. Around two thirds of economy activities consist of services in which telecommunications and tourism play a key role. The industrial sector represents around one third of the economic activity, with an important contribution of free zone firms. Some commodities from agriculture (i.e: banana, cocoa, coffee) and mining activities (gold, silver, bauxite) are currently increasing their contribution to the GDP.

This research is intended to be presented as part of the open track topic: How do we know what works? New approaches to impact assessment and evaluation, given that the methodological approach used to evaluate the preferences of incentives to innovation in the context of a developing country, opened a discussion about new ways of including the firm's perspective in STI policy making and assessment.

**Main analytical basis**

The CA has been used successfully in marketing studies, in the health field for studies on service improvement, in transportation and infrastructure projects, in prospective studies for energy projects, and over the last 25 years it has been intensively used in the fields of environmental economic valuation and management of natural protected areas. Its main tenets rely on the approach developed by Lancaster called the "new consumer theory" in which consumers derive utility from the characteristics or objective attributes of the goods or services (price, size, etc.), instead of the goods themselves. The other theoretical component is called "random utility theory, which basically states that the decision-making process is conditioned by the random or unobservable characteristics that lie behind the choices or preference, such as personal tastes, education or incomes, in the case of consumers.

In terms of the analytical framework, the main conceptual elements of this research have been: the existing literature about knowledge and innovation, the economic impact of fiscal and non-fiscal incentives to R&D as a proxy variable of innovation and a review of the concept of national innovation systems (NIS), in order to contextualize the analysis of incentives in the frame of national innovation system of the Dominican Republic. About this latter we conclude that, although it has all the components of a NIS, its institutional actors do not operate under the logic of a system given the lack of mechanisms and interfaces that promote the public and private dialogue on innovation.

## Methodology

The 326 surveyed firms were presented 16 packages of stimulus to innovation, which were defined in the context of an experiment's factorial design. The attributes and levels utilized in the factorial design were the result of a series of workshops with groups of experts from the Dominican Republic and Spain. In these workshops, eight attributes and its levels were defined: 1) tax deferral, 2) tax deduction for innovation projects and R&D, 3) amortization of capital expenditures, 4) tax credit for total expenditure on innovation and R&D; 5) tax exemptions for R&D and related activities; 6) guarantee funds investment in innovation and technology transfer; 7) public funds for co-financing R&D Projects, and 8) transfer of intellectual property or patent box.

The CA was carried out using the statistical software SPSS® version 20. In order to perform the AC, this software follows two routines which are: the ORTHOPLAN procedure for orthogonal fractional and factorial design, which resulted in the above mentioned 16 innovation packages; and the CONJOINT procedure for the analysis of preferences. The descriptive analysis of the variables was performed by the method of Categorical Principal Components Analysis (CATPCA), which is an optimal scaling method that allows the identification and simplification of groups of variables into meaningful dimensions. The analysis of preference ranking and the hypotheses testing were carried out through an ANOVA (analysis of variance) and a MANOVA procedure (multivariate analysis of variance of principal components).

The treatment of the descriptive variables through optimal scaling highlighted the following as the most important variables: 1) the composition of the capital stock of firms; 2) the life cycle of the firms' main product; 3) the tax regime to which firms are affiliated; 4) the age of firms; 5) main market of firms; and 6) the technological level of goods or services.

## Main Results

In terms of preferences of packages of stimuli, the main finding is that the structure of preferences is very similar between groups of firms and of this with the general structure of preferences, concluding that manufacturing and service firms will prefer: tax exemption (23%) to any other fiscal figure, followed by the amortization of capital goods (16%), public funds for co-financing R&D (15%) and guarantee funds (11%). The least preferred tax figures are: the tax credit (10%), the tax deduction (9%), the transfer of intellectual property (8%) and lastly, tax deferral (7%). Although preference structures are very similar, manufacturing and services firms are affected in different ways by the explanatory variables, particularly in the probabilities of choice: manufacturing firms more affected by the size, while service firms are affected by the tax regime and the capital composition.

Based on the forecast of preferences, in general companies will prefer a basket of tax incentives for innovation that provides a profit balance that minimizes the tax liability (which is what they have to pay at the end of each fiscal year), and that at same time, maximizes the impact on the tax base and public co-financing. Finally, in regards to public policy recommendations, this paper provides guidelines for a program of policy reforms from the perspective of the analysis of the Dominican innovation system, to simplify the legal framework and make it more intelligible, including the current platform of innovation incentives. These reforms should focus on creating interfaces (coordination and communication mechanisms) among the diverse institutional actors of the system, to help them overcome the reciprocal ignorance and silence between them.

#### Concluding remarks

In the context of a developing country, two kind of contributions could be highlighted: 1) the relevance of the analysis of preferences of innovation incentives for policy design and, 2) the relevance of the Conjoint Analysis as a tool for ex-ante evaluation of public policies. The first type imply that the structures of preferences and the probabilities of choice of manufacturing and service firms tend to be similar, although the probabilities of choice are more sensitive than the structure of preferences to the characteristics of firms, and the preferences of firms will focus on the combinations of attributes and levels that minimize risk and reduce the costs of innovative activities. From the above perspective, direct public funding and indirect funding through tax exemptions will be probably preferred by firms. The second type of contribution point outs the robustness of the methodological foundations in which the Conjoint Analysis lies. The selection of the Conjoint Analysis method based on ranking of preferences was correct, given the exploratory nature of this research.

The analysis of partial contributions (part-worths) and decompositional approach has provided results that are consistent with the underlying theoretical framework, as well as with the somewhat sparse literature on incentives of innovation in the Latin American and Caribbean context.

This research has been possible thanks to the support of several public agencies of the Dominican Republic, primarily the Dominican Fund of Economic and Social Research (FIES), the Ministry of Economy, Planning and Development, the National Office Industrial Property (ONAPI) and the National Competitiveness Council (NCC).

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***Understanding the dimensions of Responsibility implied in the concept of “Responsible Research and Innovation”***

**Abstract:** The concept of Responsible Research and Innovation is gaining value in EU policy agenda in recent years, in particular within the Horizon 2020 strategy; it expresses the ambition to integrate broad societal needs within techno-scientific innovation at an early stage, considering ethical and social aspects during innovation processes (like its global and inter-generational impacts).

While the broad aims and the ambitions of the concept are clear enough, the concept lacks a more precise definition in order to be translated in practice, as in one hand it involves explicit and implicit assumptions about responsibility, which is eminently a contested subject, and in the other hand it has to deal with the existing (de facto) practices of responsible innovation (whether explicitly labelled that way or not).

Techno-scientific innovation tends to escape to traditional legal regulation for the very nature of the research and innovation activities, whose consequences are largely unpredictable, making hard establishing in advance comprehensive standards of care; therefore, legal responsibility does not suffice alone to ensure commitment to future-looking goals and early engagement of both innovators and stakeholders, and complementary instruments of responsibility are becoming fundamental, as the development of the CSR paradigm clearly illustrates.

Long-established ideas of responsibility are being felt to be insufficient for dealing with Research and Innovation outcomes, as the legal system typically manages responsibility ex post facto, by the means of liability (bearing the consequences of one's actions) or accountability (being prepared to give an account of one's actions), so it reflects only partially the multiple meanings of responsibility, which are nowadays focusing on anticipatory, future-looking (“prospective”) forms of responsibility.

The idea of RRI both presupposes and fosters regulatory approaches based on actors' responsabilisation, so it makes room not only for the use of soft law and self-regulatory instruments (e.g. Codes of Conduct), but also for other less formal ways of regulation, such as best practices, benchmarking, peer-pressure etc., which stand far away from typical legal regulation.

Responsibility is a multi-faceted concept and its understanding is constantly oscillating between a passive pole (being held responsible: obligation to bear the consequences of an action) and an active understanding of it (assuming responsibility: capacity to act taking into account consequences).

From a temporal perspective Responsibility looks both to the past (“historic responsibility”) and to the future (“prospective responsibility”): this latter is often considered as being derived and logically dependent from the first (which is often considered to be the “authentic” meaning of responsibility); nevertheless these two dimensions are not separated and the idea of a prospective responsibility has importance and value independently of accountability or liability to sanction [Cane 2002].

Responsibility is therefore wider than the idea of liability or accountability (as giving an

account is still a backward-looking process) and it is also wider than that of traditional role-responsibility (intended as a pre-established set of duties or tasks), since it cannot be identified merely with a set of tasks or duties but it implies also a wider proactive attitude and commitment towards responsibility (“virtue-responsibility”) focusing on the idea of acting responsibly (ex ante) rather than holding someone responsible (ex post).

A future-oriented responsibility at the individual level is to be declined in terms of responsiveness (intended as the capacity to respond readily and sympathetically to appeals), at the collective level it has to be realized through instruments of participation in the decision-making.

Nowadays participation has to encompass the limits of traditional political representation, which is inapt to catch global and long-term issues of responsibility, pointing rather to more informal mechanisms of governance. Participatory dimension is then crucial in order to open the scientific expertise, which is usually the reference for risk assessment, to more general questions, introducing representation in to scientific debates.

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*How can innovation be governed? Reflections on RRI from an innovation perspective*

**Abstract:** The call for contributions to this session at the EU-SPRI conference is in particular oriented at governance challenges related to the emergence and diffusion of policy mechanisms for Responsible Research and Innovation (RRI). In this paper, we seek to reflect upon five specific governance challenges using established knowledge about the characteristics of innovation processes, outcomes and systems. Our aim is to shed light on central policy challenges that need to be handled by researchers and policymakers alike if the RRI ambition is to be realised at a grand scale, and to help develop a research agenda for RRI scholars that moves beyond support in policy processes.

RRI is a theme emerging from several cross-disciplinary areas like STS and ethical aspects of science and technology that has gained momentum especially in the EU the last couple of years (Owen et al. 2013). Competing notions of RRI exist. The European Commission Expert Group on RRI highlights the need to evaluate research and technology outcomes and alternative options in terms of societal needs and moral values, and use these considerations as functional requirements for innovation (EC 2013, p. 3). Stilgoe et al. (2012) argue that RRI should aim at being anticipatory, inclusive, reflexive and responsive. Von Schomberg (2013) claims that RRI should address European normative anchor points and increase deliberative democracy.

Although it is hard to argue against the notion that research and innovation activities should also contribute to shared values in society outside of the individuals, organisations and networks engaged in research and innovation, the actual policies and research agendas remain at an early stage with much reflexive and conceptual work to be done. In particular, the move from studying and governing advanced science-based technologies like nanotechnology and genetically modified organisms towards including innovation in general in RRI is a huge move with many possible implications. Our aim in this paper is to reflect upon governance mechanisms for responsible innovation in light of a contemporary evolutionary innovation perspective, and to use this as a basis for discussing future research agendas.

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### ***Training quality and return to training in the Italian regions***

#### **Abstract:** Aim and background

A great importance has been devoted to the role played by formal education and education policy for both innovation and employment. More recently, training and national training systems have been brought into the picture (Acemoglu and Pischke 1998; Dearden, Reed, and Van Reenen 2006; Estevez-Abe, Iversen, and Soskice 2001; Filippetti and Guy 2010). A few studies have looked at the relationship between employment status and training. In this type of analysis workers are usually divided into temporary versus permanent workers (Boeri and Garibaldi 2007; Lucidi and Kleinknecht 2010; Picchio and Van Ours 2011).

Yet, several weaknesses characterize this area of research. First, the focus is on on-the-job training, while scarce attention is devoted to training activity outside the firm, with a consequent gap in the understanding of how a training system works as a whole. Second, the fact that training systems can profoundly differ in terms of quality is scarcely taken into account. Thirdly, within-country differences in the quality and impact of training are another issue almost entirely neglected in the literature: this is particularly relevant since in several countries sub-national governmental bodies are responsible for training provisions, as it is the case of Italy. Finally, the effects of training for workers already in the labour force may be contingent on formal education received prior to entering the labour force.

This paper studies the return to training activity and training quality across the Italian regions at the level of the individual. We estimate the return to individual workers from training carried out both by employers and by public agencies or other third parties, for both employed and unemployed workers. We also investigate differences in the returns to training across the Italian regions depending on objective and subjective measures of the quality of the training system.

There are two reasons why this is particularly worth exploring in the Italian case. First, there are remarkable differences across regions in terms of both rates of unemployment and industrial specialization which are interdependent with the functioning of regional labour markets. Second, since the 2001 reform, Italy's twenty regional governments have become responsible for the bulk of training policy. Differences in the regional effects should make it possible to draw some implications which go beyond the national case. Indeed, the design of training system provision is currently at the top of the policy agenda across Europe to address rising rates of unemployment (ILO Report, 2014).

#### Data and methodology

We use data from the PLUS survey (Survey on Labour Participation and Unemployment Survey) developed by the Institute for the development of professional education and training of workers (ISFOL) of the Ministry of Labour and Social Policy in Italy. PLUS covers



about 40,000 individuals in each cross-section wave; we use the most recent panel which includes the years 2008-2010-2011. This survey is a particularly rich source of data on training.

We employ multilevel modelling techniques (or hierarchical linear models) for our estimates, as this approach is particularly appropriate in research designs in which the units of analysis are individuals who are nested within contextual elements, i.e. the regions, which are also targets of attention.

#### References

- Acemoglu, Daron, and Jorn-Steffen Pischke. 1998. *The Structure of Wages and Investment in General Training*. National Bureau of Economic Research.  
<http://www.nber.org/papers/w6357> (February 6, 2014).
- Boeri, Tito, and Pietro Garibaldi. 2007. "Two Tier Reforms of Employment Protection: a Honeymoon Effect?" *The Economic Journal* 117(521): F357–F385.
- Dearden, Lorraine, Howard Reed, and John Van Reenen. 2006. "The Impact of Training on Productivity and Wages: Evidence from British Panel Data\*." *Oxford Bulletin of Economics and Statistics* 68(4): 397–421.
- Estevez-Abe, M., T. Iversen, and D. Soskice. 2001. "Social Protection and the Formation of Skills: A Reinterpretation of the Welfare State." In *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage*, eds. B. Hall and D. Soskice. Oxford: Oxford University Press.
- Filippetti, A., and F. Guy. 2010. "Varieties of Labour Market Institutions and Skills, and the Effects of the Financial Crisis on Innovation in Europe." Prepared for the EAEPE Conference Bordeaux, October 29-30.
- ILO. 2014. "Global Employment Trends 2014: The risk of a jobless recovery". Geneva.
- Lucidi, Federico, and Alfred Kleinknecht. 2010. "Little Innovation, Many Jobs: An Econometric Analysis of the Italian Labour Productivity Crisis." *Cambridge Journal of Economics* 34(3): 525 –546.
- Picchio, Matteo, and Jan C. Van Ours. 2011. "Market Imperfections and Firm-sponsored Training." *Labour Economics* 18(5): 712–22.

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***Measuring the evolving morphology of the European Research Area***

**Abstract:** Motivations

The European Research Area is said to be completed by the end of 2014 (European Commission, 2012). Apart from the (rhetoric) question whether this is feasible or not as a target, this idea of completion of the ERA raises the question what a completed ERA looks like.

So far, the official definition of the ERA rests on the 5 priorities identified in the ERA-Communication 2012. Little attention has so far been put on the dynamic overlap between them and with them and other policy domains. In other words, little is known on the morphology of the ERA and its evolving nature. Yet, understanding the links between priorities, and between the ERA and other policy domains, is critical to define appropriate policy responses.

This paper aims at drawing a clearer map of the nodes, and trade-offs between the 5 ERA-priorities and with the other policy domains, placing the latter in a broader policy spectrum characterised by multi-level governance. The paper will thus offer insights on the dynamic challenges of co-ordination and implementation of policies within and beyond ERA. ERA-Policy mixes to obtain a certain policy goal need to be translated into trade-offs with regard to both the nodes and connections that need to be strengthened versus the ones that may subsequently weaken.

Building on several experiences with monitoring the ERA within the European Commission's Joint Research Centre, the paper will try to map the morphology of the ERA, identifying inter-priority nodes and connections and contributing to operationalising their measurement.

The analysis is conducted against the background of the Europe 2020 strategy on Smart, Sustainable and Inclusive Growth, which assigns two roles to research in Europe: increasing competitiveness and addressing societal challenges (European Commission, 2010).

**Data sources**

The analysis in this article is primarily based on the following experiences:

- An analysis (Doussineau et al, 2013) of dedicated country information on the five ERA priorities in the EU Member States and countries associated to the Seventh Framework Programme. This information has been systematically collected with the support of independent national experts and focuses on the nature and status of national laws, policies and policy measures relevant to the five priorities and associated actions set out in the 2012 European Commission ERA Communication: a Reinforced European Research Area Partnership for Excellence and Growth (European Commission, 2012).
- 2012&2013 ERAWATCH country reports of EU Member States and Associated States (ERAWATCH, 2013)

- A forthcoming impact assessment of transnational research programming in Europe, building on a European-wide survey among ERA-NET participants, as well as in-depth case studies (Haegeman et al, 2013)
- A mapping of the current state of the ERA (Haegeman et al, 2012; Marinelli et al., 2013) as well as the construction of scenarios for the future of ERA (Teufel et al, 2013) in the context of the FP7 project 'Visions for the future of the European Research Area' (VERA)

#### Expected results

The work conducted so far shows a complex map of ERA, with 'nodes' that go far beyond the five priorities that are currently on the political agenda. Informed by such work, the paper will identify sound criteria to define the nodes, and, through an analysis of policy instruments, the degree to which they are so far addressed by policy.

#### Policy implications

By systematically identifying the nodes across priorities, and by placing the ERA in the broader policy spectrum, this paper will provide insights on current policy gaps and on more efficient ways to address trans-priority issues.

Furthermore, it will allow drawing a clear picture of where ERA is today and where it is going, proposing alternative ways of 'measuring the ERA'.

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#### References

Barré, R., Henriques, L., Pontikakis, D. and Weber, M. (2013) Measuring the integration and coordination dynamics of the European Research Area, *Science and Public Policy* 40, pp. 187-205.

Doussineau, M., Marinelli, E., Chioncel, M., Haegeman, K., Carat, G., Boden, M. (2013) ERA Communication Synthesis Report, JRC Scientific and Policy Reports, European Commission, EUR 26232 EN, Luxembourg: Publications Office of the European Union, <http://ftp.jrc.es/EURdoc/JRC85253.pdf>.

ERAWATCH (2013) 2012 ERAWATCH Country Reports, European Commission, <http://erawatch.jrc.ec.europa.eu/>.

European Commission (2010) Europe 2020 – A strategy for smart, sustainable and inclusive growth, COM(2010)2020 final, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF>.

European Commission (2012) A Reinforced European Research Area Partnership for Excellence and Growth, COM(2012) 392 final, [http://ec.europa.eu/euraxess/pdf/research\\_policies/era-communication\\_en.pdf](http://ec.europa.eu/euraxess/pdf/research_policies/era-communication_en.pdf).

Haegeman, K., Marinelli, E., Elena Perez, S., Carat, G., Degelsegger, A., Weiss, G. and

Warnke, P. (2012) ERA Fabric Map – First Edition, JRC Scientific and Policy Reports. Luxembourg: Publications Office of the European Union, EUR 25451 EN, <http://ftp.jrc.es/EURdoc/JRC71972.pdf>.

Haegeman, K., Harrap, N., Özbolat, N., Boden, M. (2013) Added value of transnational research programming: lessons from longstanding programme collaborations in Europe. Netwatch Policy Brief Nr 3, European Commission, <http://netwatch.jrc.ec.europa.eu/strategic-analysis/policy-briefs>.

Marinelli, E. Degelsegger, A., Buesel, K., Chioncel, M., Doussineau, M., Haegeman, K., Carat, G., dos Santos, P. and Daimer, S., (2013) ERA Fabric Map – Second Edition, JRC Scientific and Policy Reports. Luxembourg: Publications Office of the European Union, JRC85302

Teufel, B., Erdmann, L., Schirrmeister, E., Daimer, S., Laredo, P., Schoen, A., Robinson, D., Loikkanen, T. (2013) D3.1 ERA Scenario Report, VERA project deliverable, [http://eravisions.eu/page/22/attach/WP3\\_ERA\\_Scenario\\_report\\_final\\_web14022014.pdf](http://eravisions.eu/page/22/attach/WP3_ERA_Scenario_report_final_web14022014.pdf)

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***The rationale and legitimacy of policy to create markets as learning arenas for emerging technologies: the innovation imperative of feed-in tariffs***

**Abstract:** The purpose of this paper is to investigate how market infrastructures for emerging renewable energy technologies (RETs) can be shaped via public policy. Understanding the policy dimensions of market formation is critical given the need for RETs in transitions to sustainable energy supply, the inherent “newness” of RETs and the competition with incumbent technologies. The paper empirically analyses a key policy tool for market formation of new RETs – feed-in tariffs (FITs). This policy tool is widely used across countries, and the focus here is on the experience of one of the most important policy innovators, Germany. The paper asks which type of rationale that underlies the use of FITs, and how legitimacy was attached to using public policy to create markets as learning arenas for emerging technologies. The analysis is based on a case study drawing on interview data and a rich documentary material.

**Conceptual framework**

Emerging technologies rarely compete with existing technologies at their introduction (Rosenberg 1976). They can however be subject to post-introduction improvements - alterations and changes in a technology after their initial introduction - that alter their economic and societal significance (Georghiou et al 1986, Kline & Rosenberg 1986, Hanson 2013). This involves complex diffusion and innovation interplay. We can think of these improvement processes as the formation and development of technological innovation systems (TIS) that shape the rate and direction of innovation (Hekkert et al 2007, Bergek et al 2008). The TIS framework is a technology specific analysis of emerging technologies and how they become introduced into society by means of structural (i.e. actor entry, institutional change etc) and process dynamics. Given crudeness of emerging technologies one of the key processes underlying system dynamics is market formation, which is key to technology diffusion and inclusion of users, and hence to TIS growth (Bergek et al 2010). Hekkert et al (2007) distinguish between niche markets and policy induced markets, where niches constitute specific applications and advantages, whilst policy driven markets usually include some sort of subsidy (for instance tax regimes, feed-in tariffs, or procurement initiatives) which circumvents the relative cost disadvantage often associated with new RETs.

Achieving this usually involves institutional alignment (Jacobsson & Lauber 2006) and processes of legitimation. The paper distinguishes between inner and outer dimensions of legitimacy for RETs (Hanson 2013). Outer legitimacy is coupled to how emerging technologies can become potential problem solvers in relation to broad societal problems and challenges, such as energy security and climate change in the case of RETs. Inner legitimacy is coupled to gaining acceptance for the specific conditions that need to be changed, be awarded with acceptance and/or stimulated in order to include new technologies within the existing system of energy supply. In the case of energy transition it

is legitimate to argue for reduction in fossil fuel usage, but vastly more complicated to argue for the specific measures that need to be taken to reach alternative goals, because these often are associated with high costs (amongst others in subsidising market formation). The paper seeks to analyse how these processes of legitimacy creation and market formation are intertwined during processes of system building for new RETs.

#### Empirical analysis

In Germany a fixed feed-in tariff is paid for the output renewable energy technologies for a period of 20 years. The tariff level depends on technology type so that a heterogeneous set of technologies are deployed. This has led to surges in investments raising the share of renewable electricity generation from 3.1% in 1990 to 20,5% in 2012 (BMU 2012a). This adheres to the primary goal of stimulating RET deployment and reducing incumbent fossil and nuclear energy sources in the energy mix.

However, this paper argues that this goal is only feasible if a secondary and less explicit goal is achieved; learning and innovation in RETs. The underlying assumption of FITs is that these drive the increase of competitiveness through cost reductions;

"At the same time the EEG (Erneuerbare-Energien-Gesetz – Law for renewable energies) fulfills an important function with regards to industry policy. The reduction of production costs for electricity from renewable energy sources through technological innovations and learning effects induced by the EEG, strengthens the already strong competitive position of the German renewable energy industry (Deutscher Bundestag 2008: 26)" (Authors translation)

Cost reduction hence is argued to be driven by innovation and learning processes induced by the EEG where FITs are an intrinsic instrument. Moreover, this is linked to industrial policy, via learning by doing in the supplier industry given that markets are assumed to trigger innovation:

"... dynamic market growth is triggered and maintained over a longer period, in order that the production-side learning effects can be mobilised under real-world conditions... (Nitsch 2008: 101)"

The innovation imperative is not only explicated in visionary statements but also in how tariffs are structured. Tariffs are reduced over time, basically based on implementation of a learning curve rationale, but this reduction applies only to newly installed projects. FITs therefore are associated with a major innovation imperative towards supplier firms – RETs need to be available at decreasing prices over time in order to accommodate for the reduction in tariff levels. In essence it is assumed that deployment will stimulate technology improvement and cost reductions. Markets are to become learning arenas for supplier firms that are the supposed innovating agents.

The innovation imperative can be identified beyond the expectancies of learning curves. One of the major legitimising factors for the use of FITs was the political argument that deployment is linked to beneficial effects beyond outer legitimacy levels such as mitigating climate change and increasing domestic energy security. Inner legitimacy for FITs was

created by attempts to create broader societal acceptance by associating deployment policy with other policy areas such as industry growth and job creation. Use of FITs was linked to arguments that a strong German RETs industry needed to develop along side increase in RET deployment (Scheer 2004). This level of legitimacy is intimately tied to the innovation imperative, given that the domestic industry needs stay competitive. In the case of solar PV, the increased global competition, (i.e. Chinas rapid entry), the following range of insolvencies and bankruptcies that hit Germany (as well as many other countries), the increasing PV imports from China and the increased societal costs may challenge this key dimension of inner legitimacy. Continuous (or the lack of) innovation in the domestic industry therefore has effect on the long-term viability of FITs. This illustrates that legitimacy and market creation are intimately tied processes, not only during early formation stages, but also during stages of growth.

### Conclusions

The paper deals with how policy can contribute to shape market infrastructures for RETs, via an analysis of how processes of market formation and legitimacy creation were linked to the implementation of FITs. The paper argues that FITs are linked to a major innovation imperative, reflected in (a) the assumption that markets will become learning arenas for emerging RETs, (b) the in reduction of tariffs over time (c) by creating legitimacy via attaching FITs to developing a domestic RETs industry that (d) needs to be innovating and stay competitive in the face of global competition.

An initial conclusion is that markets in themselves do not function as learning arenas, but can provide firms and organisations with incentives towards learning opportunities. FITs can of course be assumed to influence firms' direction of search, trigger entrepreneurial experimentation and mobilisation of resources. Whether or not firms and other actors embark on "learning ventures" to the extent that is prescribed in FIT policy is however uncertain. It depends on the structure and functions of the system where market formation is one amongst many processes that need to be in place in order for a system to develop. Due to this complexity the potential learning trajectories (or curves) may not materialise and not necessarily develop in accordance with what is "prescribed" in learning curves. This can challenge the long-term legitimacy of using policy to create market infrastructures for emerging technologies. Given the innovation imperative of FITs, they are intimately tied to various dimensions of legitimacy. A final conclusion with regards to legitimacy is that it not only needs an initial creation, but a continuous maintenance given that FITs must be used over time both to achieve primary deployment as well as secondary innovation goals.

The discussion also has broader implications for how we commonly distinguish between demand and supply side policy instruments. This corresponds to a distinction between economic instruments and technology policy instruments. The paper argues that although being oriented towards the demand side, learning in supplier industries becomes a prerequisite for FITs to be a viable long-term deployment tool. The argument made in this paper is that behind this apparently straightforward economic instrument lie complex technological issues to do with the pace and scale of innovation. In other words, the effectiveness of the economic instrument depends on technological activities. FITs thus can be seen to be as much a supply side instrument as a demand side one.

## References

Bergek, A. Jacobsson, J., Carlsson, B., Lindmark, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. *Research Policy*, 37 (3), 407-429

Bergek, A., Jacobsson, S., Hekkert, M. & Smith, K. (2010). Functionality of innovation systems as a rationale for and guide to innovation policy. In: Smits, R.E.H.M, Kuhlman, S. & Shapira, P. (Eds). *The theory and practice of innovation policy*. Cheltenham: Edward Elgar

BMU (2012a). *Erneuerbare energien in Zahlen – Internet update ausgewählter daten*. Berlin: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

Deutscher Bundestag (2008). Drucksache 16/8148. Entwurf eines Gesetzes zur Neuregelung des Rechts der Erneuerbaren Energien im Strombereich und zur Änderung damit zusammenhängender Vorschriften. Berlin: Deutscher Bundestag

Georghiou, L., Metcalfe, S., Gibbons, M., Ray, T., & Evans, J. (1986). *Post-innovation performance*. London: MacMillan

Hanson, J. (2013). *Dynamics of innovation systems for renewable energy technology: The role of post-introduction improvements*. PhD Thesis, University of Oslo

Hekkert, M. P., Suurs, R.A.A., Negro, S.O., Kuhlmann, S., Smits, R.E.H.M (2007). Functions of innovation systems: A new approach for analysing technological change. *Technological Forecasting and Social Change*, 74 (4), 413-432

Jacobsson, S. & Lauber, V. (2006). The politics and policy of energy system transformation – explaining the German diffusion of renewable energy technology. *Energy Policy* 34 (3), 256-276.

Kline, S. & Rosenberg N. (1986). An overview of innovation. In: Landau, R. & N. Rosenberg (Eds.), *The Positive Sum Strategy. Harnessing Technology for Economic Growth*. Washington: National Academy Press.

Nitsch, J. (2008): *Lead Study 2008 - Further development of the “Strategy to increase the use of renewable energies” within the context of the current climate protection goals of Germany and Europe*. Berlin: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit.

Rosenberg, N. (1976). *Perspectives on technology*. Cambridge: Cambridge University Press

Scheer, H. (2004b). *The acceleration of PV and the role of the German programme*. 19th European PV-Conference.



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***Models of innovation, policy rationales and measurement: the persistent high-tech myth***

**Abstract:** Evidence-based policy has become a buzzword in most policy domains, including science, technology and innovation (STI) policies. Research efforts have indeed provided a significant amount of evidence: insights as to the nature and dynamics of knowledge creation, diffusion, and exploitation processes, lending theoretical justification for policy interventions. These results have influenced policy documents of major supranational bodies, too, such as the EU, the OECD and various UN organisations. Policy-making processes – in a broader sense: policy governance sub-systems – themselves, together with the impacts of various STI policy tools have also become subjects of thorough analyses.

Evidence cannot be turned into an ‘optimal’ set of policy measures in an ‘objective’, ‘scientific’ way as it needs to be interpreted in the context of given policy issues and then translated into actions. Moreover, different schools of thought offer contrasting policy advice, and perhaps more importantly, various actors also influence the policy-setting processes, pursuing their own interests and values. Thus, in spite of major research results, policy-making is still more of an art than an easy-to-handle ‘technology’, that is, a set of proven methods prescribed in handbooks with engineering precision – and STI policies are no exception.

It is no surprise, therefore, that the world of STI policy-making is characterized by major puzzles. One of these is the apparent contradiction between the perceived ‘European paradox’ and the still dominant view of the importance of ‘high-tech’ research and ‘high-tech’ sectors. The first claims that the European Union achieves excellent research results, but is ineffective in exploiting those. The policy response should thus be to put more emphasis on fostering knowledge exploitation. Yet, various EU documents and the policy practice discernible from the composition of important monitoring tools still ‘push’ for a science-push model of innovation.

This paper aims to analyse whether it is beneficial to focus on supporting high-tech research and promoting structural changes in favour of high-tech sectors, or, whether a different policy rationale, one promoting knowledge-intensive activities across the whole economy, would be more appropriate to enhance competitiveness and improve quality of life. First it juxtaposes various models of innovation as well as the policy rationales derived from mainstream economics and evolutionary economics of innovation. By discussing the indicators selected for the Innovation Union Scoreboard and another major comparative report by the EC DG Research and Innovation, it argues that the science-push model of innovation is still highly influential in the EU STI policy circles, despite a rich set of research insights stressing the importance of non-R&D types of knowledge in innovation processes. The paper also highlights the potential drawbacks of the persistent high-tech myth, especially massive opportunity costs in the form of lost improvements in productivity,

‘unborn’ new products and services, and thus ‘unopened’ new markets and ‘undelivered’ new jobs. Then it considers possible theoretical, historical and sociological reasons for its perseverance and discusses policy implications of the systemic view of innovation. The latters include: i) STI policies should promote knowledge-intensive activities in all sectors, including low- and medium-technology industries and services; ii) it is a highly demanding set of tasks to identify systemic failures, devise appropriate policies to tackle those, and organise the vital dialogues with stakeholders; iii) several policies affect innovation processes and performance, perhaps even more strongly than STI policies, and hence policy goals and tools need to be orchestrated across several policy domains; iv) analysts and policy-makers need to be careful when interpreting their country’s ranking on ‘scoreboards’; v) the choice of an economics paradigm to guide policy evaluation is likely to be decisive.

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***How Smart is Specialisation?***

**Abstract:**

This paper examines the regional specialisation patterns of knowledge production in Astrophysics, Biotechnology, Nanotechnology and Organic Chemistry between 1996 and 2012. In all fields, the rise and fall of cities over time can be attributed to their specialisation pattern of scientific knowledge production as indicated by the use of key words. It is shown that the patterns of specialisation differ systematically across scientific fields, but are remarkably similar across cities in each field. Two patterns of specialisation are identified. The first represents a turbulent pattern: concentration of research activities is low, knowledge production in cities is of small size in terms of output, stability in the ranking is low and comparative advantages are short lasting. Relatively few related topics are available for research locations. The second represents a stable pattern: concentration of research activities is higher than in the first group, cities produce more output, stability in the ranking is greater, and comparative advantages last longer. For research locations, often many related topics are available. The former group comprises biotechnology, while the latter includes astrophysics and (in later years) nanotechnology. Organic Chemistry has an intermediate position. The fields differ in the number and specific nature of the capabilities they require and require different policy measures that take into account the differences in accumulation and relatedness in order to achieve smart specialisation.

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***A History and Analysis of Grand Challenges in US Science Policy***

**Abstract:**

Today, over 60 years after its introduction, the concept of basic research has become somewhat shopworn. The limits of the concept are well recognized and much lamented, creating a void in the language available to research policy not seen before in the era of massive Federal support for science. In the never ending struggle for resources that is US Federal science policy making, such a void might create dangerous instability. Strong proposals for substitutes have been made and found favor mostly among analysts and mostly outside the US – Pasteur’s Quadrant (Stokes, 1997), Mode 2 (Gibbons et al., 1994), Triple Helix (Etzkowitz and Leydesdorff, 2000) -being the most prominent candidates. Recently, the phrase “Grand Challenges” also seems to have attained a certain currency

Grand, meaning large in scale or scope, has connotations of magnificence, of nobility. Challenge, meaning a task that tests someone’s ability, implies an invitation to join. Together, Grand Challenges evoke excitement, in the context of research - intellectual excitement. Grand Challenges show potential as a new language with which to unite the promise of intellectual excitement in research with an integral invitation to join the larger group. “Grand” by evoking magnificence and nobility perhaps evades any hints of inferiority that might be expected to accompany mention of application. The implied invitation to join stands opposed to the individual effort entailed in autonomy. Thus the phrase entails intellectual excitement, aligns with the group effort that characterizes research today and transcends limits imposed by the old vocabulary.

This paper will explore the origins of Grand Challenges discourse in early 1980s US science policy. Early insurgent strategies used Grand Challenges and were successful in achieving their goals. The early examples were Kenneth G Wilson’s advocacy for supercomputing and the Gates Foundation global health initiative. After Gates, the Grand Challenges idiom spread widely and was adopted by establishment actors, culminating in the Obama administration endorsing the approach.

The paper follows Maarten Hajer’s discourse analytic strategy contrasting modernist and deliberative policy environments. With the adoption of Grand Challenges by establishment actors at the top of the modernist system, it seems likely that Grand Challenges will be reinterpreted during the process of implementation, as has happened in the European Horizon 2020 programme. It is possible to interpret Grand Challenges within the modernist framework. This was the approach taken in a special issue of Research Policy on Grand Challenges devoted to gleaning lessons learned from the history of mission oriented research, the idea being that grand challenges are another name for mission oriented research. However, within that issue, the differences between mission oriented research and Grand Challenges were noted: greater breadth, longer time scale, no single agency

being the intended “user”, intersectoral research collaboration required, competitive environment of application, and many sources of R&D funding (Foray et al., 2012). The reduced control of a single agency over the activity in question goes to the heart of the difference between the modernist and deliberative policy environment described by Hajer (Hajer, 2003). Thus the article itself admits that equating grand challenges with classical-modernist mission oriented research doesn’t work, if grand challenges are framed according to the definition given by actors using the concept.

Of Grand Challenges, the White House states:

Grand challenges have come to the forefront in part because science has evolved: ‘as various technologies such as bio, info, and nanotechnology become more and more powerful – the question “what should we do” is arguably as or more important than “what can we do.”

The idea that science itself has changed echoes the argument for Mode II in Gibbons et al. (Gibbons et al, 1994). In this framing, basic research belongs in Mode I, which still has a role of course, but “more important” today is something newer. The argument serves to position basic research as anachronistic, an accusation to which basic research seems increasingly vulnerable. “Investigator initiated” sounds individual which could become a liability in an age focused on the virtues of team science, networks and collaboration. Working well together being the new ideal in scientific life, insistence on individual pursuits might soon sound somewhat selfish. Basic research is also tainted when described as research “without a goal.” Formerly, research was tainted when performed with a goal in mind, but in an era guided by conceptions of grand challenges as the right and proper framing for science policy, the taint could well transfer to research that cannot show a connection to a grand challenge. This is implied in recent discussions of the ethics of using sentient animals in research.

That basic research seems something of an anachronism might be expected within a framework recognizing that society has moved from modernist, post-war institutions of government towards a greater role for deliberative governance (Hajer, 2003). For example, Hajer notes that in hindsight much of postwar politics relied on institutional trust. Thus Congress gave scientists money for basic research trusting their argument that benefits would flow later. Those who trust scientists will be comfortable with their operating autonomously even while spending public money. Hajer notes that trust can no longer be assumed and in particular trust in scientific expertise has eroded (Hajer, 2003). The breakdown in that trust has been most recently symbolized by the US Congress passing a bill to require the NSF director to certify that political science grants serve the national interest. In general, justifications for research funding in the post-trust environment might be expected to rely more heavily on more immediate and articulated links between research results and societal benefit.

The paper will explain the Grand Challenges model, as made visible in the above mentioned initiatives. It will show how this model evolved and will compare the model with others proposed to frame post-Vannevar Bush linear model science, such as Pasteur’s Quadrant and Mode 2. Grand Challenges seems to be having more success than these other models in eclipsing basic research as a framing for science policy discourse in the United States. The reasons for this will be explored, as well as some of the consequences and the limitations of

the Grand Challenges model.

## References

Etzkowitz, Henry, and Loet Leydesdorff. "The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university–industry–government relations." *Research Policy* 29.2 (2000): 109-123.

Foray, D., D. C. Mowery, and R. R. Nelson. "Public R&D and social challenges: What lessons from mission R&D programs?." *Research Policy* 41.10 (2012): 1697-1702.

Gibbons, Michael, et al. *The new production of knowledge: The dynamics of science and research in contemporary societies*. Sage, 1994.

Hajer, Maarten A., and Hendrik Wagenaar, eds. *Deliberative policy analysis: understanding governance in the network society*. Cambridge University Press, 2003.

Stokes, Donald E. *Pasteur's quadrant: Basic science and technological innovation*. Brookings Institution Press, 1997.

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***Economic crisis and innovation in Spain: a view on the perceived barriers to innovation***

**Abstract:**

There is broad agreement among economists and policy makers that economic growth is nowadays largely driven by the capacity of firms to innovate. Most advanced countries have therefore developed public support programs to reduce barriers to innovation and thus promote innovation-related activities among firms.

The financial and economic crisis that started in late 2007 has had a far reaching impact on countries around the World. Spain has been one of the countries worst affected. With the economic crisis, the government has reduced public funding in R&D. At the same time, the continued credit crunch has worsened dramatically the possibilities for financing of new ideas and projects. One of the consequences of the economic crisis is that many companies have reduced their innovation-related activities. Filippetti and Archibugi (2011) and Archibugi et al. (2013a) provide evidence for European countries.

We investigate the perceived barriers to innovation before the economic crisis and since the start of the economic crisis and its relation to the innovation behaviour of Spanish manufacturing and service sector firms. We use a detailed micro-data set that allows us to empirically investigate firms' heterogeneity in how the crisis has affected their innovation process. There exists now an important body of empirical research that shows considerable heterogeneity in firms' innovation behaviour. However, very little is still known about how economic crisis affect the innovation behaviour of different types of firms (both in terms of investment for innovation as well as innovation performance). Archibugi et al. (2013b) is a recent exemption. Their study on a panel of UK firms shows that while overall, firms have reduced their innovation expenditures, there is also a small group of firms that has increased innovation expenditure with the economic crisis. De Propriis (2013) identifies some sectors which seem more resilient than others to the current downturn in the UK and attributes their capacity to survive to innovation (as measured by formal and informal intellectual property protection); low sunk costs and flexible professional networks. In her view, these characteristics have facilitated adaptation to a contracting demand. Paunov (2012), who analysed Latin American firms in 2008-2009, found that one in four of them cut back on innovation projects during this period. She identified different reasons for project discontinuation, especially financial constraints. Young firms were more likely to abandon projects. Firms which benefitted from public funding were more likely to stabilize innovation. In the author's view public support contributed to counteract cyclical trends. This research suggests that there is important heterogeneity in the way the economic crisis has affected firms' innovation behaviour. In this paper we aim to explore such heterogeneity in innovation responses to the economic crisis among Spanish firms.

Our data come from the Spanish Technological Innovation Panel (Panel de Innovación Tecnológica, PITEC) collected by the Spanish National Statistics Institute (INE). This is an annual representative survey of all the main sectors in the Spanish economy, including services and manufacturing. The PITEC survey provides rich information on the technological innovation activities of firms including information on innovation inputs as well as on innovation performance. PITEC also reports information on perceived barriers to innovation. This may differ from actual causes for the inability to innovate. However, perceptions of key decision-makers are instructive as to the realities the companies face. The set of questions related to barriers to innovation distinguishes between cost factors (3), knowledge factors (4), and market factors (2). There are furthermore two questions related to the motives of firms for not engaging in innovation activities.

Previous research has shown the importance to distinguish firms according to their attitude towards R&D and innovation: We distinguish stable R&D performers as firms that report innovation expenditures every year they are in the sample, occasional R&D performers as firms that report innovation expenditures some year they are in the sample, and non R&D performers as firms that never report R&D.

Because we have annual data from 2004 to 2011 we can explore how the patterns of innovation and barriers to innovation have changed with the onset of the economic crisis in Spain. Our preliminary analysis shows that the economic crisis has discouraged an important number of firms from engaging in innovation. Although the group of stable R&D performers, on average, has maintained their innovation effort. We detect the type of firms that have ceased to perform R&D as well as those that have reduced, maintained or even increased their innovation activities. Our preliminary results indicate R&D has been discouraged mainly in smaller, unaffiliated companies that do not sell in international markets and that are technological laggards in their specific sector. However, we also observe a reduction in innovation expenses among technological leader companies.

The information on perceived obstacles to innovation reveals that cost factors are the main factors hindering innovation in Spain, although knowledge factors and market factors also play a role. However, with the economic crisis, the perception about the importance of knowledge factors has hardly changed. In contrast, one can observe a sharp rise in the importance attached to cost factors hindering innovation activities. For example, the percentage of firms that perceive the lack of internal financial resources and the lack of external finance as highly important factors hindering innovation has risen from about 25% of sample firms before the economic crisis to over 35%. Another relevant rise can be observed in the importance attached to the uncertainty regarding the demand for innovative products and services. Before the economic crisis, less than 20% evaluated this obstacle to innovation as highly important. In 2011, this figure has risen to over 25%.

Following a general analysis of how innovation patterns and patterns of perceived barriers to innovation have changed since the onset of the economic crisis, we develop an econometric analysis to study how changes in the perception of obstacles to innovation relate to structural characteristics of firms as well as to change in innovation effort. Our main research questions concerns the heterogeneity in experiences.



In Spain, the vast majority of firms belong to the small and medium size enterprise category (SMEs). Analysing SMEs in the Murcia region of Spain, Madrid-Guijarro et al. (2013) find, for example, that reported innovative activities decreased from 2005 to 2009. SMEs were likely to reduce commitment to all types of innovation (product, process and management) owing to general expenses reduction. The authors find that during the growth period managerial innovation was the least important. A similar result was found for the recession period. However, process innovation declined more quickly than product innovation and management innovation, probably because it is more costly. In general, SMEs are characterized by lower levels of innovation and the literature has shown that they face particular problems constraining their innovation activities. Iammarino et al. (2009) and D'Este et al. (2012), among others, show that firm size significantly affects perceptions of obstacles to innovation. An important question is how the economic crisis has changed the perceived obstacles to innovation and their relation to innovation patterns.

Exploring the determinants of change in innovation effort among firms as well as change in perceived obstacles to innovation over the economic crisis provides lessons for managers and policy makers as well as important information for the design of innovation policies.

## References

Archibugi, D., A. Filippetti, M. Frenz (2013a) The impact of the economic crisis on innovation: Evidence from Europe, *Technological Forecasting & Social Change* 80:1247–1260.

Archibugi, D., A. Filippetti, M. Frenz (2013b) Economic crisis and innovation: Is destruction prevailing over accumulation? *Research Policy* 42: 303– 314.

De Propris, L. (2013) How are creative industries weathering the crisis? *Cambridge Journal of Regions, Economy and Society*, 6: 23-35.

D'Este, P., Iammarino, S., Savona, M., Von Tunzelmann, N., 2012. What Hampers Innovation? Revealed Barriers versus Deterring Barriers. *Research Policy* 41, 482–488.

Filippetti, A. and D. Archibugi (2011) Innovation in times of crisis: National Systems of Innovation, structure, and demand, *Research Policy* 40: 179–192.

Iammarino, S., Sanna-Randaccio, F., Savona, M., 2009. The perception of obstacles to innovation Foreign multinationals and domestic firms in Italy. *Revue d'Economie Industrielle* 125, 75–104.

Madrid-Guijarro, A., D. García-Pérez-de-Lema, & H. Van Auken (2013) An investigation of Spanish SME innovation during different economic conditions. *Journal of Small Business Management*, 51(4): 578-601.

Paunov, C. (2012) The global crisis and firms' investments in innovation. *Research Policy*, 41: 24-35.

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**Europeanization of Finnish research policies: the cases of research infrastructures and researcher mobility**

**Abstract:**

The importance of research and innovation (R&I) policies has grown both on domestic and EU arenas over the past few decades. R&I policies have become closely connected with general economic policies and especially those emphasizing growth. R&I has had a spotlight role in information society projects and in competitiveness discourse. It has been seen as a way to break off from economic downturns.

Thus, a lot of effort is put into the formulation of R&I policies and their implementation at national and EU levels. EU received new powers in this respect, when the Lisbon Treaty placed research policy under the shared competences of the EU and its' member states (art. 2, TFEU 2007). This was a major legal change, but it has not changed the policy dynamics yet. The common approaches in research policies are reached through non-binding coordination efforts and with the mediation effect of the EU's research Framework Programmes (FP).

Even without legal or contractual obligations, the trends in R&I policies are very identical in the EU and in Finland. The same seems to be true in a wider perspective as well (Pelkonen et al 2010). Certain big themes are on the agenda of both the EU and several member states: the role of research in solving big societal problems, the development of research infrastructures and the enhancement of research mobility are frequently brought up in policy debates both in EU and in Finland.

In the conference paper I will look into the interconnectedness of the EU and Finnish R&I policies by

examining and comparing two moderately distinct research policy cases: research infrastructures and researcher mobility.

**The key questions are:**

- **Have the EU research policies influenced the Finnish research policies, and if they have, how, to what extent, and by what kind of mechanisms (causal and temporal aspects)?**

- **Are there differences in how these specific research policy areas have advanced and have been enforced. Are there some denominators which connect them or set them apart?**
- **Is the possible convergence of RDI policies a wider phenomenon or is there something specifically European to explain it?**

The influence of EU on domestic politics and policies has attracted notable interest in social sciences at large. Several authors have studied how the member states (and some others) adapt to the impact of EU. Much of the literature approaches the issue using a concept of Europeanization.

Europeanization became quite widely used in the 90's and the concept has since sprouted new meanings and readings. Europeanization can be conceptualized in different ways (Radaelli 2000; Olsen 2003; Ladrech 2010), but the most commonly used meaning in the current literature is the one that studies the domestic adaptation to the pressures from the EU integration processes. It is a useful concept in studying the connections of the EU and Finnish RDI policies as well.

A lot of studies have been produced on the Europeanization processes of different policy areas in different countries (see Alecu De Flers, 2012; Graziano and Vink 2007; Scimmelfennig and Sedelmeier 2005; Jordan and Liefferink 2004;), but research on the Europeanization of RDI policies has been quite scarce (Gornizka 2009, Trondal 2002, 2005, Van der Meulen 2002), although there is increasing interest on the subject (Barre et al 2013, Nedeva 2013).

## Case studies

The general approach to the cases is to study the national and EU policy developments in parallel based on a comprehensive policy and implementation activity mapping. There will be a strong cause-effect perspective, but not in a strict linear sense. By comparing the cases I try to find whether there are similar or differing models of explanation to the processes of Europeanization.

### Case 1: Policies for researcher mobility

Researcher mobility has been at the heart of EU R&I policies from the start of the ERA (EC 2000, 2001). It is a widely accepted thought, that mobility is one basic element of a robust R&I system. Boosting the internationalization of the Finnish innovation system and increasing the cross-border researcher flows have also been major components in the Finnish R&I policy.

The expression of political will to increase and support mobility has been strong both on national and EU level policies. I will examine the grade of similarities, differences and interplay of the policies. **Have the policies led to action in EU or in Finland? Is there a clear connection between policy and action, and if not, what explains this? Is there linearity or discrepancy between the EU and national policy-action axis?**

The research data comprises mostly of EU and Finnish policy documents and implementation data on internationalization and researcher mobility. The implementation data ranges from regulations and budget figures to modes of mobility support. Researcher mobility statistics (OECD, Eurostat, national databases) as well as interviews with experts from the relevant national authorities and the Commission will provide state-of-the-play and background information.

## Case 2: Research infrastructure policies

Although research infrastructures (RI) were also one of the original ERA themes, it was the establishment of European Strategic Forum for Research Infrastructures (ESFRI) in 2002 that gave RIs a prominent place in EU R&I policies. ESFRI Roadmaps for pan-European research infrastructures described the scientific needs for RIs in Europe for the next 10-20 years.

RIs were not on the policy agenda in Finland in the early 2000s', but the ESFRI roadmap and subsequent EU Council recommendation to develop national roadmaps boosted RI policy making in Finland, too, culminating in the establishment a Finnish RI Committee in 2012.

RI policy seems to be a model example of how European developments influence national activities. The importance of EU policies and of ESFRI, in particular have seemed to be elemental for the RI policy development in Finland. Why is it that EU developments seem to explain the Finnish RI policy in 2000's? **Why is the policy also turning into identifiable action quite rapidly, as this is not often the case? How does the RI policy development compare to developments in researcher mobility policies?**

I will analyze EU and Finnish policy documents and implementation developments (such as policy process and administrative changes, budget allocations). Supportive background interviews will be conducted with the EU Commission staff, with ESFRI delegates and relevant national authorities.

## References:

Alecu De Flers, N. (2012) EU Foreign Policy and the Europeanization of Neutral States. Comparing Irish and Austrian foreign policy. London: Routledge.

Barré R., Henriques L., Pontikakis D., Weber M. (2013) Measuring the integration and coordination dynamics of the European Research Area, Science and Public Policy vol. 40, no 2, April 2013, p. 187-205.

European Commission (2000): Towards a European research area. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2000) 6 final, Brussels, 18.1.2000.

European Commission (2001): A Mobility Strategy for the European Research Area. Communication from the Commission to the European Parliament, the Council, the

European Economic and Social Committee and the Committee of the Regions. COM(2001) 331 final. Brussels, 20.6.2001.

Gornitzka, Å (2009): Research Policy and the European Union – Multi-Layered Policy Change? in The Research Mission of the University: Policy Reforms and Institutional Response; Clancy and Dill (eds.), Sense Publishers: Rotterdam.

Graziano P., Vink M. (2007): Europeanization: New Research Agendas, Palgrave-McMillan: Basingstoke.

Jordan, Liefferink (eds.) (2004) Environmental Policy in Europe: Europeanization of national environmental policy. Routledge: London.

Ladrech, R. (2010): Europeanization and National Politics. Palgrave-MacMillan: Basingstoke.

Nedeva, M. (2013) Between the global and the national: Organising European science, Research Policy, 42, p. 220-230.

Olsen, J. (2003): Europeanization in Cini, Michelle (ed.) European Union Politics, Oxford University Press: Oxford.

Pelkonen A, Teräväinen T., Häyrynen-Alesto M., Waltari S-T., Tuominen T. (2010): Tiedepolitiikan kansainvälisiä kehitystrendejä 2000-luvulla – Finnish Science Policy in International Comparison. Opetus- ja kulttuuriministeriön julkaisu 2010: 14. Valtioneuvosto.

Radaelli, C. (2004): Europeanisation: Solution or problem? European Integration online Papers (EIoP) Vol. 8 (2004) N° 16; <http://eiop.or.at/eiop/texte/2004-016a.htm>

Scimmelfennig F., Sedelmeier U. (2005): The Europeanisation of Central and Eastern Europe. Cornell University Press: Ithaca.

Scimmelfennig F., Sedelmeier U. (2005): The Europeanisation of Central and Eastern Europe. Cornell University Press: Ithaca.

Trondal, J. (2002) The Europeanisation of Research and Higher Educational Policies – Some Reflections European Integration online Papers (EIoP) Vol. 6 (2002) N° 12; <http://eiop.or.at/eiop/pdf/2002-012.pdf>

Trondal, J. (2005) Two Worlds of Europeanisation – Unpacking Models of Government Innovation and Transgovernmental Imitation, European Integration online Papers (EIoP) Vol. 9 (2005) N° 1, <http://eiop.or.at/eiop/pdf/2005-001.pdf>

Trondal, J. (2005) Two Worlds of Europeanisation – Unpacking Models of Government Innovation and Transgovernmental Imitation, European Integration online Papers (EIoP) Vol. 9 (2005) N° 1,  
<http://eiop.or.at/eiop/pdf/2005-001.pdf>

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**Towards New Actor Constellations in Higher Education Governance: The Emergence of Academics' Political Movements**

**Abstract:**

The governance of research, innovation and higher education systems have been subject to profound changes in the past decades. It has become a complex territory where the boundaries between levels are blurred and where power and authority between different actors in the system are in flux (Middlehurst, 2013, p. 276). Due to changes in the steering role of government in general, several policy arenas have opened up for new actor constellations.

Also in the case of research, innovation and higher education policies, one can increasingly speak of “shared responsibilities” between sub-national, national and supranational actors (Kuhlmann, 2001, p. 966). The EU Modernization Agenda of Universities, Europe 2020 and the definition of research priority areas by EU-funding bodies or national research councils are examples to this trend (Magalhaes et al., 2013). Further, in the past decade the New Public Management (NPM) based higher education reforms have fostered universities to become more corporate and managerial organizations (Leisyte and Dee, 2012; Krücken and Meier, 2006, Braun and Merrien, 1999), with strengthened role of university managers and external stakeholders, such as representatives of the industry. The influence of external stakeholders and the power of the purse have been especially visible in recent years due to the financial crisis and the consequent introduction of austerity plans by the governments which have led to budget cuts in higher education institutions, forcing them to diversify their funding base (Leisyte and Westerheijden, 2014). Traditionally academics were the key actors in collegial university governance, while in the managerial university (e.g. the Netherlands or the UK) academics play increasingly a minor role in university central decision-making (Deem et al., 2007; Enders, De Boer and Weyer, 2013). This development however is at odds with the traditional self-governance model of academia (Clark, 1983, Whitley et al., 2010). One may argue that the participation of academic elites in the national policy arena and research funding bodies still shows that the academic self-governance is still influential. However, in the past few years one can observe increasing involvement of academics in a collective resistance against the managerial governance.

This paper thus aims to understand this new phenomenon. We seek to understand what new forms of collective responses academics undertake in order to reclaim their position as influential actors within the higher education governance systems? That is, what prompted the creation of the collective response, how are the academic platforms organized, and what are their action repertoires? To answer the posed questions we combine insights from both higher education studies and studies on social movements. In several public policy areas such as labour or environment policies, social movements have traditionally been

important actors in shaping the governance of these policy fields. The concepts borrowed from this body of research seem highly relevant for examining collective resistance activities of academics



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***A model of academic engagement with the science and technology policy process:  
Demand, capability and motivation factors***

**Abstract:**

This paper develops an analytical model of factors to explore why and how academic engagement in the science and technology (S&T) policy process happens. We address motivational and capability factors of academics and academic organisations, and demand factors from policymakers and government bodies. Development of the model draws upon existing literature and 15 interviews with policymakers in two UK Government Departments (Department of Environment Food and Rural Affairs [DEFRA] and Ministry of Defence [MOD]) as well as with academics that engage with these departments in various ways. We also explore several policy and practice pressures that may cause a dynamically changing balance of motivation, capability and demand factors over time.

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***Standard-Setting and Compliance in Food Sector in India: Negotiations Among Different Interest Groups***

**Abstract:** Standards are an omnipresent yet generally taken-for-granted part of our everyday life (Higgins and Larner 2010a; Timmermans and Epstein 2010; Busch 2011). Specifically, standards are agreed-upon criteria or rules intended to measure a product, person or service's performance or specific characteristics (e.g. the amount of pesticide residue on apples) or the process through which the good was produced (e.g. an organic apple) (Nadvi and Waltring 2004). By providing a common language and rules of measurement, standards are used to classify and categorize in order to create uniformities and equivalences between people and things. Through this process it is argued that relationships are ordered and disciplined across time and space: 'made to work' despite the heterogeneity that exists between cultures, languages, political systems, and markets (Busch 2000; Higgins and Larner 2010b, pp.1-17; Timmermans and Epstein 2010; Busch 2011; Ponte et al. 2011).

Standards are agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products, processes and services are fit for their purpose. When such agreements are international, they become "International Standards".

For example, the format of the credit cards, phone cards, and machine-readable cards that have become commonplace is derived from an ISO International Standard. Because manufacturers throughout the world apply the same standard, these cards can be used everywhere for it ensures the fairness and effective-ness of the standards ... and confidence in their use. Standards are an integral element of consumer protection, as they often underpin national legislation and certification schemes.

Until recently, standards within the agri-food sector were typically dismissed (if thought of at all) by social scientists as rather benign, technical tools, primarily of interest to specialists concerned with facilitating markets and trade. Over the past decade, however, this assessment has changed considerably and many agri-food scholars now view standards as a useful entry point for analyzing and understanding our social and material world. In part, this shift in interest reflects the influence of science studies and its concern with studying 'mundane' and taken-for-granted objects and practices (Higgins and Larner 2010b, pp.1-17). Here scholars take inanimate objects seriously, to understand, for example, how non-human actors such as standards allow humans to 'act at a distance' (Latour 1987), thereby ordering relations across time and space.

Many agri-food researchers are also concerned with the rise of private food standards developed by global retailers and non-government organizations, including understanding the role that these standards might play in coordinating and governing production and consumption relations within the context of globalization (Giovannucci and Ponte 2005;

Hatanaka et al. 2005; Mutersbaugh 2005; Tallontire et al. 2011). Within this context, agri-food researchers have focused on standard-makers as well as the nature and implications of private forms of governing and regulatory relations within the context of global trade. Scholars are grappling with a variety of new social, political and normative questions, whose answers, they believe, are increasingly important for understanding our heterogeneous world. For example, who is included or excluded in the standard-setting process? How are the benefits and burdens of standards distributed? In what way are trust, accountability and legitimacy created? How are conflicts negotiated and reconciled? What and whose values are reflected in the standards? How do standards act to make some concerns visible and others invisible? (Bain, C., Ransom, E. and Higgins, V. 2013).

Standards and standardization processes serve a number of different purposes and their importance to industry and society can be seen from several different perspectives. Some of the more important objectives of standardization are the establishment of compatibility and interoperability, the removal of trade barriers through harmonization, and the safety and health of citizens. As a consequence, the three groups of stakeholders primarily benefiting from standardization processes are industry, consumers and governments. Just as there are many participants to the standardization process, there can also be several definitions for standards and standardization.

Safe and nutritious food is a necessity that was taken for granted for long by the lawmakers in India. The formulation of the Food Safety and Standards Act in the year 2006 was a mammoth task undertaken over a period of several years of deliberations and negotiations amongst various interest groups. The contribution of different actors needs to be assessed in relation to the standardization process. Consumers worldwide always demand to have their foods of higher standards or better quality. However, the term standard or quality is more often than not unclear. In many cases quality means different things to different people. Food quality may be its sensory property (appearance, taste), nutritional value (nutrient content), health benefit (functional ingredient) or safety (chemical, physical, biological). There is general consensus that food safety is the very basic right of people. Increase in public concern regarding food hazards and decline in public trust in food risk regulations suggests the need for a policy to address these concerns and develop specific risk communication. Food quality and safety are of concern to every individual, industry and the government. Consumers expect their food to be enjoyable, nutritious and more importantly safe. The responsibility for ensuring that this expectation is consistently and continuously rests with the policymakers, entrepreneurs and the consumer themselves.

Thus, before a regulatory agency can engage in a process of balancing the variety of interests that relate to a particular issue, those interests must be articulated before the agency. The agency then needs to facilitate the process by making its proceedings as accessible as possible to the largest number of interests so that the ultimate decision may be based upon a variety of relevant inputs.

With the establishment of World Trade Organization (WTO) and the expected disappearance of trade barriers in the near future, issues of food safety and quality have acquired greater significance for consumers, enterprises and the policymakers worldwide. Global food trade would likely to increase due to expected spurt in income levels, improved transportation networks and growing population requiring greater quantities of nutritious

and safe food. With the free movement of foods from country to country, there is a concern that foods produced in one country must meet the standards and quality and safety of the importing country. So, it is imperative that consumers receive food products that are of minimum acceptable quality, risk-free and not hazardous to public health. Delivering safe food to the consumer's dining table is the culmination of the efforts put up by the producers, transporters, processors, distributors, handlers and numerous others who perform actions every day that may affect the quality and safety of food.

The review of literature in the field of food standards development in India has shown that there is both scope for research as well as need for documented efforts in tracing the various stages involved in the process of standardization. As discussed in the section, there have been studies from techno-scientific, economic, trade and even historical perspectives. There are instances from other countries, especially the developed ones, but there is an obvious lack of studies in India from the socio-scientific and STS perspectives which necessitates undertaking the task and qualifies the research problems of this study.

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***Academic careers - who is the most competitive?***

**Abstract:** Asymmetric international mobility of highly talented scientists is well documented. We try contributing to the explanation of this phenomenon, looking at the “competitiveness” of higher education systems in terms of being able to attract talented scientists in their field. We characterise countries’ capability to offer attractive entry positions into academic careers using the results of a large scale experiment on the determinants of job choice in academia. Examined areas refer to the level of salaries, quality of life, PhD-studies, career perspectives, research organisation, balance between teaching and research, funding and probability of working with high quality peers. Our results indicate that overall, the US research universities offer the most attractive jobs for early stage researchers, consistent with the asymmetric flow of talented scientists to the US. Behind the US is a group of well performing European countries, the Netherlands, Sweden, Switzerland and the UK. Austria and Germany are next, closely followed by France, which in turn is followed by Italy. Spain and Poland are, according to our results, least able to offer attractive entry positions to an academic career.

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***Institutional Change and Innovation System Transformation: A Tale of Two Academies***

**Abstract:** The Academies of Science have been a key institution in the development of science and technology in the Nation state over the centuries. These bodies were places where new discoveries were shown and new ideas developed. In the twenty-first century, the Academy of Science has a dual role, on one hand appearing to engage in scientific research but on the other, as a body of scientists and people with an interest in the development of science, they have also taken on the position of a key institution with the power to influence future developments in science and potentially shape future socio economic outputs of applied sciences.

Both the 'Rising Powers' Russia and China had National Academies of Science (RAS and CAS respectively) engaged in the development of emergent nanotechnology but as this paper will show, the outcomes were vastly different. Seen through the lens of this technology, can the change of the system cause a change in the research trajectory of science and technology in that institution? In particular, how do particular drivers of change influence these acts and are they adopted or disregarded by incumbent powers within these institutions?

Whether these institutions adapt or remain the same in the face of new challenges and influences is especially important as constitutional changes in the Russian Academy of Science have begun as a result of poor performance (Kremlin, 2013).

More specifically our research questions are the following:

- How do the key institutions such as RAS and CAS transform the system they are in (system transformation)?
- What are the drivers, capacities, enabling and constructing factors for system transformation influenced by key institutions such as RAS and CAS?
- How does the change in systems transform key institutions (institution transformation) such as RAS and CAS?
- What is the relationship between system transformation and institutional transformation at RAS and CAS?

The object of this study is research in nanoscience and nanotechnology carried out in the Chinese and Russian research systems in 1990-2012, with particular attention to the performance of the Chinese and the Russian Academies of Sciences. Nanotechnology has often been vaulted as the revolutionary next technology (Drexler, 1992; Feynman, 1959). In the 2000's it was given a new lease of inspiration, outlining a roadmap for innovations which would occur over the next twenty years and how the scientific community would take part in this process (Roco, 2007). Both Russia and China have policy objectives to use breakthrough technologies to transform their economies, and by doing so to catch up with the potential and performance of the leading developed countries. (Appelbaum et al., 2011; Klochikhin and Shapira, 2012; Terekhov, 2012)

This paper sits within the innovation literature stemming out of a wider view of evolutionary

economics and “creative destruction” (Schumpeter, 1962) and the National Innovation Systems (NIS) perspective. By highlighting the figures, networks and institutions involved in the process of Innovation, we can better understand the overall development of policy and research agendas (Flanagan et al., 2011; Shapira and Wang, 2010; Zheng et al., 2014). Within the field of Nanotechnology, there have been some studies made on the wider international networks of nanotechnology and the application of a NIS model onto the development of nanotechnology between these different contexts. (Shapira and Wang, 2010; Shapira et al., 2011, 2010)

Russian and Chinese Academy of Sciences, as identified in previous studies, occupy central positions in their respective national research systems (Liu et al., 2009; Zhou and Leydesdorff, 2006), yet there is little literature dedicated to the investigation of the role that these institutions play for the development of their national systems. The Academies of Sciences share the legacy of having descended from the Soviet Academy as a benchmark institution, (Radošević, 2003, 1999), but have dramatically transformed since then. (David-Fox and Péteri, 2000; Liu and Zhi, 2010; Lu and Fan, 2010; Suttmeier et al., 2006) However, RAS and CAS remain key institutions in their respective research systems, share common problems and have opportunities for mutual learning. (explored in (Klochikhin, 2013)). Studies have demonstrated the interdependence of the institutions and the systems they are embedded into. (Hira and Hira, 2000; Peters, 2005; Pierson, 2004) We are exploring this interdependence using these two case studies of research systems that have a key institution. We analyse the performance of the research system and the performance of its key institution based on a number of parameters, such as economics and funding patterns, human resources, research fields, path-dependencies, agency, mutability, learning and innovativeness, challengers and multiplicity of institutions. (Bell, 2011; Berk and Galvan, 2009; Clemens and Cook, 1999; Mahoney and Thelen, 2010, 2010; Pierson, 2000; Powell and DiMaggio, 1991) The institutional and system factors contribute towards the transformation of the post-S&T planning science, research and innovation systems, along the lines of capacities of change.

We employ mixed method approach in analysing the system transformation and transformation of key institutions such as RAS and CAS. We particularly focus on the development of nano technology in China and Russia. On the quantitative side, we analyse all nanotechnology publications from 1990 to 2012 published by at least one author located in Russia or China, following the methodology developed by Arora et al. (2013). Our database includes 176 472 publications for China and 33 538 publications for Russia. On the qualitative side, we utilise vast number of data sources including interview with key stakeholders, previous studies, and a rich literature on event histories.

Our findings indicate the different places that key institutions can take as the larger institutional framework around them changes rapidly. Earlier studies suggested the importance of KIP programme for transformation of the Chinese Academy of Sciences and its leadership and guidance in doing national nanotechnology research (Liu and Zhi, 2010). We find support of this by uncovering structural changes within the Academy, such as the rise of the importance of the Graduate School and the returning scientists as a part of a bigger human resources reform. Besides the scientific achievements, CAS plays an important role in reforming STI system of China by “encouraging academic openness, scientific collaboration, a multidisciplinary approach and the intensive cultivation of talent” (CAS, 2013).

We found a different situation in the Russian research system. The Russian Academy of

Sciences still dominates the nanotechnology research, although it is challenged by new emerging centres, such as National Research Universities. The development of the Russian Academy of Sciences has been largely inertial, as well as the overall development of the Russian research system. Attempts to reform the system, therefore, had to come from the outside, and have been fiercely resisted. The Russian Academy of Sciences conserved itself structurally: we found no new emerging fields or centres, nor sustained collaborations with non-RAS institutions, or international collaborations. The funding is concentrated in the areas and institutions that are already successful. Our research indicates that this may have led to a sustained gap in performance and the lagging of the RAS in development in the research in nanotechnology, especially in comparison with China and other developing countries.

This paper will show the way in which science and technology programmes engaged with by CAS and RAS can have lasting influences on the development of the approach to research. On a practical level we codify the nature of change for an institution in this context and how these Academies were examples of positive and negative involvement in the process. While both bodies are academies, CAS presents a more active member of a wider research community in Nanotechnology in China. RAS has instead dominated the sector of publications and research in Nanotechnology and limits collaboration to a select grouping of research bodies underneath its umbrella organisation. CAS appears to be a key player amongst others whereas RAS is the only key player in a limited research community pool. CAS has also diversified into graduate education and wider engagement with policy groups, however RAS remains intensely basic research orientated which although admirable, lacks the diversity which a multifarious subject such as nanotechnology requires. In turn these findings can be considered in both the application of funding and policy towards Academies of Science around the globe and how they may be able to engage in constructive forms of research and development in emergent technologies.

### Bibliography

- Appelbaum, R.P., Parker, R., Cao, C., 2011. Developmental state and innovation: nanotechnology in China. *Glob. Netw.* 11, 298–314. doi:10.1111/j.1471-0374.2011.00327.x
- Bell, S., 2011. Do We Really Need a New “Constructivist Institutionalism” to Explain Institutional Change? *Br. J. Polit. Sci.* 41, 883–906. doi:10.1017/S0007123411000147
- Berk, G., Galvan, D., 2009. How people experience and change institutions: a field guide to creative syncretism. *Theory Soc.* 38, 543–580. doi:10.1007/s11186-009-9095-3
- CAS(2013). Brief introduction.  
[http://english.cas.cn/ACAS/BI/200908/t20090825\\_33882.shtml](http://english.cas.cn/ACAS/BI/200908/t20090825_33882.shtml).
- Clemens, E.S., Cook, J.M., 1999. Politics and institutionalism: Explaining durability and change. *Annu. Rev. Sociol.* 25, 441–466. doi:10.1146/annurev.soc.25.1.441
- David-Fox, M., Péteri, G. (Eds.), 2000. *Academia in upheaval: origins, transfers, and transformations of the communist academic regime in Russia and East Central Europe*. Bergin & Garvey, Westport, Conn.
- Drexler, E.K., 1992. *Engines of creation*. Oxford University Press, Oxford.
- Feynman, R.P., 1959. Plenty of Room at the Bottom [WWW Document]. plenty. URL <http://www.its.caltech.edu/~feynman/plenty.html> (accessed 2.7.14).
- Flanagan, K., Uyarra, E., Laranja, M., 2011. Reconceptualising the “policy mix” for innovation. *Res. Policy* 40, 702–713. doi:10.1016/j.respol.2011.02.005
- Hira, A., Hira, R., 2000. The New Institutionalism: Contradictory Notions of Change. *Am. J.*



Econ. Sociol. 59, 267–282.

Klochikhin, E.A., 2013. Innovation system in transition: Opportunities for policy learning between China and Russia. *Sci. Public Policy* 40, 657–673. doi:10.1093/scipol/sct021

Klochikhin, E.A., Shapira, P., 2012. Engineering Small Worlds in a Big Society: Assessing the Early Impacts of Nanotechnology in China. *Rev. Policy Res.* 29, 752–775. doi:10.1111/j.1541-1338.2012.00596.x

Kremlin, 2013. Vladimir Putin signed Federal Law On the Russian Academy of Sciences, Reorganising State Academies of Science and Making Amendments to Certain Legislative Acts of the Russian Federation. [WWW Document]. URL <http://eng.kremlin.ru/news/6047> (accessed 11.29.13).

Liu, X., Zhang, P., Li, X., Chen, H., Dang, Y., Larson, C., Roco, M.C., Wang, X., 2009. Trends for nanotechnology development in China, Russia, and India. *J. Nanoparticle Res.* 11, 1845–1866. doi:10.1007/s11051-009-9698-7

Liu, X., Zhi, T., 2010. China is catching up in science and innovation: the experience of the Chinese Academy of Sciences. *Sci. Public Policy* 37, 331–342. doi:10.3152/030234210X501162

Lu, D., Fan, J., 2010. Strategies and Actions of Chinese Academy of Sciences.

Mahoney, J., Thelen, K., 2010. Explaining Institutional Change: Ambiguity, Agency, and Power. Cambridge University Press.

Peters, B.G., 2005. Institutional theory in political science: the “new institutionalism”. Continuum, London; New York.

Pierson, P., 2000. The limits of design: Explaining institutional origins and change. *Gov.- Int. J. Policy Adm.* 13, 475–499. doi:10.1111/0952-1895.00142

Pierson, P., 2004. Politics in Time: History, Institutions, and Social Analysis. Princeton Univ Press, Princeton.

Powell, W.W., DiMaggio, P., 1991. The New institutionalism in organizational analysis. University of Chicago Press, Chicago.

Radošević, S., 1999. Transformation of science and technology systems into systems of innovation in central and eastern Europe: the emerging patterns and determinants. *Struct. Change Econ. Dyn.* 10, 277–320. doi:10.1016/S0954-349X(99)00016-8

Radošević, S., 2003. Patterns of preservation, restructuring and survival: science and technology policy in Russia in post-Soviet era. *Res. Policy* 32, 1105–1124. doi:10.1016/S0048-7333(02)00117-8

Roco, M.C., 2007. National Nanotechnology Initiative - Past, Present, Future, in: Handbook on Nanoscience, Engineering and Technology. Taylor and Francis, USA, pp. 3.1–3.26.

Schumpeter, J.A., 1962. Capitalism, socialism and democracy. Harper & Row New York.

Shapira, P., Wang, J., 2010. Follow the money. *Nature* 468, 627–628. doi:10.1038/468627a

Shapira, P., Youtie, J., Kay, L., 2011. National innovation systems and the globalization of nanotechnology innovation. *J. Technol. Transf.* 36, 587–604. doi:10.1007/s10961-011-9212-0

Shapira, P., Youtie, J., Porter, A.L., 2010. The emergence of social science research on nanotechnology. *Scientometrics* 85, 595–611. doi:10.1007/s11192-010-0204-x

Suttmeier, R.P., Cao, C., Simon, D.F., 2006. Priorities and funding - “Knowledge innovation” and the Chinese Academy of Sciences. *Science* 312, 58–59. doi:10.1126/science.1122280

Terekhov, A.I., 2012. Evaluating the performance of Russia in the research in nanotechnology. *J. Nanoparticle Res.* 14, 1–17. doi:10.1007/s11051-012-1250-5

Zheng, J., Zhao, Z., Zhang, X., Chen, D., Huang, M., 2014. International collaboration

development in nanotechnology: a perspective of patent network analysis. *Scientometrics* 98, 683–702. doi:10.1007/s11192-013-1081-x

Zhou, P., Leydesdorff, L., 2006. The emergence of China as a leading nation in science. *Res. Policy* 35, 83–104. doi:10.1016/j.respol.2005.08.006

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***The emergence of mission-oriented ST systems and policies in Central and Eastern Europe: the case of Estonia***

**Abstract:** Research question

The Central and Eastern European (CEE) science and technology (ST) systems are currently experiencing the 'second coming' of the Europeanization of ST and innovation systems and policies. In many CEE countries, the existing, mostly horizontal, innovation policies emerged in the late 1990s and early 2000s mainly through the influence of European accession processes. The new European financial period (2014-2020) seems to be again bringing a sea change into how CEE economies are advised (and conditioned) to design and implement policies for innovation and design/reform their ST systems. The policies and recommendations on how to contribute to the EU's actions on social/grand challenges through smart specialization, demand-side innovation policy etc seem to be leading CEE economies towards more targeted, or mission-oriented ST systems and policy mixes. In this context, this paper asks whether the CEE economies are equipped with sufficient policy skills and resources to design and implement these new policy concepts and orientations? In the paper we describe and analyze the emergence of Estonian ST policies for 2014-2020 to highlight the opportunities and barriers of these processes in the CEE economies.

As a theoretical contribution, we combine the literature on: a) how to legitimize and design mission-oriented STI policies (e.g. Weber and Rohracher 2012); b) how to implement mission-oriented STI policies and programs for solving social challenges (e.g. Foray et al. 2012; Mowery et al. 2010); and c) on the evolution of the CEE STI systems and policies (e.g. Suurna and Kattel 2010; Karo and Kattel 2010). We show that the European initiatives of the late 1990s and 2000s to build horizontal innovation policies (to deal mainly with market and system failures) and current initiatives to develop more mission oriented focuses in ST systems and policies assume the development of parallel, or even conflicting, routines of policy-making and implementation. In other words, the CEE countries have been building specific policy skills and routines – to design and implement relatively broad policies with limited ex-ante prioritization of sectoral and/or technological goals – that may not be compatible with the new ST paradigm; in fact, ST systems and policies oriented to social challenges may require even opposite policy skills and routines.

Thus, based on the theoretical literature, we argue that:

- on the level of policy legitimization and design, the CEE economies may face particularly difficult challenges in designing and legitimizing policy responses to what Weber and Rohracher (2012) have labeled as transformational system failures (i.e. directionality, demand articulation, policy coordination and reflexivity failures) as the new failures brought into ST policy focus by the orientation towards social challenges and systemic

transformations;

- on the level of policy implementation and design of mission-oriented programs, the CEE policy-makers may face particularly difficult challenges in what Foray et al. (2012) and Mowery et al. (2010) have discussed as ingredients of good mission-oriented programs (i.e. adopting policies defining and affecting – catalyzing, supporting – demand for new technologies; developing criteria and processes for indentifying where and how public investment can catalyze, complement, and usefully augment private-sector investments; balancing between decentralization of R&D activities and centralization of administrative activities for setting broad priorities, monitoring and evaluating performance of programs and policies).

## Method

We test and elaborate our theoretical claims through the case study of Estonian STI policy processes. The case study is based on participant observations carried out in the framework of the Science and Innovation Policy Monitoring Programme initiated by the Estonian Ministry of Education and Research and Estonian Ministry of Economic Affairs and Communications. The case study will analyze the processes of:

- designing and legitimizing the Estonian Research and Development and Innovation Strategy for 2014-2020 (during 2013);
- designing and implementing the Estonian Smart Specialization Strategy (as the Estonian Research and Development and Innovation Strategy for 2014-2020 is mostly financed by the EU's Structural and Cohesion Funds, this process was an ex ante conditionality for the strategy) (during 2013-2014);
- developing policy measures and programs to implement these strategies (during 2014, ongoing).

## Results

Based on these observations and subsequent analysis, we can make the following conclusions.

Firstly, the broad legitimization of mission-oriented ST policy orientation has not been as difficult as theoretical discussions might predict, but mainly because in the case of Estonia (and CEE in general), the old horizontal ST and innovation policies have not contributed significantly to the techno-economic and socio-economic change; and the impact of the financial crisis has revealed this failure even more.

Secondly, designing of a more mission-oriented ST strategy and policy mix has been a more difficult task than might be predicted given the relatively easy general legitimization. The main reason for this challenge stems from the institutionalization of the routines of horizontal innovation policy whereby:

- policy-makers have not faced the need to develop skills and capacities for defining the direct role of ST systems in addressing societal challenges and defining and articulating demand for specific technologies, skills etc; rather, the ST system has been built as self-

organizing and reacting to market/industry demand;

- this policy routine has also de-emphasized public and private interactions in policy design and implementation (as the core task of policies has been to influence framework conditions), and thus, has not managed to overcome some of the structural system failures, especially interaction failures and capability failures in firms and industries;
- there is a general lack of experiences in developing and legitimizing specific instruments and programs of technology policies; the previous efforts at developing government-led mission-oriented technology programs have been very small-scale attempts at mimicking the international best-practices rather than making government responsible for certain technology developments.

Thirdly, in the current policy rhetoric the EUs main expectation for increasing the quality and focus of ST policies has relied on the processes and outcomes of the smart specialization strategies. The Estonian smart specialization strategy is also strongly related to the rhetoric of social challenges. Yet, given the overall context of the Estonian ST system, the smart specialization strategy has so far largely reproduced the weaknesses or patterns of the existing policy routines:

- the Estonian smart specialization strategy has evolved mainly as a top-down initiative of policy-makers (to fulfill the EU ex ante conditionality for obtaining Structural Funds);
- it has taken the form of a policy program with few explicitly targeted policy measures (i.e. one R&D program covering all priority fields and managed by the Ministry of Education and Research), but with limited explicit integration with other government policy measures (especially demand side policy instruments, which is also being designed under the logic of the EU Structural Funds);
- it has not developed significantly new patterns of cooperation and networking between different government institutions (ministries, agencies etc) related to strategic and societal challenges and it has also not created more intense cooperation and networking with industry and industrial associations.

## Conclusions

In sum, we claim that these processes of ST policy-making have unfolded in this way for two main reasons:

- although the CEE economies (of which Estonia could be considered as an extreme case) have experimented only about 10-20 years with modern horizontal innovation policy, this period – and the lack of complementary industrial policy in most CEE economies – has created sufficiently strong policy-making routines and capacities; and the shift of policy orientation towards social challenges and mission oriented ST is especially difficult as the existing routines have not invested in needed capacities;
- secondly, existing academic discussion on mission-oriented ST for social challenges and policy-making models (also smart specialization) pay insufficient attention to the issues of how to in fact build policy-making and administrative capacities needed for mission-oriented ST systems and policies.

Based on the case study of Estonia, we can conclude that the development of mission-

oriented ST systems and policies in CEE needs explicit 'audit' of not only the existence and level of transformational systems failures (directionality, demand articulation, policy coordination and reflexivity failures), but also structural system failures, especially regarding networking and capability failures in firms and industries. In addition, the process of policy implementation and design of mission-oriented programs is likely to be initially more a process of experimentation, policy and program failures and policy learning than a clear-cut contribution to solving social challenges. Thus, initial investments and commitments to mission-oriented ST policies and programs in CEE should be limited and complemented with (more) investments into the development of basic policy and administrative capacities and private sector capabilities of the ST systems.

## References

Foray, D., Mowery, D.C., Nelson, R.R. (2012) Public R&D and social challenges: What lessons from mission R&D programs, *Research Policy* 41: 1697-1702.

Karo, E., and R. Kattel (2010) The Copying Paradox: Why Converging Policies but Diverging Capacities for Development in Eastern European Innovation Systems?, *International Journal of Institutions and Economies* 2(2): 167-206.

Mowery, D.C., Nelson, R.R., Martin, B.B. (2010) Technology policy and global warming: Why new policy models are needed, *Research Policy* 39: 1011-1023.

Suurna, M., and R. Kattel. 2010. Europeanization of Innovation Policy in Central and Eastern Europe, *Science and Public Policy* 37 (9): 646-664.

Weber, K.M. and Rohrer, H. (2012) Legitimizing research, technology and innovation policies for transformative change, *Research Policy* 41: 1037-1047.

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***Getting the policy measures right: integrating System Archetypes and Leverage points into the Innovation Systems framework***

**Abstract:** The innovation systems (IS) framework is based on the idea that the complex interaction between actors and prevailing institutional infrastructure strongly affects the speed and direction of innovation. The framework is used to analyse the innovativeness of nations (Lundvall 1992), sectors (Malerba 2002) or systems around a technology, which are called Technological Innovation Systems (TIS) (Bergek et al. 2008, Hekkert et al. 2007). Policymakers who are interested in stimulating technological development and implementation, e.g. to reduce energy-use or CO<sub>2</sub>-emissions, can use the TIS-framework to identify policy measures to achieve these goals. Practical application of the TIS-framework has led to the insights that the current framework (1) does not provide the tools to understand what causes system problems to exist and (2) is not able to prioritize and sequence different types of policy measures, leaving policy makers to judge which potential measures will have the most impact. Two concepts from the established research field of Systems Thinking can help to solve these inefficiencies: First, the concept of System Archetypes (bounded rationality of actors causes common problems) and second, the concept of Leverage Points (certain types of system interventions are often more effective than others).

The preferred methodological approach within today's TIS research is to combine the analysis of the structure and the functioning of a system for identifying the weaknesses of the system (Bergek et al. 2008, Wieczorek, Hekkert 2012). Analyses of technological innovation systems usually starts with a description of the system structure, followed by an assessment of the system functioning. If the system does not perform well on certain key-processes, called system functions in TIS terminology (Hekkert et al. 2007), the subsequent step is to find the underlying causes in the system structure. Weaknesses in the system structure that follow from such analyses have been called 'Blocking mechanisms' (Bergek et al. 2008), 'Structural system failures' (Weber, Rohrer 2012) or 'System problems' (Wieczorek, Hekkert 2012). The last step is to find ways to elevate the identified system problems, resulting in lists of system interventions that could be implemented. Such lists of system problems and potential policy measures are certainly useful, but (1) the exact causes of the identified problems often remains vague and (2) the TIS approach currently lacks a way to prioritize and sequence the potential system interventions, leaving policymakers to decide which ones to implement.

Systems Thinking is an established research field that focuses solely on describing and analysing the dynamics within complex systems and has been extensively used to get insight into, e.g. natural, political, social and economic systems. Systems Thinking emphasizes that just observing complex systems is not enough, because they behave counterintuitively (Forrester 1995). The research field relies on creating models of complex systems and



thoroughly analysing the system behaviour. Ideas from Complex Systems thinking fit well with Technological Innovation Systems thinking, because the general logic behind both research fields is similar. Systems Thinking stresses that the structure of a system causes its behaviour (Meadows, Wright 2008), which is similar to the logic from the TIS approach (namely, that the structure of the system strongly determines the functioning of the system).

The concept of System Archetypes from Systems Thinking is based on the idea that complex systems often show similar behaviour, because of similarities in system structure. This idea of the 'transferability of structure' (de Vries 2012) is formalized in the concept of 'system archetypes' (Senge 1990). System archetypes are a set of common system structures that lead to problematic system behaviour. According to Systems Thinking, these system archetypes exist because actors (people and organizations) in a complex system are rationally bounded. Incomplete information and cognitive limitations of actors cause their decisions (that seem logical from their perspective) to lead to suboptimal results on system level. This idea from Systems Thinking implies that some problems in innovation systems are not specific to the system under research, but are the result of a general characteristic of any complex system, namely the existence of rationally bounded actors.

The concept of System Archetypes can help to understand what causes common problems in innovation systems to exist. Using System Archetypes in analyses of Innovation Systems can make it easier to recognize problems that are caused by the decisions of bounded rational actors. Of course, some system problems will be unique to the system under research, so attention to such specific problems will remain important. The concept of System Archetypes can also make the formulation of policy measures easier, because each archetype has its own corresponding standard solutions. If a certain system archetype is recognized in an innovation system, the standard solutions give the policymaker ideas for the direction in which efficient policy measures can be found. Specifying these standard solutions to the specific innovation system will always remain a necessary step.

Another idea from Systems Thinking that can help policymakers to get policy measures in innovation systems right is related to the concept of Leverage Points. Leverage Points are the 'silver bullets' that change the system in the desired direction, something that every policymaker is looking for. Systems Thinking has defined Leverage Points as 'places within a complex system [...] where a small shift in one thing can produce big changes in everything' (Meadows, 1999). Unfortunately, finding the leverage points in complex systems is difficult, because they are often counterintuitive. An example comes from the famous report 'Limits to Growth' by the Club of Rome (Meadows et al. 1972) in which 'growth' was identified as leverage point. Instead of pursuing more growth to solve the major global problems (something which the whole world had been doing so far), this report suggested that more could be achieved by pursuing less growth. Donella Meadows has created a list of twelve places within a system where leverage points can be found and has made a preliminary ranking based on their effectiveness for changing the system (Meadows 1999). The higher the place to intervene in the system is on the list, the higher the potential effect on changing the system is. For example, adding information flows to the system often has a bigger effect compared to adding another subsidy, and changing the rules of the system often has a bigger effect compared to adding information flows. Unfortunately, 'The higher



the leverage point, the more the system will resist changing it' (Meadows 1999). There are two reasons for this. Firstly, because leverage points are often counterintuitive, people will not always believe them at first sight. Secondly, vested interests in the existing system can make parties resistant to make fundamental changes to the system as this is often not in their self-interest. As a result, discussions about making changes to a system often focus on lower ranking, and thus less effective, places to intervene in a system. An example is that discussions often focus on adding another subsidy, while often more can be achieved when intervening in the system by changing information flows, system rules or even system goals. Integrating the concept of leverage points into the Innovation Systems approach can help policymakers to make choices between different types of policy measures. Potential policy measures can be ranked based on their potential effectiveness to change the system and the extent to which resistance from the current system can be expected. The policymaker can subsequently make a decision between potential measures based on own ambition levels. It should be remembered that complex systems are, well, very complex, so that also the idea of Leverage Points will not lead to a 'one size fits all' solution for all innovation systems.

We are currently applying the concepts of System Archetypes and Leverage Points to the innovation system around energy-efficient building. This mature innovation system is pressured to innovate because of energy-efficiency goals and to solve problems caused by the financial crisis. The dynamics in this system are highly complex, i.a. because of vested interests of actors within the system, conservative attitudes and deeply entrenched regulations. First results show that many of the System Archetypes described by Systems Thinking can be recognized in this innovation system. Also, the concept of Leverage Points is helping us to understand in which places of the system policy intervention would be most effective. An Innovation Systems framework extended with System Archetypes and Leverage Points can help researchers and policymakers to get the policy measures right. More work is needed to identify a set of System Archetypes for Innovation Systems, to relate these to current literature on failure frameworks (e.g. Weber, Rohrer 2012) and to create a ranking of places in an innovation system where Leverage Points can be found.

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### ***Understanding the Third Mission: changes in strategies, capabilities and resources***

#### **Abstract:** Introduction

For over a decade, governments at European, national, and regional levels have been concerned with a 'third mission' of universities/HEIs in addition to the traditional teaching and research functions. While this third mission is not new, it is increasingly considered as a 'critical' dimension of universities' activities (Laredo, 2007) and, as a result, actively supported by public policy and promoted through various funding mechanisms across the OECD countries.

From an institutional theory perspective, the global spread of the 'entrepreneurial university' concept and the third mission policy agenda has arguably created 'formal/regulative, normative and cognitive' forces ("one size fit all" model) that may influence institutional missions and strategies, leading to a process of institutional isomorphism (DiMaggio & Powell, 1983). Etzkowitz and Leydesdorff (2000; p.313) indeed refer to the 'entrepreneurial university' as a "global phenomenon with an isomorphic developmental path, despite different starting points and modes of expression." However, the third mission consists of multiple forms knowledge exchange (KE) activities with a broad range of stakeholders, including knowledge users in the commercial, public, and voluntary sectors. There seem to be a number of factors at work differentiating institutional approaches to the third mission. In this light, this study contributes to a more contextualised understanding by analysing differences in third mission across institutional types, agents and geography of such interactions over time.

#### Scope of the research

Since the early 2000s, the UK government has devoted increasing policy attention and resources to promote the third mission agenda. In this paper we focus on Higher Education Institutions (HEIs) in England because higher education policies differ significantly between England and the devolved regions of Scotland, Wales and Northern Ireland (Scott, 2013) including the instruments and incentives for third mission (Huggins and Kitagawa, 2011). The Higher Education Funding Council for England (HEFCE) provides funding for 'third stream' activities, which refers to 'interactions between HEIs and external organizations in the private, public, and voluntary sectors, and wider society' that supports the transfer and exchange of knowledge between HEIs, business, and the wider community (HEFCE 2009). The development of recent third mission policies in the UK has paralleled the transformation from an elite to a mass system of higher education (Scott, 2010) and growing differentiation of the higher education system (Charles et al., 2014). Through this process, institutional characteristics and historical heritage have influenced the 'entrepreneurial architecture' of HEIs (Vorley and Nells, 2008) leading to more differentiated

organisational strategies and capabilities (see Perkmann et al., 2011; Abreu and Grinevich, 2013; Hewitt-Dundas, 2012). The relationships between different types of institutions and the specificities of third mission need more evidence and investigation.

### Objectives

There is a limited understanding of how universities have prioritised their third mission activities – how they have selected and shifted their focus and their strategic areas of capability, the ways in which such differences have evolved over time and how external environments have configured such processes. We therefore examine the evolution of third mission activities over time with a variety of activities, with different combinations of actors at different geographical scales. Focused on HEIs in England, this paper addresses the following main question: In what ways has the third mission been re-configured across universities over the years and which factors explain these evolutionary changes? Specifically, we want to study three issues: How have the mechanisms or activities changed? How have different patterns of interaction evolved as part of triple helix? At which geographical scale have the interactions happened?

### Data sources

The study is based on the Higher Education Business Community Interaction Survey (HEBCI) data over the period 2003/4-2011/12. The survey collects data on a broad range of third mission and knowledge exchange activities encompassing the contributions of HEIs to both economy and society, covering the HEIs in the UK. The key knowledge exchange activities from the HEBCI survey used are: collaborative research, consultancy, contract research, facilities and equipment related services, continuing professional development and continuing education, intellectual property including shares and sales and spin-offs. The data allows us to examine the relationships between universities' institutional characteristics and the evolutionary changes in the third mission performance shown as income from KE activities responding to a variety of environmental changes. We examine 107 of the 130 HEIs funded by HEFCE in England covered in the HEBCI survey. In this paper, the English HEIs are divided into five categories adopting and refining the frameworks used by recent studies such as Hewitt-Dundas (2012) and McCormack et al. (2014). (1) 'Top 5'; (2) 'The rest of the Russell Group'; (3) 'Other Old' universities, founded before 1992; (4) 'Former Polytechnics' and (5) 'Other New' HEIs.

### Data analysis

We use three main methodologies. First, we apply a factor analysis based on a Principal Components technique with Kaiser Normalization (Hair et al., 1998). A factor analysis identifies five categories to summarize 15 indicators measuring third mission activities: Research-oriented activities, Facilities, Consultancy, Training and Spin-offs. Figures 1-5 show that the efforts of universities vary within the sector and across time. In addition, and following the methodology used in Consoli and Rentocchini (2013), we have developed a multivariate regression analysis for panel data to validate graphical information and to check the correspondence between third mission activities (factors) and cross-universities (clusters) by regressing the likelihood of belonging to a particular cluster against

the performance constructs.

Preliminary results indicate that the probability of belonging to the Top 5 universities is positively and significantly associated with research oriented activities and negatively and also significantly related to facilities and training. This means that universities located in this group have a behaviour more focused on research-intensive activities within their third mission. Second, Russell Group universities present positive and significant signs for R&D activities, Facilities and Training and negative for other factors. Other Old universities show spin-offs as positively and significantly related to this cluster. Finally, for Post-1992 universities, only Consultancy activities are positively and significantly related to Former Polytechnics while Other New HEIs do not present positive sign for any factor.

Taking into account that the third mission is based on the interaction between universities and external agents, one of the main factors shaping the differentiation of these activities is the demand side – relationships with users. To measure changes in the surrounding factors that affect patterns of interaction across HEIs, we use the income derived from interaction with different type of agents: SMEs, Non-SMEs and Non-commercial agents (such as government bodies and third sector organisations) in specific KE activities: contracts, consultancy, facilities and licences (Figure 6-9). Results show that in general contracts and consultancy show a clear drop in terms of the value for these activities with private agents, specifically SMEs, while non-commercial activities increase. For all types of activities the decline with SMEs is more pronounced for the Top 5 universities, reaching 17.7% in the case of contracts. Facilities and licences present slightly different patterns because the average annual growth rate tends to be positive, even interacting with SMEs. Furthermore, in order to analyse the geographical dimension of the third mission, changes in patterns of interactions at regional level are analysed by calculating the average annual growth rates for the income from KE activities.

## Discussion/Conclusion

Our preliminary findings demonstrate that universities develop a ‘specific mix (inherited and/or constructed)’ (Laredo, 2007) of third mission activities with specific stakeholders as knowledge users. The paper shows that a differentiated picture is emerging in England over the decade- the configuration of third mission activities has been shifting over time with different patterns of activities, external agents and geography unfolding under the generic vision of university’s third mission. This is arguably the result of two forces working together: on the one hand, each ‘type’ of institutions tends to select certain type of ‘mix’ of third stream activities according to their internal capabilities as well as deliberate strategies of differentiation within the sector. On the other hand, external agents –SMEs, Non-SMEs and Non Commercial- surrounding HEIs influence the availability of resources for third mission activities. The preliminary findings also suggest that there are marked differences in the patterns of regional interactions across universities.

As Jacob et al. (2003) note, the transition towards an entrepreneurial university is an evolutionary process that takes several years as both infrastructural and cultural changes are necessary. Our results highlight the variety of scale and scope of third mission within English higher education system and the shortcomings in the vision of universities as ‘isomorphic institutions’ by pursuing the “one-size-fits-all” university third mission model. The analysis provided in this paper shows that the configuration of third mission has been differentiating over time, between different types of institutions, with different external

agents. Further analysis is needed to understand the geographical patterns and factors that influence complexity of relationships.

Recent government policies towards higher education are shaping the institutional strategies for third mission activities. Universities will respond differently to the challenge of identifying their strategic areas of engagement as a result of external pressures (Charles et al., 2014). The positioning of universities in their perceived environments is also highly contingent and path dependent, including the perceived opportunities, policy pressures and competitions related to the third mission. A key reflection for policy therefore relates to the need to balance the multiple expectations regarding universities' roles with the increasingly differentiated HEIs' strategies and their interactions with a variety of stakeholders.

## References

- Abreu, M. & Grinevich, V. (2013). "Academic Entrepreneurship and the Geography of University Knowledge Flows in the UK". In: Crescenzi, R. & Percoco, M. (Eds.), *Geography, Institutions and Regional Economic Performance, Advances in Spatial Science*. Springer Berlin Heidelberg, pp. 187–206.
- Charles, D., Kitagawa, F. & Uyarra, E. (2014) "Universities in Crisis? -New Challenges and Strategies in Two English City-regions". *Cambridge Journal of Regions, Economy and Society*, available on-line.
- Consoli, D. & Rentocchini, F. (2013). "Multi-Industry Labour Force Skills: Structure and Dynamics". Paper presented at the 35th DRUID Celebration Conference 2013, Barcelona, Spain, June 17-19.
- DiMaggio P. J. & Powell, W. (1983) "The iron cage revisited" institutional isomorphism and collective rationality in organizational fields". *American Sociological Review*, 48: 147-160.
- Goldstein, H.A. (2010). "The "entrepreneurial turn" and regional economic development mission of universities". *Ann Reg Sci* 44, 83–109.
- HEFCE (2009). Evaluation of the effectiveness and role of HEFCE/OSI third stream funding: Report to HEFCE by PACEC and the Centre for Business Research. University of Cambridge. Available at [23/01/14]: <http://www.hefce.ac.uk/pubs/year/2009/200915/>
- Hewitt-Dundas, N. (2012) "Research intensity and knowledge transfer activity in UK universities". *Research Policy*, 41: 262–275.
- Huggins, R. & Kitagawa, F. (2012). "Regional Policy and University Knowledge Transfer: Perspectives from Devolved Regions in the UK". *Regional Studies* 46, 817–832.
- Laredo, P. (2007) "Revisiting the Third Mission of Universities: Toward a Renewed Categorization of University Activities?". *Higher Education Policy*, 20, 441-456.
- McCormack, J.; Propper, C. & Smith, S. (In Press). "Herding cats? Management and university performance" *The Economic Journal*.
- Molas-Gallart, J., Salter, A., Pastel, P., Scott, A. and Duran, X. (2002). *Measuring Third Stream Activities. Final Report to the Russell Group of Universities. Science and Technology Policy Research (SPRU), University of Sussex. Brighton (UK)*.
- Perkmann, M., King, Z. & Pavelin, S. (2011) "Engaging excellence? Effects of faculty quality on university engagement with industry". *Research Policy*, 40: 539–552.
- Scott, P. (2010). "Structural changes in higher education: the case of the United Kingdom". In Palfreyman, D. & Tapper, T. (Eds.), *Structuring Mass Higher Education: The Role of Elite Institutions* New York: Routledge.

Vorley, T. & Nells, J. (2008). "Conceptualising the Third Mission: Entrepreneurial Architecture of Higher Education Institutions". *Policy Futures in Education* 7.3: 284-296.

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***The role of KIBS in institutional changes in the socio-technical transitions: the case of smart meters in the UK***

**Abstract:** Knowledge Intensive Business Services (KIBS) influence the emergence of new set of policies and regulations to support the roll-out of smart meters in the UK. KIBS influence three main concepts of ideas, institutions, and interests that affect policy change. This paper shows how KIBS either provide legitimacy for institutional changes proposed by actors who are bound by the very same institutions, or by acting as “institutional entrepreneurs”, and therefore contributes to the debate over the paradox of embedded agency.

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***Demonstration projects in transition processes to sustainable energy and transport***

**Abstract:** In the transition towards sustainable energy and transport systems the development and up-scaling of niche experiments plays a decisive role. The problems of the incumbent fossil-based socio-technical regime increase possibilities for niche development, but this is not sufficient to succeed. Following processes have been highlighted in the transition literature as decisive for successful niche development: facilitating learning processes, the formation of broad and aligned networks and institutional embedding, voicing and shaping of expectations and visions, and the development of complementary technologies and infrastructures (Hoogma, et al., 2002:30; Raven, 2005). We concentrate here especially on the formation of broad and aligned networks and involvement of users, both industrial users and customers and analyse public funded demonstration and trial projects as one type of niche experiments for facilitating niche development.

This paper gives first results of an analysis of effects of demonstration projects in transition processes to sustainable energy and transport in the Scandinavian countries on knowledge networks and interaction with users. The paper is based on a research project which includes following steps: (1) a state of the art study on the role of demonstration projects in innovation and transition processes (Klitkou et al., 2013); (2) the compilation of a database over Scandinavian demonstration and trial projects (Dannemand Andersen, Cramer-Petersen, Harnes, & Nikoleris, 2014); (3) a social network analysis of collaboration patterns; (4) a survey about the results and learning effects of those projects (Olsen, 2014); and (5) a number of focus groups and interviews on the outcomes, effects and impact of demonstration and trial projects. Here we present results mainly from the three first steps and will add some insights also from the latter steps.

The main purpose of this paper will be twofold: (1) analysing the role of public funded demonstration projects for the changes of the knowledge networks of project participants over time and (2) analysing the role of involvement of users in these demonstration projects.

Demonstration projects target core processes and key instruments needed to facilitate the alignment of promising new technologies with societal conditions. Such alignment is necessary for the successful adoption of radical new technology and if the development and diffusion of emergent technologies, in a transition to more sustainable energy and transport systems, is to be sustained and accelerated. Demonstration projects have proven to be an important instrument both for policy-makers, researchers and firms in helping to reduce uncertainty and learn about the acceptance, desirability and adaptation of new technology in society. Interaction with societal actors, monitoring experiences with governance of such projects and policy learning are all important issues.

We have selected technologies that are promising platforms for a transition to a more sustainable energy system and transport system, such as renewable electricity, hydrogen,



and sustainable biofuels. The future development pathways of these technologies are challenged by a high degree of technological, social and economic uncertainty as well as durability of the incumbent fossil-fuel based energy and transport system.

The measurement of the tangible and intangible outcomes, intended and unintended effects and long-term impacts of trial and demonstration projects can provide important insights for policy makers. Countries have invested heavily in trial and demonstration projects for sustainable energy solutions over recent years. This makes it crucial to understand why certain projects do or do not succeed and how the funding programmes can be improved. Success can be measured by comparing the aims of the projects and the achieved outcomes of the project. Intangible learning outcomes are important (Kamp, Smits, & Andriessse, 2004) and strengthened networking between firms, technology providers, authorities, user groups and other stakeholders (Hoogma, Kemp, Schot, & Truffer, 2002).

We created a database over demonstration and trial projects funded by public agencies or programmes in Scandinavia over the last decade. The database gives an account over the targeted energy and transport technologies, project aims, project partners, funding programmes, duration and funding. We identified 445 demonstration projects starting in the period 2002–12, in Denmark 223 projects, in Norway 113 projects and in Sweden 109 projects (Dannemand Andersen, et al., 2014). Less than one fourth of the projects targeted road transport solutions, mainly electrical mobility and biofuel/biogas.

The group around Harborne, Hendry and Brown developed a taxonomy for demonstration and trial projects and programmes according to their aims (Harborne & Hendry, 2009:3588; Hendry, Harborne, & Brown, 2010), distinguishing between (1) prove technical feasibility, (2) reduce building, materials, components, operating and maintenance costs, (3) prove feasibility in commercial applications, and hybrid projects with a combination of aims. We developed in our state of the art study this taxonomy further and distinguish between following aims, acknowledging that projects can have several aims and categorised the identified projects accordingly:

1. prove technical feasibility
2. reduce building, operating and maintenance costs
3. prove feasibility in commercial applications
4. prove environmental feasibility
5. contribute to the formation of knowledge networks
6. improve public acceptance
7. introduce institutional embedding
8. expose system weaknesses
9. facilitate learning

From the analysis of the database we conclude that to prove technical feasibility is the aim in more than half of all projects, while for one third of the projects following aims were listed: to reduce building, operating and maintenance costs, to prove feasibility in commercial applications, and to facilitate learning. In less than one fourth of the projects to contribute to the formation of knowledge networks was the project aim. The other aims are less prominent.

In our paper we concentrate on the analysis of effects of such projects for networking of the involved actors. This will be shown by social network analysis (SNA) of the involved project partners at different points of time to show if there are changes over time. We distinguish between different types of partners, such as private companies, universities, research

institutes, non-governmental organisation, municipalities, regional and national administration, public funding agencies and other public agencies. And we distinguish between national and international collaboration patterns based on the localisation of the partners. We identified about 360 nodes in the Danish projects, 340 nodes in the Norwegian projects and 190 nodes in the Swedish projects. SNA techniques to measure different types of centrality in the networks will be applied.

The state of the art study pointed out that project design should not be too rigid to allow user input and modifications to improve effectiveness, and that careful planning is needed to take account user involvement. Therefore we assume that beside project collaboration the involvement of users as crucial. Here we will look at the interaction with individual users and customers, stakeholder organisations and politicians. These issues cannot be targeted by the social network analysis and will therefore be addressed by interviews and focus groups and will have some impact on our conclusions for the governance of demonstration projects and programmes.

#### Selected references

- Dannemand Andersen, P., Cramer-Petersen, C., Harnes, K. N., & Nikoleris, A. (2014). Inventory of demonstration and trial projects in sustainable energy and transport in Scandinavia: InnoDemo Work Package 2 Report. Copenhagen: DTU.
- Harborne, P., & Hendry, C. (2009). Pathways to commercial wind power in the US, Europe and Japan: The role of demonstration projects and field trials in the innovation process. *Energy Policy*, 37(9), 3580-3595.
- Hendry, C., Harborne, P., & Brown, J. (2010). So what do innovating companies really get from publicly funded demonstration projects and trials? innovation lessons from solar photovoltaics and wind. *Energy Policy*, 38(8), 4507-4519.
- Hoogma, R., Kemp, R., Schot, J., & Truffer, B. (2002). *Experimenting for Sustainable Transport*. London, New York: Routledge.
- Kamp, L. M., Smits, R. E. H. M., & Andriess, C. D. (2004). Notions on learning applied to wind turbine development in the Netherlands and Denmark. *Energy Policy*, 32(14), 1625-1637.
- Klitkou, A., Coenen, L., Dannemand Andersen, P., Fevolden, A., Hansen, T., Nikoleris, A., et al. (2013). Role of demonstration projects in innovation: transition to sustainable energy and transport. Paper presented at the 4th International Conference on Sustainability Transitions. Eawag and ETH Zurich, Zurich.
- Olsen, D. S. (2014). Learning to make technology work – a study of learning in technology demonstration projects. Paper presented at the 2014 Conference on Organisational Learning, Knowledge and Capabilities. BI Norwegian Business School, Oslo.
- Raven, R. (2005). *Strategic Niche Management for Biomass: a comparative study on the experimental introduction of bioenergy technologies in the Netherlands and Denmark*. PhD thesis. Technische Universiteit Eindhoven, Eindhoven.

**Knut Koschatzky. "Forschungscampus"**

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***New forms of science-industry interaction in the German science system***

**Abstract:** The paper analyses the 'Forschungscampus' (Research Campus) program as a new science-based instrument in German innovation policy. It supports strategic, long-term oriented private-public research partnerships between universities and companies on the campus of the university. Different challenges the research campuses recently face will be discussed and conclusions regarding the role of new and dynamic flexible transfer bridges between research and industry in the German innovation system and especially the role the universities play in these partnerships will be drawn.

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***Counterfactual thinking and the governance of innovation policy***

**Abstract:** This paper considers the usefulness and implications of counterfactual thinking for policy guidance. A central issue in the governance of innovation policy is whether firms might be more innovative if the intervention had not been implemented. From the philosophical point of view: How does one interpret the counterfactual outputs generated by a model? Alternatively we can ask: can we identify artificial parallel worlds that have sound innovation policies. And are there counterfactual worlds that get closer and closer to the actual world policymakers live in?

Counterfactual analysis provides an important way to identify and estimate causal effects between a particular policy intervention and its outcome. The counterfactual measures what might have happened if an instrument had not been adopted, and is important for both experimental and non-experimental designs and is used in both quantitative and qualitative research. It is ideally suited to assess the impact of an intervention by comparing outcomes for groups that have participated in the program with similar outcomes for groups that have not participated.

Using counterfactuals is important for good research design. They should be able to address any threats to its internal validity, or whether the analysis contains any bias and its external validity, or whether it relates to the real world. What constitutes a good research design, however, is highly controversial. There has been considerable debate among academics over whether an experimental approach, based on random assignment of those receiving assistance (treatment group) and those that do not (control group), or the non-experimental approach that compares the outcomes of those receiving a subsidy with those that do not, is better.

The counterfactual approach to causation is traced to David Hume. David Lewis provided a modern theory of the counterfactual conditional in terms of the theory of possible or artificial worlds. In the evaluation context, counterfactual analysis is carried out using a control (or comparison) group to assess the impact of a measure. The outcome of the experimental group (who has been exposed to the initiative) is compared here with the outcome of the comparison group (the counterfactual situation).

Counterfactual thinking lies at the heart of sound scenario analysis. This was the starting point of Haavelmo's (1944) Probability Approach to Econometrics, used by Tinbergen to derive alternative policy alternatives, and it is also essential to agent-based models. In agent-based models the counterfactual appears as a hypothetical parallel worlds, or what Lane (1993) calls artificial worlds. An artificial world consists of a population of micro-level agents; the agents interact with one another; and as a result of their interactions, the population of agent's changes. Counterfactual thinking describes the condition that would have occurred if a policy instrument had not been adopted, irrespective of whether the research design is experimental and non-experimental. Statistics are then used to analyse each parallel world to better understand whether it is a good match for the way individuals behaved during the policy instrument.

There is much debate and controversy over whether the treatment group or control comparison group can be fully randomized, leading Heckman (2005) to claim that policy

evaluation must rely on non-experimental methods, which rely on existing data to provide forecasts and simulation. Heckman (2000; 2001) focused on research designs using non-experimental data where the treatments are neither fully randomized nor autonomous. He recognized that decisions of economic agents are usually discrete, but the outcome is generally continuous, which meant that behavioural relationships are generally captured in non-randomly selected samples, which create a specification error or sampling bias (Heckman, 1979). Sampling bias is common in non-experimental designs when a policy instrument, or treatments effect, is related to an unmeasured characteristic that is also related to the policy being evaluated. It occurs because of the inherent difficulty in obtaining a truly representative sample of a complex population. Sampling bias becomes an econometric problem as well as a problem for evaluating research and innovation policy because treated agents differ from the non-treated agents, which often leads to a misleading and often an incorrect estimation of the policy instruments.

By contrast agent-based computational economics and experimental economics both provide an experimental design, with fully randomized experiments (Guala, 2005; Kirman, 2011). Experimental designs depend on fully randomized-based inference and are frequently considered to be strong on external validity. Agent-based models differ from experimental economics in that they are computerized simulation of a number of decision-makers (agents) and institutions, which interact through prescribed rules. The economic agents, organizations and the institutional arrangements heterogeneous behaviour, depending on the breadth of agent types, number of agents of each type, and nested hierarchical arrangements of agents. They are also goal-oriented, with the economy moving on some path toward some desired equilibrium state. Certain rules govern the behaviour of agents, which are most often derived from psychology experiments. The artificial economy is then simulated with the help of a computer, which captures various non-linearities and social interactions between the different agents simultaneously with agent decisions.

#### References:

- Cowan, R. and D. Foray 2002. Evolutionary economics and counterfactual threat: on the nature and role of counterfactual history as an empirical tool in economics, *Journal of Evolutionary Economics* 12, 539-562.
- Guala, F. 2005. *The Methodology of Experimental Economics*, Cambridge: Cambridge University Press.
- Haavelmo, T. 1944. The Probability Approach in Econometrics. *Econometrica* 12, Supplement.
- Heckman, J.J. 1979. Sample selection bias as a specification error, *Econometrica* 47: 153–161.
- Heckman, J.J. 2005. The Scientific Model of Causality, *Sociological Methodology* 35: 1–97.
- Heckman, J.J. 2000. Causal Parameters and Policy Analysis in Economics: A Twentieth Century Retrospective, *Quarterly Journal of Economics* 115: 45-97.
- Heckman, J.J. 2001. Accounting for Heterogeneity, Diversity and General Equilibrium in Evaluating Social Programmes, *Economic Journal* 111: F654-F699.
- Lane D.A. 1993 Artificial worlds and economics, parts 1 and 2, *Journal of Evolutionary Economics*, 3: 89-107 and 177-197.
- Kirman, A. 2011. *Complex Economics: Individual and Collective rationality*, London: Rutledge

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***The Impact of System Building on Personalized Cancer Therapeutics' Innovation System - the case of Tarceva® in England***

**Abstract:**

Institutions have a central role in an innovation system along with actors and networks (Bergek et al. 2008; Edquist, 1997) and generally they are regarded as supportive towards technological innovation (Edquist & Johnson, 1997; Nelson & Nelson, 2002). However, institutions can often act also as obstacles to innovation, and therefore emerging technologies in an innovation system need to be accompanied by institutional change. To accomplish this, innovative actors undertake different system building activities to shape the institutions in an innovation system according to the interest of their new technologies. Personalized medicine represents a new and emerging concept of novel technologies in biopharmaceutical innovation that enables not only to treat but also to diagnose a number of diseases – including various types of cancer – earlier, faster, and with higher precision than was possible before (Bono de & Ashworth, 2010; Paoletti & Hayes, 2014). However, the progress towards realising the potential of personalized medicine has been problematic (Huang et al. 2014) and differs significantly between European countries (Wilking et al. 2009). In the beginning of last decade, England had one of the slowest uptakes of the first personalised breast cancer drug Herceptin® and its companion diagnostics in Western Europe (Wilking et al. 2009). Innovative actors that were involved in this personalized cancer medicine innovation system, carried out a number of system building activities, also called institutional work (Kukk et al. 2013). These activities eventually led to major institutional changes that significantly improved not only the further uptake and diffusion of Herceptin®, but also had an impact on the subsequent personalized medicine cancer drugs in England.

The current paper attempts to shed light on how the uptake and diffusion of subsequent cancer drugs, such as the personalized lung cancer drug Tarceva®, were influenced by the institutional work done earlier for Herceptin® and whether it involved any novel institutional work strategies and system building activities of the actors involved.

The paper studies the institutional transformation in the innovation system together with different actor strategies and activities around Tarceva® and its companion diagnostics in England. By combining institutional change analysis with the concept of system building, the current paper is going beyond focusing only on regulative institutions (regulations, constitutions, laws, property rights) and also considers activities directed towards normative and cultural – cognitive institutions (Scott, 2001) and general system building (i.e. creation of a supportive environment for an emerging technology) (Hughes, 1979; Musiolik et al. 2012; Van de Ven, 1993).

The main findings are then analysed and possible policy paths presented which could improve the functioning of the system and speed up the future development and diffusion

of personalized cancer therapeutics and their companion diagnostics in England.

The main research objectives of the study:

- To understand the impact of the institutional changes that took place during the development and diffusion of the first personalized cancer therapeutics and diagnostics on subsequent ones. Can any patterns of institutional change be detected in the system?
- To identify novel/additional strategies of institutional work by system builders regarding the improvement of the implementation and diffusion of the subsequent cancer therapeutics and diagnostics in modern healthcare system.

Expected results:

- Firstly, based on the empirical findings, this study aims to provide advice for policy makers in their decision making process in developing a more supportive environment for the development and diffusion of personalized cancer therapeutics and diagnostics in England. Additionally, the research tries to identify major hurdles for different stakeholders involved in adopting the personalized medicine approach in modern health care and will try to offer some possible solutions to overcome these currently emerging bottlenecks.
- Secondly, based on the theoretical findings, this study not only looks at the development and diffusion of modern cancer therapeutics from a Technological Innovation Systems functional perspective, but it also analyses the importance of actor level strategies on system building and transformation of institutions around emerging technologies in a system. The literature on TIS has had a bigger emphasis on institutions from a structural perspective and there have been fewer attempts to study the dynamics of institutional change and the interplay between actors' interests and institutions in a TIS framework. Owing to the high dependencies between actor level strategies and system performance, its analysis may lead to new insights for the TIS community regarding better understanding in institutional change factors that shape the innovation system transformation and the role of actor strategies.

References:

- Bergek, A.; Jacobsson, S.; Carisson, B.; Lindmark, S.; Rickne, A. (2008): Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. In: *Research Policy*, 37 (3), pp. 407-429.
- Bono de, J.S.; Ashworth, A. (2010): Translating cancer research into targeted therapeutics. In: *Nature*, 467 (7315), pp. 543-549.
- Edquist, C. (1997): "Systems of innovation approaches. Their emergence and characteristics", in Edquist, C. (Ed.) *Systems of innovation: technologies, globalisation and economic performance*. London: Pinter Publishers/Cassell Academic, pp. 1-35.
- Edquist, C.; Johnson, B. (1997) "Institutions and organizations in systems of Innovation", in Edquist, C. (Ed.) *Systems of innovation - technologies, institutions and organizations*. London: Pinter Publishers/Cassell Academic, pp. 41-60.
- Huang, M.; Shen, A.; Ding, J.; Geng, M. (2014): Molecularly targeted cancer therapy: some lessons from the past decade. In: *Trends in Pharmacological Sciences*, 35 (1), pp. 41-50.
- Hughes, T.P. (1979): The electrification of America: the system builders. In: *Technology and Culture*, 20 (1), pp.124–161.



- Kukk, P.; Moors, E.H.M.; Hekkert, M.P. (2013): Speeding up the Development and Implementation of Personalized Cancer Therapeutics - the case of Herceptin® in England. Presentation, EU-SPRI Forum Conference 10-12 April 2013. ISBN 978-84-695-7408-9.
- Musiolić, J.; Markard, J.; Hekkert, M. (2012): Networks and network resources in technological innovation systems: Towards a conceptual framework for system building. In: *Technological Forecasting & Social Change*, 79, pp. 1032-1048.
- Nelson, R. R.; Nelson, K. (2002): technology, institutions and innovation systems. In: *Research Policy*, 31 (2), pp. 265-272.
- Paoletti, C.; Hayes, D.F. (2014): Molecular Testing in Breast Cancer. In: *Annual Review of Medicine*, 65 (1), pp. 95-110.
- Scott, W.R. (2001): *Institutions and organizations*. Sage Publications, Thousand Oaks.
- Van de Ven, A.H. (1993): The development of an infrastructure for entrepreneurship. In: *Journal of Business Venturing*, 8 (3), pp. 211–230.
- Wilking, N.; Jönsson, B.; Högberg, D. (2009): *Comparator Report on Patient Access to Cancer Drugs in Europe*. Karolinska Institutet and Stockholm School of Economics: Stockholm, 15 January, 2009.



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***Engaging with dynamism and uncertainty of innovation pathways: Towards realistic accounts of policy interventions' contributions to complex systems***

**Abstract:** While evaluations of interventions in the multi-faceted field of research and technology development and innovation policy (RTDI) have become more and more widespread across the past two decades, the stage reached by these efforts to support evidence-based policy making is nevertheless marked by some disillusionment. A large-scale analysis of evaluation work in Europe has recently argued that limitations to the enabling of policy learning are still severe (Edler et al 2013). The diagnosis names factors such as conceptually linking and assessing how policy interventions impact upon innovation, a tendency to look at the effects of interventions along output variables, and the employment of 'success' metrics that fail to grasp intervening factors or unintended effects. Also, a Meta-Evaluation of evaluations of the European Commission DG RTD framework programs (EPEC 2011) has concluded that the existing evaluation record tells little about wider or longer-term impacts or about the achievement of political and policy objectives.

Committed to the idea of evaluation as a reflective practice, this paper sets out to explore two lines of thought which have developed independently and outside the field of RTDI evaluation, but may nonetheless constitute promising ground for fruitful evaluation designs in the future development of concerning efforts. Opportunities situated on a conceptual level are found with a relatively small body of scholarly work on innovation which has become known under the brand-name of Actor-Network Theory (ANT), and with developments in evaluation research over the last decade which have originally emerged in evaluation of policy interventions in the social sphere and in development cooperation, and can be seen to more and more spread also into other policy areas.

**Dynamic and complex innovation pathways**

Academic work summarised under ANT represents a specific type of investigation from the broader field of sociological, historical, and philosophical studies aimed at examining the contexts and contingencies of scientific knowledge and technology. ANT essentially approaches science and technology 'in the making'. Whereas ANT aims at describing why and how we have the science and technology that we do, and is not explicitly interested in policy analysis, this present discussion is exploring inherent potential for informing and advancing evaluation theory and practice.

To this end, two central texts and the way in which these capture particular innovations are briefly revisited. Latour's interpretation of Jenkin's account of the success of the Eastman-Kodak camera (Latour 1991) identifies 36 steps of combinations and re-combinations of more than 20 elements – called 'actants' – of technical as well as social and organisational nature which altogether form the 'socio-technical path' across more than 30 years. Law and Callon (1994) give an account of a failed large-scale innovation project promoted by government agencies which identifies the evolution of this project not so much in terms of

an 'unpacking' of a technological opportunity, but a 'translation' occurring from one project stage to another. The intended object of a military jet changes shape in the course of developments over time. Ultimately, the project's failure is observed in the fact that not only different kind of input and support from a range of different actors was needed, but also these actors held their specific expectations and positions in a large-scale socio-technical realm. While these networks appear manageable in the beginning, the entry of new actors ultimately destabilises the arrangement. Whereas technical failure occurred at intermediate stages, the project turns out a technical success and an economic failure in the evaluative thinking of those responsible at the time.

Both ANT studies include repeated research efforts, new discoveries that are taken up, and revisitations of technical developments as well as failure at specific points of the overall innovation pathway. Both studies also highlight variation on the organisational side of the innovation process, so that the cited authors speak of the 'co-production' of all involved elements. The notions of 'trajectory', 'translation', 'shifting assemblies and substitutions', or 'association chains', which are central to ANT rhetorics, point us to the fact that innovation processes are marked by complexity, embeddedness, contingency, non-linearity, and also by uniqueness and uncertainty. Vice versa, policy intervention into this sphere will ultimately be restricted to specific points of insertion into the broader landscape. Properties of dynamism and unpredictability in large-scale environments alter our understanding of what interventions in the RTDI arena can be expected to do at a certain point of time and at a certain locality. An attempt to identify a parallel in evaluation methodology draws our attention to the realist movement in evaluation research which runs its course from Pawson & Tilley (1997).

### Promising Evaluation models

Realistic evaluation points out that interventions will always remain dependent on the specific context in which they insert. The fundamental approach to causation is hence governed by the question: What works for whom under which circumstances? Furtheron, the aspect of emerging and not clearly pre-determined merit of an initiative is emphasised. The paradigm strongly relies on the explication of the 'theory of change' which motivates and governs a specific intervention: where it inserts in the broader field that it aims to influence and what exactly it tries to achieve (and what not). A conceptual model for achieving an initiative's vision will address the set of linkages among strategies, outcomes and goals that support a broader mission or vision, along with the underlying assumptions that are related to these linkages. Real-world conditions under which change occurs, and which an intervention simultaneously has to rely on, are coined 'mechanisms'. The approach includes the acknowledgement that an intervention may work in different ways for different recipients, and can trigger different change mechanisms for different stakeholders. It is the inevitable interaction between context and mechanism which creates the programme's outcomes, this including expected as well as unexpected factors, and intended as well as unintended results, to be captured in so-called Context-Mechanism-Outcomes (CMO) configurations

Contribution Analysis (Mayne 2001, 2008) proposes a specific approach to evaluations of interventions in complex settings, aiming at a proportional way of dealing with a localised

perspective of e.g. policy makers, programme owners, or an organisation with a specific mission and portfolio.

It has been proposed as a means for making impact analysis feasible and rigorous simultaneously. The model focuses on how change agents or initiatives perceive of the ways in which they expect their interventions to work out towards the final goal. The paradigmatic question then is: In how far can the 'theory of change' held by the program owners be seen to work out under real-world conditions, and in how far can a plausible case be made that the interventions represent a valuable contribution to a change that can actually be observed? This amounts to putting the 'theory of change' to test in an interactive design that aims at verifying the assumptions that the programme is based on, paying attention to other factors that may influence the outcomes, and is meant to enable the evaluator to account for direct and indirect influence.

## Conclusion

The broad and evolutionary socio-technical perspective embodied in ANT and evaluation models focusing on contribution, instead of attribution, appear as mutually reinforcing concepts. ANT guides our view to the breadth and scope of features and elements that can and will ultimately exert influence on innovation processes in the mid- and longer-term. In aiming at profound and secure knowledge on what works in RTDI policies, we will also do good to embrace the idea that all policy initiatives, as they are introduced in preshaped settings of RTDI landscapes with eventually non-interchangeable properties, tackle complex systems locally and in segmented manner, at specific points in time. While ANT-type studies certainly lie beyond the reach of the evaluation endeavour, realist evaluation and, specifically, Contribution Analysis can reconcile challenges on the conceptual level with due pragmatism that will ultimately characterise any evaluation exercise. Through a more circumspect identification of the specific role that an intervention or organisation has actually played, or can reasonably be expected to play, the model can be expected to enhance the learning potential of evaluation efforts. It can also be expected to produce more portable results that rely on the inclusion of the unexpected and the limitations that form part of a situated activity in the broader innovation pathway, starting from basic research and possibly leading to market success, employment, and similar longer-term results.

An evolutionary-systemic approach to innovation is e.g. present in concepts of behavioural additionality. The fruitfulness of conceptually shifting from attribution to contribution has been addressed by Spaapen & van Drooge (2011), with view to social impact of R&D, and by Larédo et al (2013), with view to strategies of R&D organisations. Contribution Analysis appears specifically prone to take this movement further, based on the acknowledgement that contribution is not external to RTDI policies and activities, but at the core of dynamic systems. This model can be seen to give the evaluator more of a role of a sparring partner for policy makers, program owners, and managers, engaging with their views and perceptions possibly already at an early stage of program design or strategy building. The approach not only appears apt to support learning among this population, but simultaneously among RTDI stakeholders who become involved in the scrutiny of 'theories of change'. Flaws that come with isolatedness of policies and actors in the RTDI landscape, and the concurrent snapshot character of evaluations, can be turned into a virtue if evaluators embrace the shift in the

approach to causation from attribution to contribution.

## Literature

Edler, J., Cunningham, P., Gök, A., Shapira, P. (2013), Impacts of Innovation Policy: Synthesis and Conclusions. Compendium of Evidence on the Effectiveness of Innovation Policy Intervention Project.

European Policy Evaluation Consortium (EPEC) (2011), Understanding the Long Term Impact of the Framework Programme. Final Report to the European Commission DG Research, 5 December 2011.

Larédo, P., Collinet, L., Joly, P.B. (2013), Evaluation and policy learning: toward a new approach to the evaluation of social impacts of public research activities. Fraunhofer Institute for Systems and Innovation Research ISI (ed.), Towards Transformative Governance? Responses to mission-oriented innovation policy paradigms. Book of Abstracts – Eu-SPRI Conference 2012 12-13 June 2012, Karlsruhe: 202-205.

Latour, B. (1991), Technology is Society Made Durable. In J. Law (Ed.) A Sociology of Monsters? Essays on Power, Technology and Domination, Sociological Review Monograph. London, Routledge: 103-131.

Law, J., Callon, M. (1994), The Life and Death of an Aircraft: A Network Analysis of Technical Change. In: W. E. Bijker & J. Law (eds), Shaping Technology, Building Society. Studies in Sociotechnical Change, 2nd ed., Cambridge Mass.: MIT Press: 21-52.

Mayne, J. (2001), Addressing attribution through contribution analysis: using performance measures sensibly. Canadian Journal of Program Evaluation 16: 1-24.

Mayne, J. (2008) Contribution analysis: An approach to exploring cause and effect. ILAC brief no. 16.

Pawson, R., Tilley, N. (1997), Realistic Evaluation, Sage.

Spaapen & van Drooge (2011), Introducing 'productive interactions' in social impact assessment, Research Evaluation, 20(3): 211–218.

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***Fostering scientific excellence as a task for regional policy actors. The case of the Vienna Science and Technology Fund***

**Abstract:** Abstract:

This paper seeks to address the question if funding scientific research on a regional level with a push for both scientific excellence/quality and contributions to develop a critical mass of research capacities in selected areas can help developing a research landscape with a distinct profile and specific synergies. How does a rationale for regional funding of excellence critical mass and synergies translate into measures, and how can outputs and impacts be evaluated?

Many regions in industrialized countries attempt to develop distinct research landscapes, i.e. concentrations of research that show a distinct profile, coherence, and synergies from local collaboration. Locality does indeed matter in that it enables collaborations depending on face-to-face contacts, by the attraction of further top-class research personnel (Good scientists attract good scientists, see e.g. Janger & Nowotny 2013) and subsequently by generating spillovers within and across research areas but also through spillovers into economic contexts. However, after some initial attempts (Inhaber 1974), little attention has been paid to the benefits of co-location for fundamental research beyond some descriptive bibliometric studies (e.g. Hoekman et al. 2010).

Yet, regional innovation policies predominantly act on the assumption that an innovative environment is served best by fostering innovation in economic contexts in thematic fields that are considered of regional public interest. Regional Innovation Systems (RIS) thus tend to neglect the relevancy of scientific research that is not directly related to economic benefits (see e.g. Feldman and Audretsch 1999, Holbrook and Clayman 2006) but rather follow triple helix models that are likely to meet the expectations of industry and government. In such settings universities and scientific research are seen as a provider of results and not much attention is being paid to the development of structures and capacities of these providers (organisations as well as research fields). In many cases, RIS mainly seek to push activities of research institutions “downstream” in the innovation chain and systematically neglect the needs and merits of “upstream activities” such as curiosity-driven fundamental research for the innovation system - although the benefits of the universities’ primary missions for the economic development have often been emphasized (see e.g. van der Ploeg & Veugelers 2008, Martin and Tang 2007): The build-up of critical mass, academic specialisation, top class graduate output, interdisciplinary networks and co-location structures is therefore often not supported by the regional level, although it might draw a lot of benefits from a well-functioning science base.

The Vienna Science and Technology Fund (Wiener Wissenschafts-, Forschungs- und Technologiefonds, WWTF) is a Vienna-based Austrian research funding organization financed predominantly by a private foundation but also managing regional public funds. Its mission is to strengthen the Vienna research landscape by contributing to the accumulation of critical mass of excellent scientific research in selected fields. It does so with relatively limited finances (about € 12m/year) that fund larger (up to 800.000 Euro) research projects

or by supporting researchers either through Science Chairs for more senior researchers, or through “Vienna Research Groups” by which young research talent can establish their first own research group. WWTF has been operating for over ten years by now, which makes first effects now visible. Embedded in a supranational, national and regional innovation system, the support of scientific research in the regional context, however, faces a number of challenges. First, one can ask how a funding organization with limited resources can contribute to the development of a research landscape that is also addressed by much larger players. Second, as it is by no means easy to determine the success of such efforts: How can efforts to ‘develop a research landscape’ be evaluated?

The following paragraphs describe a key element of the recent WWTF impact evaluation:

Comparative case studies were conducted in three selected research areas of WWTF funding activities, namely Life Sciences, Information and Communication Technology, and (interdisciplinary) Mathematics. The case studies were based on semi-structured interviews with 25 grantees from all major funding programmes. The interviews were prepared by bibliometric structural analysis of their publication oeuvre. The micro-level approach chosen here enables to reveal the mechanisms by which the research landscape has been changed:

- Quality and fit are the main criteria for the selection of funded professors and group leaders. New research areas could only be established where “something was already there”. Candidates from abroad can only be attracted if potential collaborations are possible.
- The WWTF’s selection procedure for funded professors and group leaders strongly involves the universities. Since universities have to make considerable financial commitments to supporting the Chairs and group leaders, and to long-term investments in the fields they will attempt to reap the greatest possible benefits from the appointments, which includes a local fit, i.e. a fit with their own research profile. This fit manifested itself either as a strengthening of existing fields, which always coincided with the addition of a new area of expertise, or as the filling of gaps in the research landscape.
- The excellence of the funded professorships attracted other excellent researchers in the same research field. Thus the initial WWTF funding acted as a trigger and created critical masses that put a certain area on the international research landscape.
- The changes in the Vienna research landscape are likely to be sustainable for professorships that are now recruited on university professorial positions that come with considerable resources. For group leaders this is still an open question because their future tenured positions come with very little funding beyond their own salary after WWTF funding ends.
- Not surprisingly, the effects on project grants on the research landscape were less strong. However, WWTF grants allow unusual interdisciplinarity. Only if researchers could secure a permanent position, got grant funding from other funding organisations and infrastructure support from their universities they could maintain their new research line. If this leads to a critical mass visible on the Vienna research landscape depended on the support of other researchers.

With the approach taken by the impact evaluation it could be demonstrated how supporting scientific research on a competitive level of excellence can have impacts on a regional research landscape at the micro-level. An open question for future research is how these changes manifest themselves on the macro-level research, namely in terms of quality, interdisciplinarity, and coherence of the research landscape. We will conclude with some lessons and implications for the policy mix of regional innovation systems and the role of

scientific research funding in this context.

#### References:

- Feldman, Maryann P. and David B. Audretsch, 1999. Innovation in cities: Science-based diversity, specialization and localized competition. *European Economic Review* 43: 409-429.
- Holbrook, J. A. and B. P. Clayman, 2006. Research funding by city: an indicator of regional technological competitiveness? *Research Evaluation* 15: 221-231.
- Hoekman, J., K. Frenken, and R.J.W. Tijssen, 2010. Research collaboration at a distance: Changing spatial patterns of scientific collaboration within Europe. *Research Policy* 39: 662-673.
- Inhaber, H., 1974. Scientific cities. *Research Policy* 3: 182-200.
- Janger, J. and K. Nowotny, 2013. Career choices in academia. Working paper no 36. [http://www.wifo.ac.at/jart/prj3/wifo/resources/person\\_dokument/person\\_dokument.jart?publikationsid=46922&mime\\_type=application/pdf](http://www.wifo.ac.at/jart/prj3/wifo/resources/person_dokument/person_dokument.jart?publikationsid=46922&mime_type=application/pdf)
- Martin, B. and P. Tang, 2007. The benefits from publicly funded research. SPRU Electronic Working Paper Series No. 161. <http://www.erawatch-network.eu/reports/sewp161.pdf>
- van der Ploeg, F. and R. Veugelers, 2008. Towards Evidence-based Reform of European Universities. *CESifo Economic Studies* 54.2: 99-120.



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***Commitment of large firms as patent holders in energy cleantech in the context of the Kyoto protocol***

**Abstract:**

Climate change has become a global concern imposing pressure on decision makers in governments and corporations since the late 1980'. In 1992 governments took on obligations to address climate change through enhanced scientific and technological cooperation, assessment of sources of greenhouse gas (GHG) emissions and removals, and policies and measures to mitigate GHG and to promote adaptation to climate changes. Two years later these obligations having been recognized as inadequate, new negotiations started in favor of deeper abatements. They ended in 1997 with the Kyoto Protocol (rejected by US in 2001) establishing emission reduction targets but with no new obligations for developing countries. The Kyoto Protocol commitment period started in 2008. Providing additional incentives to invest in research and development (R&D) the post Kyoto period displayed an exponential growth of the patenting activities in Climate Change Mitigation Technologies (CCMT) that contrasts with the decline of patents granted in traditional energy sectors (fossil and nuclear energy) since 2000 (EPO, 2010). Among CCMT, growth rates in areas such as solar photovoltaic, wind or biofuel outperform particularly well while others like geothermal or hydro/marine energy lag behind. From the origin of patent owners, it was shown that, not surprisingly, research activity in CCMT occurs primarily in Japan, United States, Germany, France, Korea and United Kingdom.

As major contributors to environmental problems, the reduction of GHG emissions is a prominent issue for MNCs. There has been striking variations in the responses of companies across sectors and countries: European industry displayed the greatest readiness to invest in CCMT while U.S. companies were more reluctant pointing to the potentially high economic costs of greenhouse gas controls. But among large firms there was a converging trend to acknowledge the role of GHGs in climate change and the need for action (Levy, 2006).

Based on the analysis of firms' patent portfolios, this paper describes how did large firms address these forthcoming technology challenges over time. It sets out the trends of R&D commitment of large firms in energy CCMT (or energy cleantech) from the 1990' to the mid 2000'. It evaluates the contribution of large firms to the growth of the patenting activities and how this contribution varies among the different sectors of energy CCMT. It will also investigate how firm commitment depends on firm countries and firm sectors and whether it relies mainly on incumbents or new entrants in the sector of energy. At last we intend to determine whether internationalization scale and locational strategies in energy cleantech differ from patterns observed in traditional sectors of energy.



## Methodology

This research focuses on priority patent applications extracted from the Patstat database (version autumn 2011) produced by the EPO and analyses (on a fractional counting basis) information pertaining to applicant names, IPC and CPC codes, filing date, inventors' addresses. It also exploits a database of the consolidated portfolios of patents applied from 1986 to 2005 of the 2800 firms with the highest annual R&D investments that includes 5,12 million priority patents (Laurens, 2013). For this research we delineated a subset of 946 large firms with sustained inventive activity (at least 5 patent applications during both periods 1994-96 and 2003-05). They account for half of the total number of priority patents applied for during 2003-05.

The energy cleantech patents were delineated using the new CPC classification (Y02) set up by EPO in 2010 to tag technologies which "control, reduce or prevent GHG emissions of anthropogenic origin as set forth by the Kyoto Protocol. We selected in Patstat the 161547 priority patent applied for from 1993 to 2005 that belong to the T02E subclass that covers technologies dealing with the reduction of GHG emission, related to energy generation, transmission or distribution (Veefkind, 2012). Main groups in T02E class deal with : - Technologies with contribution to GHG emissions mitigation that towers with 64% of T02E patents. It includes energy storage (batteries) (39%), fuel cells (18%), hydrogen technology (2,9%), -Renewable energy sources (23%) with photovoltaic (10%), wind (4,6%), thermal solar (3,9%), hydro (3,2%), oceanic (0,6%) and geothermal (0,5%) energies, -Technologies for the production of fuel of non-fossil origin (4,1%) (biofuel (1,6%), from wastes (2,5%) - Combustion technologies with mitigation potential (Combined Heat and Power, ...) (3,4%), - Nuclear Energy (3%), -Technologies for efficient electrical power generation, transmission or distribution (1,8%).

For each year we calculate for the T02E class and across its main groups and subgroups: the share of energy cleantech patent in each firm portfolio and the share of all firm patent portfolios to the overall Patstat patents for energy cleantech patents and for other technologies. The internationalisation of firm invention is measured in 1994-96 and 2003-05 by comparing the nationality of the firm (i.e. the country where the MNC headquarter is located) and the residence country of the inventor. In order to estimate firm motives for internationalizing inventions we rely on Revealed Technological Advantage (RTA) indexes assessing the relative technological strengths (and weaknesses) of firm and host countries. This allows classifying the internationalisation strategy of firm invention according to Technology or Market Seeking (Le Bas 2002, Laurens 2013).

## Results

From 1994 to 2005, the number of energy cleantech patents in Patstat increased by 168% (107% for all patents). The highest growths are in fuel cells (1252%), hydrogen technologies (547%), wind energy (386%), biofuels (339%), marine energy (259%), energy from waste (218%) and solar energy (190%). Photovoltaic, Batteries and hydro energy sectors show a mild growth (from 40% to 90%) while nuclear energy declines (-59%).

Firm commitment to energy cleantech: Results show that from the mid 1990' to mid 2000', a larger number of firms carried out research in energy cleantech: in 1994-96, 285 (over 946) large firms had applied for energy cleantech patents ; ten years later 433 firms did (+45%).

In 2003-05, large firms account for 56% of all patent applications in energy cleantech, a

share higher than in other technologies (50%). This share dropped from 1994-96 to 2003-05 (-13%) but more slowly than in other technologies (-20%). Nuclear energy, hydro energy, photovoltaic, batteries are technologies where large firms were already very active in the mid 1990' but then lowered their engagement leading to a possible decline of patenting (for example in nuclear energy). In fast growing sectors, like fuel cell or hydrogen energy, firms were already main actors in the mid 1990' and still are 10 years later. Firms strongly increase their commitment in wind energy, another fast growing sector but still do not dominate it. In marine, biofuel, solar energy, large firms are not very active. These sectors remained thus minor patenting sectors in energy cleantech but grew fast.

Japanese firms show the highest commitment in energy cleantech. From mid 1990' to mid 2000', they stably concentrated more than 80% of firm energy cleantech patents. This share largely exceeds their share in other technologies (61%). US firm share decreases while that of European firms (Germany, France) and Korean firms rise.

Internationalisation of firms : First results show that the internationalisation rate of firms invention in energy cleantech slightly decreased from 1994-96 (4.1%) to 2003-05 (3.4%). The internationalisation rates vary strongly among energy clean technologies: in western countries the nuclear sector relies only on national competence (as fuel cell in larger European countries) while wind energy is a strongly internationalised (US large firms exploit European skills in particular from Germany). Japanese firms exclusively rely on national inventors except in the sector of nuclear energy where 17% of their patents involve foreign inventors.

In other main countries contributing to energy cleantech patenting (Japan, United States, Germany, France, Korea, ...) patent holders in cleantech always rely more on national R&D than in other technologies.

#### Conclusion

Since the mid 1990' large firms are key actors in the development of energy cleantech. Their commitment become more and more important but depends on the energy sector and firm characteristics (country, sector). Japanese firms are by far the most engaged and specialized firms in energy cleantech. Except in nuclear energy, they exclusively rely on national competence. Most often large firms in western countries also emphasize national skills in energy cleantech compared to other technologies but we also evidenced much more internationalized R&D for example in wind energy. Such particular trends are currently under study in order to assess the motives of such internationalisation schemes.

#### References

EPO 2010 : « Patents and clean energy: bridging the gap between evidence and policy », UNEP-EPO-ICTSD

[http://documents.epo.org/projects/babylon/eponet.nsf/0/cc5da4b168363477c12577ad00547289/\\$FILE/patents\\_clean\\_energy\\_study\\_en.pdf](http://documents.epo.org/projects/babylon/eponet.nsf/0/cc5da4b168363477c12577ad00547289/$FILE/patents_clean_energy_study_en.pdf)

Levy 2006 : « US Business strategy and climate change », Levy D.L. Paper presented at the conference on "Climate Change Politics in North America," Woodrow Wilson International Center for Scholars, Washington, D.C., May 18-19, 2006.

Laurens, 2013 : "Internationalisation of Large Firms R&D: is the increase trend levelling off?", Laurens P., Le Bas C., Schoen A., Villard L., Larédo P., Working paper,

<http://ifris.org/publications/?gotype=article&goauteur=laurens-patricia-et-al&godate=all>

Le Bas 2002 : « Location versus home country advantages in R&D activities : some further results on multinationals' locational strategies », Le Bas C., Sierra C. , Research Policy. 31, 589-609.

Veefkind, 2012 : « A new EPO classification scheme for climate change mitigation technologies », Veefkind V. Hurtado-Albir J., Angelucci S., Karachalios K., Thumm N., World Patent Information, 34(2),106–111.

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***Towards a Pan-European Innovation Ecosystem: EIT's co-creation approach***

**Abstract:** Europe's economic history is plenty of knowledge and innovation-related successes. Still today, the old continent has a number of world-class Universities, inventive research centers, large companies and a vibrant SME fabric. However, notwithstanding long standing support to collaborative R&D by European Union institutions and member States, recent evidence and research demonstrates that few young leading innovators created in the last 25 years of the 20th century have European roots, a tenth of those originated in the US. On the other hand, taking aside defense, European citizens already invests publicly per capita more than the US. Consequently, not only the level of support but also the established top-down design of established innovation policy support mechanisms needs consideration.

The 'European Institute of Innovation' (EIT) is a new and interesting policy experiment aimed at getting the EU back on track for entrepreneurial innovation. Created in 2008, the EIT crystallizes Europe's political will to approach innovation radically different with an increased focus on people. EIT operates through so-called 'Knowledge and Innovation Communities' (KICs) which integrate excellent partners from the knowledge triangle of Higher Education, Research and Business, encompassing bottom-up 'co-creation' strategies in shaping novel innovation models.

The paper discusses why and how EIT-KIC 'living partnerships' represent a disruptive innovation policy compared to any other offering at EU level. The paper studies three unique features of the EIT, namely, 1. KICs's role as forerunners of communities-driven innovation schemes for grand challenges, 2. the unique governance and management approach to EIT-KIC partnerships and 3. KIC's co-location centers as melting pots of knowledge, skills and entrepreneurial attitudes.

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***Does Innovative Human Capital drive firm-level innovation? Empirical evidence and implications for public policy***

**Abstract:** Abstract

This research considers the role of public policy in the development and support of a new and holistic concept, which we coin Innovative Human Capital (IHC). We extend the standard measure of human capital by developing a more all-encompassing concept, as a valuable resource for firms' innovation.

The theoretical framework underlying this research is grounded in a boundary spanning and comprehensive approach to the literature and theory, including economics, management, and human resources. The theoretical framework presented underpins the first part of the research, to develop IHC and subsequently, to investigate the internal and external factors that support and drive the novel concept. The second part of this research addresses the role and challenges for public policy in the support and development of IHC as a valuable resource for firms' innovation activity. In so doing, we ask the question as to how useful existing policy instruments are in unleashing the potential of IHC? In a similar vein, we also ask what kinds of changes to instruments and policy mixes are needed to promote IHC in the future?

Competitive advantage depends, in part, on firms' capacity to innovate, evaluate, and exploit internal and external knowledge (Cohen and Levinthal, 1990). There is an abundance of literature pointing to the importance of research and development (R&D) as a major determinant of innovation and the need for skilled scientists and engineers in science-based sectors (Arundel et al., 2007). While numerous policy initiatives have focused on supporting R&D in the pursuit of innovation, in the current economic climate of severely reduced budgets (European Commission, 2010; Forfás, 2012), a refocus of attention on the internal resources and capabilities of firms is timely. From both academic and policy perspectives, this research is predicated on the case that sustained competitiveness depends upon the innovation-based strengths of the national economy.

People, as well as organisations have an important role in driving innovation (Lundvall, 2007), while firms' growth is related to the quality and investment in their human capital (Benhabib and Spiegel, 1994). It is suggested that human capital provides a competitive advantage for firms in terms of employees' skills, expertise and willingness to work (Hewitt-Dundas, 2006) by working in teams, developing new ideas and bridging different bodies of knowledge (Vona and Consoli, 2011). Human capital promotes growth and development through increasing productivity of labour and capital. In his seminal work, Becker (1993) examined the consequences of investing in a person's knowledge and skills through education and training. He describes capital as money in the bank or shares in a company, but adds that schooling and training are also investments in the individual. The ability to identify and evaluate the competitive advantage of employees' transferable and innovative characteristics is of fundamental importance to firms and policymakers, but has largely been

overlooked by research to date. Many studies have focused on efforts to identify tangible internal and external conditions and attitudes towards innovation related to the individual person. Østergaard et al., (2011), for example, study the effect of employee diversity (in the case of age, gender, ethnicity and education) on innovative performance, and Junge et al., (2013) consider the educational mix of employees and the probability of firms' innovation activities. While it is an essential part of innovation, there is no standard measure of human capital, though formal education is commonly used as a proxy. In particular of late, there is a great deal of interest in addressing the challenge of measuring human capital (Soboleva, 2010) and it is clear from the recent literature that the more tacit characteristics of human capital are increasingly being examined: for example, creativity (Storper and Scott, 2008) and work experience (Ganatakis, 2012).

To overcome the limitations of measurements used previously, this research extends the standard measure of human capital by developing a holistic and novel concept of IHC, and considers its effect on firms' product, process, and service innovation. This novel IHC concept captures four elements of the individual employee-manager: the tangible measures of educational attainment and training provided by the firm, with the addition of the intangible elements of the individuals' willingness to change in the workplace and their job satisfaction. The research also examines the factors at regional and firm level that may be causally connected to IHC. Specifically, we examine the level of regional entrepreneurship activity and workforce diversity, along with the internal factors regarding firms' work practices and arrangements. Regional entrepreneurship activity is measured by the level of informal investment, the number of people expected to start a business in a region and the total number of early stage entrepreneurs. Regional diversity is measured using a Blau index (1977). This index measures the probability that two people chosen at random from a region will differ vis-à-vis their education and nationality.

Our research uses a unique pooled dataset from four sources (employing firms' regional location as the common identifier): an Irish workplace survey dataset, Irish national census data, Global Entrepreneurship Monitor for Ireland, and an Irish innovation panel dataset. The empirical analysis uses multiple logit regressions to estimate our hypotheses. The results highlight the importance of extending the measure of human capital and finds IHC as a significant contributor to firm-level innovation, particularly for small firms (<50 employees). The estimations also find internal (firm) factors to be more significant (at varying degrees) than the external (regional) factors in the case of all four elements of IHC. The results could potentially have important implications for innovation and enterprise policy and indeed any policy aimed at driving firms to improve their innovation activity. From a policy perspective, the research explores current policy and programmes from a number of developed economies at various levels (including firm-level) to assess existing direct and indirect programmes, instruments and policy mixes in pursuit of promoting IHC. In line with current Irish policy to promote innovation, job creation, and economic growth, and in an attempt to operationalise the valuable IHC for innovation, we propose a new policy offer (comprising a series of policy instruments). The new offer is designed to encourage and incentivise firms to promote IHC as a competitive resource. We argue that policy makers who look beyond education and training as measures of human capital may enhance returns on investments, particularly in the longer term.

While we use Irish data, the methodological approach adopted and the analysis applied in this research has broad-based application beyond the Irish locale. In this regard, we identify a number of similar workplace surveys (from various economies) where further research

would advance the understanding of IHC and add to the current debate on human capital measures beyond those of education and training.

In sum, this research contributes to knowledge by considering a holistic measure of human capital, and creates and coins the novel Innovative Human Capital concept as a determinant of innovation. In addition, it identifies factors internal and external to the firm, which foster this valuable resource. Public policy has a potentially important role to play in enabling IHC to flourish, with the ultimate aim of increasing firms' innovation activity.

## References

- Arundel, A., Lorenz, E., Lundvall, B. and Valeyre, A. (2007) 'How Europe's economies learn: a comparison of work organization and innovation mode for the EU-15', *Industrial and Corporate Change*, 16(6), 1175-1210.
- Becker, G. S. (1993) *Human Capital*, Chicago and London: The University of Chicago Press.
- Benhabib, J. and Spiegel, M. (1994) 'The role of human capital and political instability in economic development evidence from aggregate cross-country data', *Journal of Monetary Economics*, 34(2), 143-173.
- Blau, P. (1977) *Inequality and heterogeneity*, New York: Free Press.
- Cohen, W. and Levinthal, D. A. (1990) 'Absorptive Capacity: A New Perspective on learning and Innovation', *Administrative Science Quarterly*, 35(1), 128-152.
- European Commission (2010) *Europe 2020 Flagship Initiative Innovation Union. Research & Innovation Policy*, SEC(2010) 1161, Brussels: European Commission,.
- Forfás (2012) *Forfás Annual report 2011*, Dublin.
- Ganotakis, P. (2012) 'Founders' human capital and the performance of UK new technology based firms', *Small Business Economics*, 39(2), 495-515.
- Hewitt-Dundas, N. (2006) 'The role of proximity in university-business cooperation for innovation', *The Journal of Technology Transfer*, 07-2012.
- Junge, M., Severgnini, B. and Sorensen, A. (2013) 'Evidence on the impact of education on innovation and productivity', available online [http://www.eea-esem.com/files/papers/eea-esem/2013/402/jss\\_eea.pdf](http://www.eea-esem.com/files/papers/eea-esem/2013/402/jss_eea.pdf).
- Lundvall, B. (2007) 'National Innovation Systems - Analytical Concept and Development Tool', *Industry and Innovation*, 14(1), 95-119.
- Østergaard, C. R., Timmermans, B. and Kristinsson, K. (2011) 'Does a different view create something new? The effect of employee diversity on innovation', *Research Policy*, 40(3), 500-509.
- Soboleva, I. (2010) 'Paradoxes of the Measurement of Human Capital', *Problems of Economic Transition*, 52(11), 43-70.
- Storper, M. and Scott, A. J. (2009) 'Rethinking Human Capital, creativity and urban growth', *Journal of Economic Geography*, 9(2), 147-167.
- Vona, F. and Consoli, D. (2011) 'Innovation and Skill Dynamics: A Life-Cycle Approach', OfCE Document de Travail, WP2011-26.

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***China's innovation system transformation: policy dilemmas and variety in developmental trajectories***

**Abstract:** This research aims to develop a conceptual framework on China's innovation system transformation, in order to understand its evolutionary process in recent years and possible trajectories in the future. The Chinese innovation system has faced policy dilemmas and variety of possible developmental trajectories that have evolved along with the process of China's economic transition and globalization. By drawing a framework of China's innovation system transformation from the perspective of both governance and sector variance, this paper provides new perspectives on research of dynamics of national innovation system in developing countries. It further sheds light on possible impacts on policy making of innovation management in developing countries.



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***Potential of Complementarity between Instruments in Regional Innovation Policy Mixes – insights from the context of China’s public procurement of innovation (PPI) policies.***

**Abstract:**

As the design and implementation of innovation policies are increasingly differentiated and intertwined with other types of policies beyond the original domain of any single policy instruments, the coordination and complementarity between different policies has become a pressing issue to be dealt with. In this context the notion of ‘policy mix’ is being heatedly debated (OECD 2010; Flanagan et al. 2011; Borrás & Edquist 2013) and has become a topic of interest for this conference. Thus far the understanding of the dynamics of policy complementarity has been underdeveloped. This paper attempts to contribute to the current debates by exploring opportunities of complementarity within and between various types of policy instruments especially in the context of multi-level governance of innovation policy mixes.

This paper pays special attention to policy complementarity issues surrounding public procurement of innovation (PPI) policies. PPI policy as a major form of demand-side innovation policy (DSIP) has been recognized as ‘a cornerstone of a co-ordinated and technology or sector specific mix of policies’ (Edler & Georghiou 2007, p.953). It is believed that situating PPI policies as part of a policy mix can maximize their effects (Edquist & Zabala-Iturriagagoitia 2012). Designing and implementing PPI policies in combination with other policy instruments can potentially offer ‘systemic’ solutions to address specific problems hindering innovation (Borrás & Edquist 2013). Two major types of ‘systemic approaches’ centred on DSIP, as coined by Edler (2013), are ‘integrated demand measures’ and ‘integration of demand- and supply-side logic and measures’ (p.9). Those ‘integrated’, ‘systemic’ approaches are in essence targeted at exploiting the complementarity between various instruments within policy mixes.

Drawing upon those existing perspectives, this paper sets out to address the following research question: how does the complementarity between PPI policies and other policies interplaying with PPI policies work, and how can it be enhanced? This study proposes a tentative typology of policy interplay between PPI policies and other policies according to what the other policies are, i.e. PPI policies interplaying with other types of DSIP, PPI policies interplaying with supply-side innovation policies, and PPI policies interplaying with policies which are not primarily innovation-oriented. The different types of policy interplay are then investigated through 9 case studies of PPI policy practice in five regions in China (see Li 2013 for a detailed account on the subject). Each case has been an outcome of implementation of PPI-related policies from the national, meso-, and local levels. Data collected to build the cases included PPI policy documentation (e.g. official announcements and policy reports), and 49 interviews with key stakeholder groups (procurers, suppliers, users and government officials) at the national and lower levels. In most of the cases investigated, policies from

domains beyond PPI and from other levels of governance served as complementary forces in shaping the functioning of regional PPI policies. For each type of policy interplay there have been different rationales enabling the complementarity and synergy between various policy instruments.

Other types of DSIP interplaying with PPI policies in the cases included regulations, standards, user subsidies and user praises/awards. In two of the cases, the use of subsidies by the local government to an extent incentivized the user companies to purchase newly developed machines/solutions; later on the national user awards/praises confirmed the contributions by lead users, and enhanced public awareness of the innovative products as well as of the PPI policy approach involved. In a new energy vehicle (NEV) case, various types of DSIP instruments were employed to create a lead market in the locality; national and local regulations provided the prerequisites for articulating the needs of large amounts of NEVs and related infrastructures; the catalysing impacts of PPI policies were enhanced as local citizens were meanwhile incentivized by the private user subsidies from both the central and the local governments. The successful implementation of PPI policies in turn enhanced the functioning of other policies and the establishment of formal technological standards nationwide. On the contrary, the absence of national regulations in cases related to the LED Lighting Programme severely compromised the functioning of PPI policies; without the support of complementary policies, PPI policies can easily be manipulated to exercise regional protectionism.

Supply-side innovation policies interplaying with PPI policies included R&D support and intermediary measures. In three of the cases, the suppliers had benefitted from various types of R&D support from the central and/or local governments before the launch of PPI policies. They had managed to produce R&D outcomes and made the local governments aware of their achievements as well as commercialization difficulties. The use of regional PPI policies then followed to facilitate the commercialization process. In this context, PPI policies to provide the 'demand pull' complemented the 'supply push' provided by R&D support. The use of intermediary measures reinforced the functioning of PPI policies as well. One of the cases situated in Beijing benefitted from the locality's holistic innovation policy setup centred on a science park. PPI policies were only one of the many types of policy instruments that influence simultaneously on tenant firms' innovation performance. Supported with intermediation tools including alliances, technology exhibits and contract-signing conferences, the implementation of PPI policies had overcome some typical obstacles such as risk aversion and stakeholder interaction deficiency. In some cases, certain individuals played informal, ad hoc brokerage roles; the lack of formal intermediation measures proved to be a barrier hindering the implementation of PPI policies, and this is potentially a gap to be addressed through public intervention at multiple levels.

A third type of policies identified interplaying with PPI policies has been sectoral policies which are not primarily innovation-oriented. For example, in the E-classroom case, provincial-level policies promoting 'education modernization' provided a major driving force leading to the demand of new solutions; a similar role in cases related to 'green technologies' was played by China's national environmental policies especially the carbon-reduction objectives. This type of sectoral policies can contribute to the creation of demand, as well as better articulation of technological specifications (OECD 2011). The combination

of those policies with PPI policies is inherently another type of ‘systemic approach’ in addition to the two types coined by Edler (2013).

Preliminary findings of this study reconfirm the perspectives of the literature referred to above, that PPI policies have great potential in achieving synergy with other types of policies to function as systemic approaches. In particular, this study illustrates various scenarios of policy complementarity. Despite the fact that those observations have been made based on empirical evidence in China, and that policy complementarities in practice are influenced by factors in context (Flanagan et al., 2011), potential of complementarity between different types of policies from different levels of governance can be exploited by drawing upon those Chinese cases. Complementarity between other DSIP instruments and PPI policy can be improved by designing and implementing them in a mutually-reinforcing fashion; complementarity between supply-side measures and PPI policy might be realizable by taking into account the sequence of implementation and the role played by intermediaries; complementarity of PPI policy with instruments beyond innovation policies can potentially be enhanced by improving framework conditions for innovation. The basic rationales of policy instruments are transferrable, thus the adaptation of the logic of policy interplay to other contexts is highly possible.

## References

- Borrás, S. & Edquist, C., 2013. The choice of innovation policy instruments. *Technological Forecasting and Social Change*, 80(8), pp.1513–1522.
- Edler, J., 2013. Review of Policy Measures to Stimulate Private Demand for Innovation. *Concepts and Effects*, Manchester.
- Edler, J. & Georghiou, L., 2007. Public Procurement and Innovation—Resurrecting the Demand Side. *Research Policy*, 36(7), pp.949–963.
- Edquist, C. & Zabala-Iturriagagoitia, J.M., 2012. Public Procurement for Innovation as Mission-Oriented Innovation Policy. *Research Policy*, 41(10), pp.1757–1769.
- Flanagan, K., Uyarra, E. & Laranja, M., 2011. Reconceptualising the “Policy Mix” for Innovation. *Research Policy*, 40(5), pp.702–713.
- Li, Y., 2013. Public Procurement As A Demand- Side Innovation Policy In China An Exploratory and Evaluative Study. The University of Manchester.
- OECD, 2011. *Driving Eco-Innovation: The Role of Demand-Side Policies*.
- OECD, 2010. The Innovation Policy Mix. In *OECD Science, Technology and Industry Outlook 2010*. OECD Publishing, pp. 251–279.

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***Global influences of the 'algorithm - 'big data' duo' on policy making***

**Abstract:**

Press reports in the Guardian and New York Times about the 'Edward Snowden' papers and the activities of NSA and GCHQ have embedded in the public mind the multi-headed hydra that is commonly called 'big data'. These 'revelations' have simply drawn public attention to a very long running situation of how computation may be placing human judgment in diminuendo in policy formulation in all spheres of human life re-shaping it by imposing effects on all life on the Earth. In 1936 Turing opened the gateway to the current algorithm dominated world with his paper on 'Computable Numbers'. All digital computers are universal Turing machines. The intention here is to promote an appreciation of the role the 'algorithms-big duo' play in all fields of life, highlighting the certainty, that this duo is already setting boundaries, real and unimagined, un-noticed and unconventional, to policy making for decades into the future. The extent to which ignorance rather than knowledge run throughout the 'algorithm-big data duo' and ultimately into their desirability is discussed. The influence of the 'algorithm-big data duo' is endemic as demonstrated by Eric Schmidt, the Chairman of Google, when he added his voice to earlier opinions that 'It's a race between computers and people – and people need to win'.

*"..... little questioning is apparent anywhere in relation to computers ..... eventually some deep matters of value and expectation will need legitimization if societies are to continue to function openly and freely. The computer will be deeply involved in this process."*

*And that:*

*"..... fear may be preventing people from holding in their hands the new tools to ground themselves in their future. It should now be a major goal for computer technologists to put new skills back into the hands of individuals rather than to continue to remove individuals from employment: ..... It is here, perhaps, ..... that the genesis of the man-machine problem lies."*

*From 'Computers and You' Loveridge (1983)*

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***The Balancing Role of Evaluation in Organizational Governance: An International Comparison of Publicly Funded Research Institutions***

**Abstract:** Introduction

Publicly funded non-university research institutions are significant academic contributors to maintaining national innovation systems. They are expected to deliver excellent research, often problem-oriented, and also to provide scientific evidence for national policy-making. With these missions, their performance evaluation systems are designed to consider both legitimacy and justification of public funding, and the appropriateness of their own organizational strategies. We expect that the interests of diverse stakeholders, such as funding bodies, the wider scientific community, research funding councils, collaborating universities and enterprises, and the general public are reflected in the institutions' organizational governance and related evaluation motives. Do evaluation mechanisms and practices help to balance potential stakeholder conflicts, through which procedures and with what outcome?

We studied three umbrella organizations: the Max Planck Society (MPG) and the Helmholtz Association (HGF), two of the four German non-university research institutions, and the Chinese Academy of Sciences (CAS). All three are key non-university institutions publicly funded through stable institutional funding and external project funding, with numerous institutes conducting research in various domains. They are governed by central headquarters, while their research institutes enjoy varying degrees of autonomy and freedom. Their evaluation mechanisms have experienced decades of development and learning and now are integrated and mainstreamed in the organizational governance. Yet, each of the three institutions has its own sophisticated evaluation procedures which are closely in tune with particular organizational mission, strategy and orientations. Our research question is: do the Institute Evaluation Mechanisms (IEM) and practices implemented by the three institutions help to balance interests and expectations of the various stakeholders' concerning three aspects of organizational governance: strategy, funding and operation?

Increased S&T collaboration between Germany and China is opening up in mutually beneficial areas for long-standing relationships. The institutional examples of the CAS-MPG Partner Institute of Computational Biology since 2005 and the Helmholtz Beijing office opened in 2003 are included in this study.

**Methodology**

A logic chart drawn up for each case starts from the organizational mission and strategy to the purposes of institute evaluation. Then it goes to practical procedures and potential impact on internal decision-making and external policy implications. During the whole process (preparation, organization, implementation and reporting), the stakeholders' interaction and communication activities are analyzed around potential conflicts: strategy, funding and operation. Finally, a comprehensive analysis with comparisons tries to find out

whether and how the balancing function works in various contexts.

The IEM is defined in this study as a three-level hierarchical model. The macro-level is a central supervisory body (L1) that makes the regulations, organizes the inspection and analyze final reports. Specific research institutes (L2) at the meso-level are evaluated by review panels through a series of procedures with particular focus and concerns, and the micro level of individual participants (L3). Data were retrieved from literature and public documents on websites of the MPG, the HGF and the CAS. Qualitative data are from 57 in-depth individual interviews at the three levels of the respective IEM.

#### The MPG

The MPG has a mandate to expand the boundaries of knowledge by pursuing basic research at the highest level. Thanks to public funding, MPIs (Max Planck Institutes) are able to conduct knowledge-oriented research in an open framework and without ties to specific applications.

MPG's strategies and corresponding evaluation procedures entail the following:

- (a) Best research worldwide from person-centered research institutes
- (b) Fostering creative and potential talents
- (c) Globalized knowledge creation and transfer

#### Balancing role of IEM vis-à-vis stakeholders

The MPG's evaluation procedures and criteria are continuously reviewed in order to ensure the top knowledge-oriented research. Frequently and updated evaluative information reflects the current potential of the institutes and discussion of the Society's prospects. The MPG's governance of institutes allows for a high degree of independence and scientific freedom. Transparent evaluation principles and procedures with convincing involvement of stakeholders contribute to the external legitimation and justification of high public funding.

#### The HGF

HGF contributes to solving grand challenges of society, science and industry by performing top-rate research in strategic programmes in six particular fields. Its research focuses on systems of great complexity by using large-scale facilities and solid research infrastructures, with aims to preserve and improve the foundations of human life at the interface between science and public policies.

HGF strategies and corresponding evaluation procedures entail the following:

- (a) Programme-oriented Funding (PoF) for scientific research in six fields
- (b) Using complex infrastructures and unique large-scale facilities
- (c) Cooperation with national and international partners, talents training and technology transfer

#### Balancing role of IEM vis-à-vis stakeholders

The PoF sets overarching policy goals rather than a multitude of isolated measures through the Strategic Guidelines from funding bodies and Position Paper of each research field. They are the result of multi-level dialogues among science, politics and industry. The PoF evaluation balances the collaboration and competition of each programme and the

involving centers with different scales and strengths.

#### The CAS

As the national academy of natural sciences, CAS is a significant contributor for the national innovation system with governance features of strong central government leadership in setting strategic directions, objectives and policy frameworks.

CAS's strategies and corresponding evaluation procedures entail the following:

- (a) Major R&D outcomes from various institutes under the control of Headquarter
- (b) Training of high quality scientific talents and incubating high technologies in China
- (c) Accomplishment of Long-term S&T Programmes with policy orientation

#### Balancing role of IEM vis-à-vis stakeholders

Without any permanent structural units like Senates in Germany, external stakeholders from politics and business are much less involved in the CAS. The CAS as a whole is characterized by complex research orientations and abstract mission statement which is interpreted by individual institutes in flexible ways. The national policy requirements permeate scientific work of CAS institutes through specialized programmes or projects. The knowledge transfer from scientists to the general public is emphasized by all three, but the German organizations specifying it in evaluation criteria which affect final rating and recommendations, while the CAS does not.

#### Tentative Result

The three IEMs indeed consider and reflect governance conflicts in their procedural designs given their particular organizational missions and research orientations. The institutionalized evaluation procedures including stakeholders' communication and interaction all experience long-term learning processes. The German cases show active participation of different stakeholders as their structural "Senate" members. The MPG has the most frequent scientific evaluation with the least thematic and public policy requirements, which implies very few conflicts about strategy and operation on all three levels. And the Society as a whole is a legal entity which restricts the institutes' developmental autonomy. But its orientation towards curiosity-driven research boosts an open framework with adequate central support and promotes scientists' freedom. The HGF – as an association of quite heterogeneous research centers - faces the strongest top-down strategic impacts thematically and financially, and competition for additional funding among their centers via shared programmes. The PoF evaluation prioritizes strategic relevance as criteria for funding, and empowers the scientific quality control to the Mid-term Review of centers. The complex and scatted research orientations of the CAS result in strategic and financial conflicts under the typical top-down governance. The newly developing "One-Three-Five" Evaluation emphasizes major scientific outputs from institutes, aiming at increasing insufficient institutional funding to focused strengths and decreasing institutes' administration, which is expected to balance governance conflicts effectively. Although under significantly different contexts of politics, economics, and governance cultures, in all three cases the IEMs perform a balancing function. The communication and interaction patterns of involving stakeholders in the IEM help to mitigate conflicts about strategy, funding and operation to varying degrees. Specifically, the central supervisory body (L1) balances the external legitimacy and justification of public funding, and internal

governance of heterogeneous research. The institutes (L2) balance following organizational strategies and developing autonomously considering the characteristics and structure of each research field and discipline. The balancing role of evaluation in S&T organizational governance particularly implies experimental evidence for national STI policy-making and learning.



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### *Effects of policy on topic selection by university research groups*

#### **Abstract:**

#### 1. Introduction

Leisyte et al. (2010) and Gläser et al. (2010) are among the few researchers who have paid attention to the increasingly important topic about the way in which university governance and external funding conditions influence topic/research agenda selection in university research groups, and thus, will influence the direction of future research. Most contemporary research policy is built upon the assumption of influence. The aforementioned authors present evidence that researchers adopt strategies to mediate and to cope with these constraints and that there are field-specific factors that modify governance relations.

This paper focuses on the role of the research field as a mediator of the influence of external funding and university governance on the choice of research agendas. It is assumed that the field mediates, especially, through dependence on and availability of external funding and relations with practice or use of research results which fields have (and which is not the same as basic-applied dimension). The purpose of the paper is model building. It draws on empirical qualitative interview material in six research fields (computer science, organic chemistry, energy, cancer research, urban studies, and archaeology) in nine universities, and in two countries, Finland and the UK. The study juxtaposes researchers' comments on factors affecting the selection of their own research agendas with how they characterize external funders and university governance. It looks for patterns by research field and how the field differentiates processes of topic selection and creates specific circumstances for influence.

#### 2. Framework

We assume that research line/topic selection is, first and foremost, affected by 1) the knowledge communities and the knowledge pools within research fields (cf. Nedeva's research fields and spaces frame, 2013). Knowledge communities are mainly comprised of other scientists, but they may be transepistemic, and include collaboration with or research conducted for industry and other societal partners that can provide an important impetus to formulate interesting research questions (Lam, 2011). Thus, the relationship with practice is not just simply that of application of knowledge to practice but also that of epistemic nature of the field, and the relationship with practice varies a great deal by field. 2) Availability of funding is an important influence via conditions and requirements funding organisations set, which again influence differently depending on the field and type of research. Furthermore, 3) the research organisation (the university) establishes the basic rules of action, for instance, its interpretation of general rules such as full-cost modelling, criteria of money

flows within the organisation, the adoption of a policy of research profiles or focus areas which may create limitations upon topic selection as well as performance expectations and measurement. The role of university governance is dependent on the degree to which universities have opted for proactive university policies and governance systems.

### 3. Methodology and analysis

The study uses qualitative semi-structured interviews with leaders of research groups in the six research fields. These fields were selected to represent scientific areas with a varying need for and availability of external research resources and with different interfaces with industry or other socio-economic stakeholders thus creating different relations with 'practice'. Interviewees were selected to control for the stage of a researcher's career, namely, the interviewees are experienced research group leaders, in most cases, full professors, and thus senior persons who have more leeway in topic selection than junior researchers, and who are responsible for securing the funding for their groups. The study was also planned to have variety in university settings. Interviews in each field were conducted in at least two different universities in Finland, and energy research and computer science interviews were conducted in the UK, making for a total of 78 interviews across the six fields.

Both studied countries have a variety of different types of funding organisation. With regard to university governance, Finland represents a country that has only recently undergone a major university reform from state-owned and -controlled universities to one where universities should have more economic and strategic freedom, becoming what some scholars have called 'enterprise' or 'entrepreneurial' universities (cf. Marginson, Considine 2000; Etzkowitz, 2002), although still dependent on government for their basic resources. In Finland, this reform took effect at the beginning of 2010; the universities are still in a learning process and the system is not settled. There is also variance between universities in terms of how actively they have started to implement the new opportunities for building their strategies and aiming at influencing what research is to be conducted. The UK, on the other hand, has had similar reforms in place for much longer so is a more stable research environment and one where the universities and disciplines typically have larger departments and longer traditions. The UK environment also has a performance-based measurement tradition with the Research Assessment Exercises previously and now the 2014 Research Excellence Framework (REF) with its newly introduced, contentious focus of evaluating the 'impact' of research insights upon non-academic users, far above and beyond traditional measures of academic quality.

By drawing on empirical material with an inductive/deductive analytical process, the paper elaborates the conceptual frame outlined above and clarifies the interrelations of intra- and extra-scientific factors in the selection of or influence on research agendas.

### References

- Etzkowitz, Henry. 2002. *MIT and the Rise of Entrepreneurial Science*. New York : Routledge.
- Gläser, Jochen, Lange, Stefan, Laudel, Grit, and Schimank, Uwe. 2010. The limits of universality: How field-specific epistemic conditions affect authority relations and their consequences. In: Whitley, Richard, Gläser, Jochen with Engwall, Lars (eds), *Reconfiguring Knowledge: Changing Authority Relationships in the Sciences and their Consequences for*

Intellectual Innovation, Oxford: Oxford University Press, pp. 291-324.

Lam, Alice. 2011. What motivates academic scientists to engage in research commercialisation: 'Gold', 'ribbon' or 'puzzle'? *Research Policy*, 40, 1354–1368.

Leisyte, Liudvika, Enders, Jürgen, and de Boer; Harry. 2010. Mediating problem choice: Academic researchers' responses to changes in their institutional environment. In: Whitley, Richard, Gläser, Jochen with Engwall, Lars (eds), *Reconfiguring Knowledge: Changing Authority Relationships in the Sciences and their Consequences for Intellectual Innovation*, Oxford: Oxford University Press, pp.266-290.

Marginson, Simon, Considine, Mark. 2000. *The Enterprise University: Power, Governance and Reinvention in Australia*. Cambridge: Cambridge University Press.

Nedeva, Maria. 2013. Between the global and the national: Organising European science. *Research Policy* 42 (2013) 220-230.

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***Policy coordination mechanisms in centralized and decentralized countries***

**Abstract:** This paper sheds light into the policy coordination concept and explores its implications for science, technology and innovation (STI) policies. We develop a framework that brings together insights from institutional and public policy theories with concepts from STI policy and innovation systems. This model is evidenced in two regions, the Basque Country (Spain) and Skåne (Sweden). As a result, the paper discusses different types of STI policy coordination according to the institutional settings (i.e. centralized vs. decentralized, agency-based vs. multi-organizational forms) in which they are embedded.

Policy coordination is an important and often neglected issue in STI policy that has been traditionally studied in the literature of institutional theory and public policy itself (Peters, 2004; Braun, 2008). However, little attention has been paid to it in other streams such as STI policy (Laranja et al., 2008; Borrás, 2008; Flanagan et al., 2011), innovation systems (Lundvall, 1992; Nelson, 1993; Edquist, 1997), or the recent developments in territorial strategy approaches (Foray, 2009; McCann and Ortega-Argiles, 2011; Aranguren et al., 2012).

Both theoretical contributions and case studies recognize the role played by public bodies and new governance models in facing policy and institutional failures. This is particularly the case in the regional context, where a huge range of complex and multi-level institutional settings coexist and conflicts among interdependent actors take place (Karlsen, 2010).

Two dimensions of complexity can be distinguished in STI policy: the policy-mix and multi-level governance (Flanagan et al., 2011; Magro and Wilson, 2013). The policy-mix concept denotes the diversity of innovation instruments from different domains that can be applied, while multi-level governance focuses on the levels in which policies are designed and administered. In this sense, we can find STI policies administered at supranational, national, regional or even local levels and instruments belonging to STI domains but also to health, industrial or energy domains, influencing the orientation of regions towards innovation. In this sense, regions can be regarded as policy spaces in which different policies and instruments administered at various levels interact, and as also as the geographical area where their outcomes will be felt (Uyarra and Flanagan, 2010).

STI policy and the instruments available for its implementation as well as regions have evolved, forming increasingly complex contexts where policy coordination mechanisms have not coevolved. In other words, STI policies are conceived as systemic policies by institutional settings that lack systemic policy-making processes (Braun, 2008). In fact, it is very common to find (in national or regional domains) policies designed and implemented by an isolated governmental department without any mode of coordination with other (related) policies implemented by other departments or at different levels. In this sense, the literature has provided some possible coordination mechanisms such as the creation of centralized agencies, coordination councils, creation of superministries, etc. (Braun, 2008; Lindner, 2012).

In this paper we aim at making a step forward and explore which are the coordination modes and mechanisms that might best fit into different STI policy-mixes and contexts. We

compare two regions which despite being different in many aspects, have many things in common when it comes to STI policy. The two territories count with economies focused on the international scene, register income per capita levels above the EU average and show intense collective organization concerning social cohesion. As to their research orientation, both regions show a similar pattern in the diversity of research areas covered and have a sophisticated innovation system in which STI activities play an important role.

From a policy perspective the Basque Country is a particular case in the Spanish system. Most competences are transferred and managed by Basque institutions, such as education, health and STI policy and therefore the regional government has developed capabilities in these areas (Walendowski et al., 2011). In this sense, the Basque Country counts with a complex institutional setting where STI policies are the result of the coexisting (and often conflicting) views of multiple governmental organizations, agencies and other intermediating bodies. In turn, Sweden counts with a centralized policy context, in which most decisions are made by few governmental bodies concentrated in Stockholm. In the particular case of STI policy, two main agencies can be distinguished: The Swedish Research Council and the Swedish Governmental Agency for Innovation Systems (VINNOVA), despite the Swedish Energy Agency has increasingly played a more relevant role in the promotion of innovation. In this centralized and agency-based setting, the Skåne region has managed to create a propitious space for the development of scientific and innovative activities. The paper contributes to the literature by analyzing the benefits and limitations of the coordination modes signaled by scholars in the STI stream and point out which coordination modes and mechanisms might best fit into diverging institutional settings.

## References

- Aranguren, M.J., Magro, E., Navarro, M. & Valdaliso, J.M. (2012). Estrategias para la construcción de ventajas competitivas regionales. El caso del País Vasco. Madrid: Marcial Pons.
- Borrás, S. (2009) The widening and deepening of innovation policy: What conditions provide for effective governance? CIRCLE Electronic Working Paper Series, No. 2009/02, University of Lund.
- Braun, D. (2008) Organising the political coordination of knowledge and innovation policies. *Science and Public Policy*, 35(4), 227–239.
- Edquist, C. (ed.) (1997) *Systems of Innovation: Technologies, Institutions and Organizations*. London: Pinter Publishers.
- Flanagan, K., Uyarra, E., Laranja, M. (2011) Reconceptualising the ‘policy mix’ for innovation. *Research Policy* 40(5), 702-713.
- Foray, D. (2009) Understanding “Smart Specialisation”. In: Pontikakis, D., Kyriakou, D. y van Bavel, R. (eds.) *The Questions of R&D Specialisation. Perspectives and policy implications*. Luxembourg: Office for Official Publications of the European Communities.
- Karlsen, J. (2010) Complejidad regional y la necesidad de una gobernanza comprometida. *Ekonomiaz*, 74, 90-111.
- Laranja, M., Uyarra, E., Flanagan, K. (2008) Policies for science, technology and innovation: Translating rationales into regional policies in a multi-level setting. *Research Policy*, 37(5), 823-835.
- Lindner, R. (2012) Cross-sectoral coordination of STI-policies: governance principles to bridge policy-fragmentation. In: Fraunhofer ISI (ed.) *Innovation Systems Revisited*:

Experiences from 40 years of Fraunhofer ISI Research. Stuttgart: Fraunhofer Information, pp. 275-287.

Lundvall, B.A. (1992) National Systems of Innovation: towards a theory of interactive learning. London: Pinter.

Magro, E., Wilson, J.R. (2013) Complex Innovation Policy Systems: Towards an Evaluation Mix, *Research Policy*, 42(9), 1647-1656.

McCann, P. y Ortega-Argilés, R. (2011). Smart Specialisation, Regional Growth and Applications to EU Cohesion Policy. *Economic Geography Working Paper 2011*, Faculty of Spatial Sciences, University of Groningen.

Nelson, R.R. (ed.) (1993) National Innovation Systems: A Comparative Analysis. Oxford: Oxford University Press.

Peters, B.G. (2004) The Search for Coordination and Coherence in Public Policy: Return to the Center? Department of Political Science, University of Pittsburgh. Available: [http://userpage.fu-berlin.de/ffu/akumwelt/bc2004/download/peters\\_f.pdf](http://userpage.fu-berlin.de/ffu/akumwelt/bc2004/download/peters_f.pdf) (last access 14th March 2013).

Uyarra, E., Flanagan, K. (2010) Understanding the innovation impacts of public procurement. *European Planning Studies* 18(1), 123- 143.

Walendowski, J., Kroll, H., Wintjes, R., Hollanders, H. (2011) Regional Innovation Monitor. Innovation Patterns and Innovation Policy in European Regions - Trends, Challenges and Perspectives. 2010 Annual Report. Project 0932 for the European Commission. Available: <http://www.rim-europa.eu/index.cfm?q=p.file&r=828f8f6df5cb0208e1640d93a9052f6d> (last access 14th March 2013).

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***Can we support European research and innovation policymaking by federating information systems?***

**Abstract:**

Inspired by the US ‘Star Metrics;’ project, this paper explores the relevance and feasibility of building a Europe-wide IT system to support research performance and assessment. It is based on research undertaken in connection with a more extensive study of the opportunities developing a Europe-wide approach to measuring scientific performance, in support of policymaking<sup>2</sup>. This involved a review of relevant academic and policy literatures, desk research and 27 expert interviews to assemble information about the practice of research performance assessments and the development of information systems in Europe. We then analysed current approaches to research performance assessment in Europe, the concepts, methods and tools used, as well as benefits and challenges in 13 European countries.

**Policy drivers**

The post-War ‘social contract’ between science and society left the research community to a high degree free to choose what it researched. But since the 1960s/70s, research is increasingly expected to support the attainment of explicit social goals, contribute to economic development and develop solutions for major societal challenges. These expectations are translated into how governance works, though governance is also influenced by wider trends in the way the state is managed. Under the influence of the New Public Management, the state makes growing use of agency, with higher levels (such as ministries) setting broad objectives and establishing performance contracts with lower levels (such as agencies).

One consequence is that evaluation has become a key component of policy making. Of late, many countries have introduced performance-based funding systems for allocating ‘institutional’ funding to universities and other research performers. These are data-hungry and are increasingly supported by country-specific research information systems. The role of evaluation more widely, however, remains contested with both the policy-making and the research communities seeking influence over how evaluation is conducted and what questions it tries to answer. At the same time, the need for research information and ‘strategic intelligence’ has increased. The growing availability of ICT-supported information generation and storage systems at all levels supports this growth.

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<sup>2</sup> Bea Mahieu, Erik Arnold and Peter Kolarz, *Measuring Scientific Performance for Improved Policymaking*, STOA, European Parliament (forthcoming, 2014)



### **Current trends in research performance assessment – methods and tools**

Policy-makers at the European and national levels already make considerable use of traditional STI indicators, notably bibliometrics, to benchmark science and innovation systems. But the inadequacy of these indicators to satisfy the current information needs for policymaking or to feed the performance based funding systems that are increasingly prevalent at national level promotes the increasing use of ad-hoc evidence collection projects, including research information systems. More systematic access to these micro-data is expected to facilitate a better understanding of the processes leading to innovation and to improve the assessment of the systemic impacts of research, in particular in the economic and social spheres.

Research information systems play a significant additional role at national and especially institutional levels by enabling access to research information (publications and data) by means of open access repositories, providing important benefits to researchers. The trend is towards increasing development of national research information systems among EU member states. In many cases, the repository function is the primary one, potentially complicating 'dual use' of such research information systems in both assessment and the provision of access to research information.

Our literature review pointed to a growing need for a European view of research performance and impacts, especially in the context of the globalisation of research as well as increasing links between European and national research policies. Horizon 2020 is the prime example of such increasing inter-linkage of European and national funding of research. Sharing information across different systems is increasingly enabled by the development of relevant standards.

It appears therefore that a multi-level research information infrastructure – at the European level and beyond – that would provide access to more fine-grained and longer-term information on the inputs, outputs and outcomes of research is not only technically feasible but desirable from the perspective of both policymaking and practice, in line with current trends to extend the use of research information systems and the launch of several initiatives to integrate or link these systems at institutional, national and European level. It is also in line with current initiatives at a global level, notably the US NSF/NIH Star Metrics programme, offering some prospect in the longer term of establishing an internationally integrated system.

### **The desirability of a transnational system for research performance assessment**

A transnational research performance assessment system collecting information at the micro-level via nationally-based research information systems appears to offer significant added value,

- The current experience with national research information systems shows the value of these systems in terms of an improvement of strategy development and capacity for all stakeholders involved
- The efficiency and effectiveness gains that the national research information systems produced at the national level can be expected to occur also in the case of a European system, in particular in relation to the costs currently covered by the European Commission for the collection of the needed micro-data



- Finally, the centrality of the research actors in the national research information systems and the search for a development path that realises the potential of such systems for both policy and research purposes as well as the alignment with the policies of open access to data cannot but be a positive factor also for extending the system to the European level

Our research suggests that benefits provided by an integrated European research information infrastructure would include

- For research institutions: the opportunity to compare and benchmark research performance with other institutions in Europe, going well beyond what is possible with bibliometric indicators alone
- For national funding agencies and policy makers: a comprehensive view of the complementarities of national research strategies versus other countries and the European Commission; improved basis for comparisons and benchmarking of national research performance with other countries
- For the European Commission: improved efficiency in the collection of micro-data, improving data availability, reducing duplicates and enhancing the sustainability of data collection efforts
- For the research performance assessment community at large: the basis for an improved understanding of knowledge exchange mechanisms in the European research system, providing a comprehensive view on input and outputs

We consider it desirable that policy-makers at the highest levels in the European system make use of the opportunities offered by the latest developments in communication and information technologies and exploit the momentum created by the current development of national research information systems.

This would also ensure avoidance of the risk for a completely business-driven approach to the use of research information systems; it is not clear that such an outcome would serve the interests of researchers, funders or policymakers.

European policy-makers should therefore start setting the basis for the development of a European integrated research information system that would enable sharing data on research across the European Research Area – and beyond.

### **The feasibility of a European integrated research information infrastructure**

Technically, a European Integrated Research Information Infrastructure is feasible thanks to recent technological developments and especially the maturity of the European CERIF standard, which allows seamless interlinking of datasets and/or research information systems, in different formats and including non-CERIF systems. Lack of compatibility of data in different systems does not necessarily constitute an insurmountable problem thanks to the availability of semantic tools. However, a standard approach is needed to the definition of outputs and indicators to allow data to be used in generating indicators.

A European integrated research information infrastructure is consistent with the current policy framework in the European Union. It would not be a substitute for existing national research information systems but an additional layer on top of them. It should comprise a

distributed infrastructure, inter-connecting existing national research information systems. With such architecture development costs should not be prohibitive.

The entire process will require a joint effort from all Member States and the relevant stakeholder communities. All our interviewees, however, considered that the achievement of a common system or approach was not manageable only through bottom-up initiatives. Early-stage steering of the process towards integration at the European level is fundamental and the European Commission is probably the only credible coordinator. Indeed, existing EU projects such as OpenAire in the field of Open Access Repositories and Eudat in the Public Sector Information sphere illustrate that the European Commission has already begun to take on parts of this role – though so far in too decentralised a fashion.

#### Taking care with indicators

An important caveat in thinking about the kind of developments discussed here relates to well-known problems associated with indicators and indicator systems, as a result of which their use is contested. These limitations include

- The problems of bibliometrics that include English-language bias, poor coverage in the social sciences and humanities, difficulties in accounting for differences in behaviour and the nature of research in different fields, and so on
- Specific abuses, such as the use of journal impact factors as proxies for the quality of specific articles or researchers' outputs
- Their tendency to indicate only things that are easy to count, while not necessarily capturing other things that may be more important
- The poor state of indicator development in relation to innovation and the even poorer state in relation to the 'societal challenges'
- Their tendency to induce 'gaming' and other perverse effects

All of these (and more) are pertinent to attempting to federate research information and assessment systems at the European level, as they are in other systems. They do not invalidate the project but they do require the use of at least the same level of intelligence in system design and interpreting results as is needed at other levels.

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***SMEs and Barriers to Eco-Innovation in EU. A diverse palette of greens***

***Abstract: 1. Introduction and motivation***

The transition towards a green economy heavily depends on the creation and diffusion of environmental innovations. These are crucial to realize the decoupling - either relative or absolute - between economic activities related to production or consumption and environmental pressures.

The introduction and diffusion of environmental innovations is affected by what has been called "double externality". On the one hand, knowledge spillovers generated by innovation activities create a positive externality, but reduce the extent to which the returns from innovation are fully appropriable by the firm. On the other hand, the reduction of the environmental burden of production and consumption is not (fully) rewarded by the market because of the absence of prices for externalities. The "double externality issue" will be likely to result in a private under-investment in environmental innovation. However, other aspects may lead to the same outcome. As environmental innovation requires skills and competencies that may be distant from the traditional industrial knowledge base, engagement in environmental innovation can be hampered by the lack of adequate knowledge and technological capabilities.

The issue of "double externality" represents the most important difference between environmental innovations and standard innovations in terms of both drivers and barriers to innovation. As concerns the drivers of environmental innovation, the literature is already quite developed, both from a conceptual and an empirical point of view (Horbach, 2008). Among other factors, this stream of literature benefited from CIS 2006-2008 which included, for the first time, questions on the adoption of environmentally-related innovations by European firms. On the other hand, we observed an empirical gap in the assessment of the barriers specific to environmental innovations, even in the presence of a limited number of more theoretical contributions (Del Rio et al, 2010).

On the contrary, literature on "standard" technological innovation has devoted more attention to innovation barriers (e.g. D'Este et al, 2012). Evidence on barriers to innovation has revealed an important aspect that should be taken into account when dealing with data on perceived obstacles to innovation activities: the counter-intuitive finding related to the positive relation between innovative performance and experienced barriers intensity.

***2. Data, methodology and main findings***

In this paper we aim at addressing the gap in the empirical literature on the barriers to environmental innovations. Our objective is to propose a taxonomy of firms based on a cluster analysis. For that purpose, we exploit a recent Flash Eurobarometer survey titled "Attitudes of European Entrepreneurs towards eco-innovations" (early 2011). The survey covers a representative sample of small and medium sized enterprises (SMEs) in all EU27

countries. Such a source of data reveals extremely useful for our analysis, as it specifically focuses on firms' eco-innovative activities. When compared to innovation surveys (e.g. CIS) largely used in studies on determinants and impacts of eco-innovation, Eurobarometer data we employ in our analysis have a main advantage: they include specific information on the investment in eco-innovative activities, its outcome in terms of eco-innovation adoption and barriers specific to eco-innovation. Our final operating sample is of 2308 firms in industrial sectors.

As for the variables that we use in our cluster analysis, we take into account two aspects that emerges from the literature on innovation barriers. First, we do not confine our analysis to financial barriers, but we consider a larger set of obstacles that refer to: cost, market and knowledge. Second, we want to account for the different nature of revealed and deterring variables. To this aim, we include a variable for the investment in eco-innovation (green R&D). In addition to cluster variables, we rely on eco-innovation adoption (product and/or process eco-innovation) as external variables to complete the profiling of the clusters. Finally, demographic analysis is aimed at scrutinizing how firms in different clusters are distributed across countries with different levels of environmental regulatory stringency and sectors with different emission and R&D intensity.

We identify six clusters of firms. First, we identify the revealed barriers cluster. Firms in this group perceive the whole spectrum of obstacles to eco-innovation as highly relevant. Nevertheless, investment in environmental R&D is relatively high. These firms perceive barriers along the innovation path, as they become aware of the difficulties related to the engagement in eco-innovative activities. In other terms, barriers for this group of firms are the result of an experiential learning process.

The second cluster that is singled out in our analysis includes SMEs that face deterring barriers. These firms are characterized by relevant obstacles related to costs, market and knowledge. Differently from the firms belonging to the previous cluster, SMEs facing deterring barriers are characterized by a low investment in environmental R&D. Hence, barriers are actual obstacles that prevent firms from engaging in eco-innovation.

Financially constrained firms constitute the third cluster of SMEs we identify. These firms report relatively high obstacles related to eco-innovation financing and costs, while relatively low barriers related to market and knowledge. Investment in environmental R&D is lower than the sample average. These firms seem to be affected by the double externality issue that characterize eco-innovation. In addition to usual problems in financing R&D, another issue emerges. Eco-innovation reduces the negative externalities associated to environmental degradation. However, no economic reward is granted to this outcome. As a result, with the eco-innovation benefits not totally internalized, firms perceive eco-innovation as characterised by higher costs and financing problems.

The fourth group of firms that emerges from our analysis is that of SMEs with a relative higher perception of market barriers, associated to an engagement in R&D which is lower than the average. Also in this case the double externality issue seems to play a crucial role. In this case, market mechanisms do not allow the full appropriation of the positive externality related to innovation, as well as that related to positive (social) environmental effects associated to the "green side" of eco-innovation.

SMEs disinterested in eco-innovation belong to the fifth group we identify. These are characterized by low levels of perceived obstacles and environmental R&D. Due to the lack of incentives, green awareness and capabilities, these firms do not seem to be interested in eco-innovative activities and they do not even try to engage in eco-innovation. In addition,

the group includes also those firms that are not interested in carrying out innovative activities, regardless their "green tone".

Finally, our cluster analysis distinguishes a group of SMEs that manage to achieve a large investment in environmental R&D without reporting serious obstacles to eco-innovation. This seems to be due to a genetically green orientation: the fact that capabilities related to eco-innovative products and processes are a fundamental component of their core business strategy.

Different clusters are also characterised by different capacities to reach environmental innovation outputs (i.e. products and processes). Finally, our clusters have little overlap with standard sector classifications, thus suggesting that policy makers should go beyond sector-specific policies aimed at promoting environmental innovations.

## References

D'Este, P., Iammarino, S., Savona, M., & von Tunzelmann, N. (2012). What hampers innovation? Revealed barriers versus deterring barriers. *Research policy*, 41(2), 482-488.

Del Río, P., Carrillo-Hermosilla, J., & Könnölä, T. (2010). Policy Strategies to Promote Eco-Innovation. *Journal of Industrial Ecology*, 14(4), 541-557.

Horbach, J. (2008). Determinants of environmental innovation—new evidence from German panel data sources. *Research policy*, 37(1), 163-173.

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***The Greener the Better? Job Creation Effects of Environmentally-Friendly Technological Change***

**Abstract:** This paper investigates the link between environment-related innovation and job creation at firm level. Although it is undeniable that the transition towards cleaner technologies will change the structure of the market as we know it, in the scientific and political debate there are contrasting views about the direction of these impacts, especially concerning their net effect on employment (see, among others, Horbach and Rennings, 2013 for a discussion). The lack of consensus on this aspect and the increasing concerns regarding the levels of unemployment in Europe - and particularly in Italy - call for a greater effort in understanding the link between the outcome policies fostering environmental related innovation and employment.

This paper tries to contribute to the debate shedding more light on the dynamic at play through a careful investigation of whether technological change towards cleaner productions, also defined as environmental-related, has led to positive changes in employment outcomes at firm level in the case of Italy. Using a novel dataset that matches firm level data with patent records, we are able to distinguish between green and generic innovation and to assess the causal effect of environmental related technological change on employment growth after controlling for firms' attitude towards generic innovation. This is to the best of our knowledge one of the few recent contributions trying to address more carefully this relevant issue in the context of a comprehensive and deeply investigated topic such as the link between technological change and employment outcomes.

The investigation of the impact of green technological change on employment growth using firm level data implies a number of methodological challenges ranging from measurement issues, to model specification and endogeneity concerns. Each of them will be specifically addressed in this paper to support the reliability of our findings.

Adopting a novel database matching Italian firm level information with records coming from the European Patent Office, we exploited the possibility to attribute to each firm all inventions patented during the period 2001-2008. Patents allow to account for the technological knowledge gathered by each firm over time. In this context the number of patented inventions during the period under analysis represents the recent stock of technological knowledge that each firm managed to accumulate. Furthermore and particularly relevant for this analysis, the sub-sample of environmentally related patented inventions may be extrapolated from the full sample of patents, allowing testing for the existence of an additional effect on job creation coming from green technologies.

Our sample consists in 4,507 Italian manufacturing firms. We selected these firms from a panel of 49,590 manufacturing firms in the AIDA (Bureau van Dijk) database based on the

criterion that they should have applied for at least one patent at the European Patent Office between 1977 and 2008.

The key interest of this paper relies to the possibility to investigate whether an additional effect in terms of job creation may be attributed to green technological change. This implies accounting for this dimension while controlling for both firm level characteristics, which may increase the likelihood of innovation, as well as firms' capability to develop other kinds of innovative activities that cannot be classified as environmentally friendly.

The estimation equation takes the following form:

$$\begin{aligned} [\Delta \text{Empl}]_{(T-t)^i} &= \beta_0 + \beta_1 [[\text{Tech\_change}]_{(t,T)^i} + \beta_2 \\ &[\text{Green\_tech\_change}]_{(t,T)^i} + \beta X]_{t^i} + \varepsilon_{t^i} \quad (1) \end{aligned}$$

where Employment is the dependent variable measuring the variation in employment in each firm  $i$  between time  $t$  and  $T$ , Tech\_Change is the number of patents per firm  $i$  over the period  $t-T$ , Green\_tech\_change is the number of green patents per firm over the same time period,  $X$  is a vector of firm level controls at the beginning of the period and  $\varepsilon$  is a well behaving error term. The vector  $X$  includes information on age, number of years since the first patent to proxy for technological path dependence, size measured in terms of initial turnover and profitability (ROI).

In order to address the endogeneity concern for our measures of technological change, for both environmental and non-environmental technologies we adopt a novel identification approach taking advantage from the strategy popularized by Haskel et al. (2007), who instrument the geographical concentration of economic activities in US with that in UK and FDI inflows in UK with those in US respectively. Exploiting data on EPO patent applications count (both total and environmental) for the period 1996-2004 filed by companies in Western Europe in the same sector (4 digits NACE rev. 2), for the same size class and the same age class, we instrument our proxies of technological change with comparable measures for a similar sample of European firms. The instrument relies on the idea that international technological trends (among technologically coherent countries) affect, for homogenous categories of firms (in terms of size, sector of activity and age), the probability to engage in technological innovation and its intensity independently on shifts in firms' specific incentives.

Results (Table 1) show that the emergence of eco-innovation stimulating the transition towards cleaner forms of production has contributed substantially to employment growth over the period 2001-2008. This evidence is robust to a number of checks and to the potential endogeneity of the regressor of interest. It emerges that eco-innovation boosted employment growth in Italian firms over and above their attitude towards generic innovation. This implies that investments in technological innovation in environmental related fields have had per se a beneficial impact that is independent on firms' capability to develop any other forms of innovation outcome.

## References

- Haskel, J. E., Pereira, S. C. and Slaughter, M. J. (2007), Does inward foreign direct investment boost the productivity of domestic firms?, *Review of Economics and Statistics*, 89 (3), 482-96.
- Horbach, J. and Rennings K. (2013), Environmental innovation and employment dynamics in

different technology fields - an analysis based on the German Community Innovation Survey 2009. Forthcoming in Journal of Cleaner Production



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***Impact of the financial crisis on research and innovation policies***

**Abstract:** The 2008 global financial crisis and the economic and public sovereign debt crisis in its aftermath have shaken not only the evolution path of research and innovation activities but also of policies in Europe. The crisis had a severe impact on the real economy resulting in tighter credit conditions, cutback in demand and trade, and in a decrease in access to finance. Venture capital started to dry out due to more risk-averse behaviour and this had an impact on innovation activities. It triggered a shift in many business strategies from long-term competitiveness to short-term survival. It has also affected public policy and it caused difficulties in maintaining research and innovation financing in several countries in times of increasingly tightening public budgets. Moreover, as a consequence some of the structural problems in the economy have become more apparent and urgent to address such as the need to further shifting to higher value added activities, rebalancing the economy between manufacturing and services, better exploiting the transformative power of services or changing the current situation of slow uptake of research results.

Five years since the start of the financial and economic turmoil in Europe finding the optimal response to the crisis is still pertinent, but this longer time period now gives an opportunity to reflect on the impact of the crisis on research and innovation activities and policies. There is nevertheless limited literature analysing the impact of the crisis on research and innovation policies and even less is available about the impact on business research and innovation activities most probably because of the relatively short time passed, lack of data and the complexity of separating general trends from the shifts as a direct result of the crisis.

Papers about the effect of the economic crisis on firm-level innovation performance showed for instance that the EU Member States have converged in their innovative potential over the 2004-2008 period, but the economic crisis has affected innovation investment in almost all EU countries (Archibugi and Filippetti, 2011). Kanerva and Hollanders (2009) analysing Innobarometer data for Europe found that companies were reporting to reduce innovation expenditures following the financial and economic crisis. The Innobarometer 2009 survey data indicates that 23% of innovating firms in the EU27 had decreased their innovation expenditures between October 2008 and March 2009. Corporate reports in 2008 showed a decline or slower growth in R&D spending (OECD, 2009).

Archibugi et al. (2012) analysed the innovation activities of a balanced panel of around 2.500 UK enterprises in the period 2002-2008 based on the CIS with the objective to explore who were the innovators during and before the economic crisis. They found that in the UK, on average, firm innovation expenditure decreased as reported in 2008 compared to 2006. On the other hand, they argue the crisis has also concentrated innovation efforts meaning that fewer firms were responsible for an increased share of innovation expenditure and supported the argument that those better equipped already in the past persist. Mazzanti (2011) explored the behaviour of Italian firms and noted the existence of strong relationships between past innovative activities and the capacity to react to the challenges brought by the crisis through innovative actions. A sustained innovative activity was found to contribute in a crucial way to the survival and to the competitive capacity of the firm in

the crisis period.

Despite of the difficult economic situation, the crisis also gave impetus for many firms to look for new niches, new business models and new opportunities, hence increasing innovation efforts. Some more recent analysis provides, a more positive picture about business innovation activities. For instance the McKinsey global survey in 2010 showed that 84% of the executives said that innovation is extremely or very important to their companies' growth strategy, although it also revealed that the barriers to innovation have barely changed. The crisis also offered opportunities for firms to seize new leadership and new growth potential. The survey of the Association of German Chambers of Industry and Commerce conducted on 1100 innovative companies in 2009 noted that on average German enterprises kept on investing in innovation activities; 30% of the surveyed firms reported even an increase and 5 % reported a decrease. It was also found that some of the large enterprises expect a reduction in their overall R&D budgets and the unfavourable credit financing conditions have a negative impact on innovation dynamics.

The impact of the crisis on research and innovation policies have been analysed by the OECD and through the Erawatch and INNO Policy TrendChart initiatives of the European Commission. As the Annual TrendChart report (2011) and the OECD report (2011) found the most relevant challenge in the aftermath of the crisis have been to preserve the stability of funding for research and innovation policies. Both the OECD and the European Commission argued that innovation is a key instrument to boost productivity and sustainable growth and warned the crisis should not damage long-term growth, but accelerate structural shifts instead. As a response to the crisis all Member States implemented economic stimulus packages, which nevertheless varied in size and their structure. Although the most important objective was to restore a functioning financial system and to stimulate aggregate demand in the short term, it was also understood that these packages can "contribute to a sustainable recovery only if the measures taken also strengthen the foundations of long-term sustainable growth" (Hutschenreiter, 2010).

In this paper we test the following hypothesis: The impact of the crisis on research and innovation activities has put pressure on public research budgets while business R&D and innovation budgets have proven to be resilient. This analysis explores both the qualitative and quantitative dimensions of the effects across 28 EU MS countries. The descriptive analysis is based on the latest available indicators of research and innovation policy and business and on the inventory of research and innovation policy measures of Erawatch INNO Policy TrendChart, before and in the aftermath of the crisis comparing how the crisis influenced policy and business behaviour. Further analysis coupled with qualitative information addresses the national research and innovation policy approaches and changes in the policy mix in the period 2009-2013.

## References

- Mazzanti, M., et al., 2011. Economic Crisis, Innovation Strategies and Firm Performance. Evidence from Italian Firm-level Data No 201102, Working Papers
- Archibugi, D., et al., 2012. Economic crisis and innovation: Is destruction prevailing over accumulation? Research Policy <http://dx.doi.org/10.1016/j.respol.2012.07.002>
- Filippetti, A. and D. Archibugi, 2011. Innovation in times of crisis: National Systems of Innovation, structure, and demand, Research Policy, Vol. 40, pp. 179-192.
- Archibugi, D., and Filippetti, A., 2011. Is the Economic Crisis Impairing Convergence in Innovation Performance across Europe? Journal of Common Market Studies 49 (6), 1153-

1182

Hutschenreiter, 2010. A forward - looking response to the crisis: fostering an innovation - led, sustainable recovery, OECD, Paris.

Kanerva, M., Hollanders, H., 2009. The Impact of the Economic Crisis on Innovation. INNO Metrics Thematic Paper. European Commission, DG Enterprise, Brussels.

OECD, 2009. Policy Responses to the Economic Crisis: Investing in Innovation for Long-Term Growth, OECD, Paris.

OECD, 2011. OECD Science, Technology and Industry Scoreboard 2011: Innovation and Growth in Knowledge Economies OECD, Paris.

TrendChart report, 2011. Funding innovation in the EU and beyond. Available at: [http://ec.europa.eu/innovation-funding-trends-2011\\_en.pdf](http://ec.europa.eu/innovation-funding-trends-2011_en.pdf)

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***Disentangling the economic, technological and innovation specialization of Western countries: a comprehensive empirical test of Varieties of Capitalism theory***

**Abstract:**

Ever since the work of Ricardo (1821), the determinants of national comparative advantages have been a major subject of debate in economics. Gradually, traditional explanations of comparative advantage involving the production factors labour and capital (Heckscher, 1919; Ohlin, 1933; Vanek, 1968), have given way to accounts of institutions as determinants of comparative advantage (Freeman & Perez, 1988; Lundvall, 1992; Porter, 1990). From a strategic management perspective, Porter (1990) showed that national institutions like the education and financial system of countries can facilitate firms in performing low-cost or high-quality strategies. Also some studies in the National Innovation Systems (NIS) literature have tried to link national (scientific) institutions to arguments about comparative advantage in certain types of innovations or sectors (Dalum, 1992; Faber & Hesén, 2004; Herrmann & Peine, 2011). Over the past decade, the Varieties of Capitalism literature has developed a comprehensive perspective that explains the comparative advantage of countries in specific types of innovation by their institutional structure (Hall & Soskice, 2001). This perspective on the comparative advantage of nations has become both highly influential and disputed (Akkermans, Castaldi, & Los, 2009; Herrmann, 2009; Taylor, 2004).

The Varieties of Capitalism (VoC) theory concentrates on the Western world and distinguishes two types of countries with different institutional structures: Liberal Market Economies (LMEs), such as the United States, and Coordinated Market Economies (CMEs), like Germany. In LMEs economic activities are structured by market-based institutions, whereas in CMEs coordinating institutions channel the interactions of economic actors. Public policies in LMEs, for example, ensure flexible labour markets, while CME policies focus more on worker's rights, resulting into rigid labor-market institutions. Due to these institutional characteristics, so the further VoC argument, CME countries have a comparative advantage in incremental innovation, and, consequently, in so-called incrementally innovative sectors like automotive and machinery. LME countries, on the other hand, have an advantage in radical innovation and associated high-tech sectors, such as biotechnology and IT.

Various empirical studies have tested the claims of the VoC literature, but the results obtained are often contradictory (Akkermans et al., 2009; Herrmann, 2009; Schneider & Paunescu, 2012; Taylor, 2004). While some studies find support for the VoC theory of comparative advantage (Schneider & Paunescu, 2012), others completely reject it (Taylor, 2004). We argue and demonstrate that these contradicting outcomes result from the different operationalizations of comparative advantage used in these studies, which also profoundly blur the discussion about the empirical validity of VoC theory (Akkermans, 2009; Schneider & Paunescu, 2012). There are two main problems related to the operationalization of comparative advantage in existing VoC studies.

First, some studies test VoC as a theory of specialization in sectors and others as a theory of specialization in types of innovation. However, these two specializations are different concepts (Leiponen & Drejer, 2007). In the initial work on VoC theory Hall & Soskice (2001) equate high-tech sectors with radical innovation and medium-high-tech sectors (e.g. automotive, chemicals) with

incremental innovation. Yet as is widely known from the fields of innovation and strategic management studies, in every sector both radical and incremental innovations are produced (Leiponen & Drejer, 2007). So, the operationalization of comparative advantage as either specialization in sectors or specialization in type of innovation is the first factor that renders the results of previous VoC studies hard to compare.

Second, of the studies test VoC as a theory of specialization in sectors some test it as a theory of economic specialization (often measured in terms of exports) (M. Allen et al., 2006; Schneider & Paunescu, 2012) or as a theory of technological specialization (often measured through patents) (Taylor, 2004). However, although these forms of specialization are related concepts, they are not substitutes or different dimensions of the same concept (Laursen, 2000). If a country excels in a particular sector technologically, it does not necessarily show a high export specialization in that sector, and vice versa (Laursen, 2000). This discrepancy further complicates the comparison of results from previous VoC work.

So, while VoC might be a promising theory of the comparative advantage of nations, its empirical validity is still unclear because of the varying operationalizations of comparative advantage used in the literature. By simultaneously testing the empirical validity of VoC theory for economic and technological specialization in sectors, as well as for specialization in a type of innovation (from now on innovation specialization) we provide a much more comprehensive insight into the predictive value of VoC theory. This also enables us to better discuss the effectiveness of public policies in LMEs and CMEs. The following central research question is posed:

To what extent are the different institutional structures as identified by VoC theory related to the economic, technological and innovation specializations of Western countries?

This research also contributes to the literature by using a more refined statistical method than previous VoC studies that often only compared the entire group of CMEs and LMEs (Akkermans et al., 2009; Schneider & Paunescu, 2012). Instead, in this study panel data models are used that include control variables for effects of both individual countries and sectors. We also distinguish between a group of CMEs with relatively stable institutions and CMEs that have liberalized their economy more extensively in recent years (Schneider & Paunescu, 2012). The analyses are performed using structural equation methods (Bollen, 1989). The economic specialization of countries is measured by export data, the technological specialization by patent data, and the innovation specialization by patent citation data (OECD, 2012a; OECD, 2012b; OECD, 2013). With the patent citation data we classify patents as either radical or incremental based on the number of citations the patent received (Akkermans et al., 2009).

The results of our study provide only limited support for VoC as a theory of economic specialization. Stronger evidence is found for VoC as a theory of technological specialization. LME countries file relatively more patents in high-tech sectors like pharmaceuticals, whereas CME countries are more specialized in medium-high-tech sectors like automotive. No support is found for VoC as a theory of innovation specialization, LMEs do not focus more on radical innovation than CMEs. Furthermore, the liberalization processes undertaken in some CME countries do not seem to influence their specialization. These results have important implications for both theory and policy.

Theoretically, we contribute to the VoC literature by showing that its arguments about specialization patterns require more concise conceptualizations. More concretely, we illustrate that three different concepts of specialization need to be distinguished, namely economic, technological and innovation

specialization. While the VoC arguments, indeed, explain technological specialization, they are insufficient for explaining economic specialization patterns of countries. This finding is also consistent with the notion of institutional arbitrage (see Hall and Soskice (2001 p.57)), according to which multi-national corporations locate their R&D facilities in countries with an institutional background that fits best with the sector in which they are active.

The finding that there is no difference in the innovation specialization of LMEs and CMEs is of interest for innovation scholars, who show increasing interest in the origin of radical innovations (Tellis et al. 2009). Our results here are in line with the idea of a “window of locational opportunity” that is used by economic geographers to explain the emergence of industries (Boschma, 1999). According to Boschma (1999) the radical innovations underlying new industries arise from triggers like factor scarcity, technological bottlenecks or demands. Yet it is “rather uncertain and unpredictable” in which location the triggers lead to radical innovations. After this first variety in the location of radical innovations, a process of selection occurs, in which institutional forces become more important and determine whether the radical innovation also leads to the emergence of an industry. This topic should be further explored in future research.

With regard to policy, our findings point to links between the public policies of countries and technological specialization patterns. The rigid labour markets of CMEs thus seem instrumental for a high technological performance in sectors like automotive, and the flexible labour markets are helpful for high-tech inventions in LME countries (cf. Harcourt and Wood, 2007). Given the finding that technological and economic specializations are not to be treated as equivalent concepts, policy-makers should, however, be aware that policy programs aimed at increasing the technological capabilities of countries do not necessarily lead to economic success. And vice-versa: they should keep in mind that policy programs supporting firms with their market growth do not implicitly trigger an increase of the technological capabilities of those firms. Finally, our finding that the liberalization in certain CME countries did not affect their specialization patterns, questions the effectiveness of these policies and points to the sluggishness of changes in specialization patterns.

#### References:

Akkermans, D., Castaldi, C., & Los, B. (2009). Do ‘liberal market economies’ really innovate more radically than ‘coordinated market economies’?: Hall and soskice reconsidered. *Research Policy*, 38(1), 181-191.

Bollen, K. A. (1989). *Structural equations with latent variables*. New York: Wiley.

Boschma, R. A., & Van der Knaap, G. A. (1999). New High-Tech Industries and Windows of Locational Opportunity: The Role Of Labour Markets and Knowledge Institutions During the Industrial Era. *Geografiska Annaler: Series B, Human Geography*, 81(2), 73-89

Dalum, B. (1992). Export specialization, structural competitiveness and national systems of innovation. In B. A. Lundvall (Ed.), *National systems of innovation - Towards a theory of innovation and interactive learning* (1992). London: Pinter Publishers.

Faber, J., & Hesen, A. B. (2004). Innovation capabilities of European nations: Cross-national analyses of patents and sales of product innovations. *Research Policy*, 33(2), 193-207.

Freeman, C., & Perez, C. (1988). Structural crises of adjustment, business cycles and investment behaviour. In G. Dosi., C. Freeman, R. R. Nelson, G. Silverberg & L. Soete (Eds.), *Technical change and economic theory* (). London: Pinter.

Hall, P. A., & Soskice, D. (2001). *Varieties of capitalism: The institutional foundations of comparative advantage* Wiley Online Library.

Harcourt, M., & Wood, G. (2007). The importance of employment protection for skill development in coordinated market economies. *European journal of industrial relations*, 13(2), 141-159.

Heckscher, E. F. (1919). The effect of foreign trade on the distribution of income. In H. Flam, & J. M. Flanders (Eds.), *Reprinted in: Heckscher-Olin trade theory* (). Cambridge, MA: The MIT press.

Herrmann, A. M. (2009). *One political economy, one competitive strategy?: Comparing pharmaceutical firms in germany, italy, and the UK* Oxford University Press, USA.

Laursen, K. (2000). Do export and technological specialisation patterns co-evolve in terms of convergence or divergence? Evidence from 19 OECD countries, 1971–1991. *Journal of Evolutionary Economics*, 10(4), 415-436.

Leiponen, A., & Drejer, I. (2007). What exactly are technological regimes?: Intra-industry heterogeneity in the organization of innovation activities. *Research Policy*, 36(8), 1221-1238.

Lundvall, B. A. (1992). User-producer relationships, national systems of innovation and internationalisation. *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, , 45-67.

OECD. (2012a). *Bilateral trade in goods by industry and end-use category*. Retrieved March, 11, 2012, from [www.oecd.org/sti/btd](http://www.oecd.org/sti/btd)

OECD. (2012b). *Patents by technology*. Retrieved March, 11, 2013, from [http://stats.oecd.org/Index.aspx?DatasetCode=PATS\\_IPC](http://stats.oecd.org/Index.aspx?DatasetCode=PATS_IPC)

OECD. (2013). *OECD citations database, version january 2013*. Paris: OECD Directorate for Science, Technology and Industry.

Ohlin, B. (1933). *Interregional and international trade*. Cambridge, MA: Harvard University Press.

Porter, M. E. (1990). *The competitive advantage of nations*. London: MacMillan Press.

Ricardo, D. (1821) *Principles of Political Economy and Taxation*, John Murray, London.

Schneider, M. R., & Paunescu, M. (2012). Changing varieties of capitalism and revealed comparative advantages from 1990 to 2005: A test of the hall and soskice claims. *Socio-Economic Review*, 10(4),

731-753.

Tellis, G. J., Prabhu, J. C., & Chandy, R. K. (2009). Radical innovation across nations: the preeminence of corporate culture. *Journal of Marketing*, 73(1), 3-23

Taylor, M. Z. (2004). Empirical evidence against varieties of capitalism's theory of technological innovation. *International Organization*, 58(3), 601-631.

Vanek, J. (1968). The factor proportions theory: the N-factor case. *Kyklos*, 21, 749-756.



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***Academic engagement and impacts in social sciences and humanities: perceptions of PhD graduates***

**Abstract:** Introduction

Increasing attention is being paid to the role of universities in the application of knowledge through commercialisation and engagement (eg Etzkowitz 1998, Siegel et al. 2007). There is a diverse range of academic engagement activities, not only commercialisation such as the award of patents and university spin-offs, but also many other activities, including collaboration with non-academics in research projects, consultancy and advising policymakers. Most academic literature on the topic has concerned commercialisation, although it has been argued that commercialisation is a relatively small part of the engagement of academics with other sectors of society. Furthermore, academic engagement in social sciences and humanities (SSH) is only recently starting to receive attention, Olmos-Peñuela et al. (2014) finding that knowledge transfer activities in which SSH research groups engage most frequently are consultancy and contract research, with commercialisation being less important.

Bastow et al identify a range of types of impact of social scientists through engagement with business, government, the third sector and the public through the media (Bastow et al. 2014). Even where types of engagement can be identified, it is very difficult to assess the impacts of these activities. Lam (2010) notes that aspects underlying the deeper cultural-cognitive aspects of new shifting academic-industry boundaries have been neglected. According to Ankrah et al. (2013), qualitative approaches to understanding engagement of universities and industry with knowledge transfer compliment the over-use of quantitative methods. Bastow et al. attempt to improve understanding of the nature of impacts in the social sciences in the UK using a range of methods.

This qualitative paper seeks to improve understanding of the impact of SSH based on a study of SSH PhD graduates throughout Europe. It examines the extent to which impacts are direct and can be demonstrated and the factors that affect this. It is based on a study of PhD graduates in 12 countries in Europe, as well as Turkey. The project is based on reviews of literature, policy and data in relation to PhD careers, a survey of PhD graduates in SSH and follow-up in-depth interviews with a minimum of 25 respondents in each country who graduated from 2000-2010. The paper is based mainly on the in-depth interviews.

**Conceptual framework**

It has been argued that the breadth of university-industry links has been growing in recent years, accompanied by a proliferation of research on engagement and commercialisation. In their literature review, Perkmann et al. (2013) distinguish between commercialisation, which involves the patenting and licensing of inventions and academic entrepreneurship, and engagement, which encompasses a broader range of knowledge exchange activities.

Several authors find that engagement is far more common than commercialisation (eg D'Este and Patel 2007, Perkmann et al. 2013). However, despite this, academic research has focused mainly on commercialisation. Moreover, science and technology disciplines have received most attention. It is argued that types of engagement are different in SSH to science and technology, and that the primary types of knowledge generated in SSH relate to developing conceptual frames and legitimization, but rarely result in patents and spin-offs, of the kinds frequently used to assess the impact of academics on society (Olmos-Peñuela et al. 2014).

According to Shibayama (2012), there have been two phases since the beginning of modern science. The first era was governed by the open science norm (Merton 1973). Based on this view of science, the goal of scientists is to be the first to advance and communicate new knowledge, the rewards being the intrinsic satisfaction of solving puzzles in science and the recognition in the form of publications, citations and prizes (Lam 2011). From the beginning of the 20th century, sciences started to be used more for practical purposes. In recent years, attempts are starting to be made to demonstrate the impacts of academic research, in particular in the UK.

Bastow et al. (2014), in a study of the impacts of social sciences, develop the concept of the dynamic knowledge inventory (DKI). They argue that, at the base of any advanced industrial society is a large dynamic knowledge inventory, of which only a proportion is drawn down and used at any point in time. They characterise this dynamic knowledge inventory as an iceberg with a flat top with a large body of knowledge not currently in use in the centre, supporting a smaller body of knowledge currently in use. Knowledge in use rests on and is dependent on knowledge not currently in use. Important is also the dynamic nature of knowledge of both types, knowledge constantly flowing between the centre and sides of the iceberg.

This highlights the difficulty in measuring impact, because academic knowledge will add to this stock or inventory of knowledge, but may add both to the stock of knowledge in use and the stock of knowledge not currently in use, which may be of a more conceptual or theoretical nature. If research adds to the stock of knowledge not currently in use, this knowledge may become useful or may be applied in different contexts but when it will be applied is not necessarily predictable.

As noted by Beyer (1997), there is a distinction between more immediate impacts of scientific research, where knowledge is used directly to solve problems, and more indirect impacts that promote enlightenment and thinking. Bastow et al. identify four key elements of the dynamic knowledge inventory that apply to social sciences (1) The direct influence of specific researchers on an individual societal organisation (2) The diffuse effect of academic research distributed across a whole range of organisations (3) The influence of an academic profession on a whole 'community of practice' (4) The mediated influence of academic work operating within the community of practice. This paper will identify factors that affect the extent to which impacts are direct and indirect and can be demonstrated. It finds that it is very hard to identify impacts, since many influences are indirect rather than one-to-one, they are sometimes filtered, and they take place at different spatial scales and timescales.

## Methodology

The paper is based on European (FP7) funded project entitled, 'Mapping the Population, Careers, Mobilities and Impacts of Advanced Research Degree Graduates in the Social Sciences and Humanities', which included 13 countries. These were France, Germany, Hungary, Italy, Latvia, Norway, Poland, Portugal, Slovakia, Spain, Switzerland, Turkey and the UK (POCARIM). The project involved several phases, which included (1) a literature review (2) a policy review (3) a data review (4) a survey of around 2,700 PhD graduates in social sciences and humanities and (5) follow-up interviews with a total of 325 PhD graduates.

The survey was based on sampling for diversity, since it was not considered feasible to survey a representative sample. A sample was selected from (1) each broadly defined discipline (2) balance of males and females (3) people employed in academia, the private sector, government and the third sector (4) people from different HE institutions based on rankings (5) varied geographical locations within countries. The survey included questions about career history, current role, international collaborations and international mobility, inter-disciplinarity and impacts. Follow-up interviews were completed with a selection (at least 25) from each country, the aim being to ask more detail on these issues, and to explore attitudes in greater depth.

This paper is based mainly on the interviews and uses qualitative methods, seeking to understand in some depth attitudes towards the extent of impact of academic engagement by exploring the views of the respondents. It takes a broad view of engagement, considering a range of potential impacts on a range of stakeholders, and going beyond purely university-industry links. The paper is concerned with the mediating factors that affect whether an impact is direct or indirect. The next Section first presents a table of the 'impact activities' from the survey and then considers the extent of impact of these based on the qualitative interviews.

## Findings

The following gives the percentage that were involved in each of these 'impact' activities:

### Impact activity %

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Published textbooks, monographs, articles, books 90.3

Taught students 89.1

Taken part in knowledge transfer activities 67.4

Managed/coordinated projects 66.9

Supervised graduate or PhD students 65.9

Participated in policy-relevant conferences or events 62.1

Given interviews in media (radio, TV, newspapers) 52.8

Advised policy-actors on the local, regional, national or international level 37.1

Participated in societal or political committees 34.7

Been a board member/volunteer/advisor in an NGO 28.2

Developed innovative products 22.9

Been a board member in a company 11.3

The above represents a range of engagement activities that could potentially impact at various levels. Some of these types of engagement are more likely to have direct impacts, whereas the impacts of others are more likely to be diffused. The following discussion considers the extent of impact of some of these activities, considering (1) to what extent can impact be demonstrated (2) at what time scale impacts take place (3) the level at which impacts take place.

The what extent to which impact can be demonstrated

An argument frequently made, was that it is very hard to demonstrate impact. Some researchers pointed out that they had discovered that their work is having an impact in some shape or form more or less by chance. For example a researcher discovered the impact of his teaching on a student, 'Lots of [the students] were just there because they had to be there ... And no one was really listening to what I was saying ... but one day a student came to me at the end of the class and told me, "I graduated yesterday and your class really marked me, and I am going to change my plan and now I am working at the NGO thanks to you."' [CH12] This demonstrates the unpredictability of impacts and the difficulties in capturing it.

It was argued by many of the interviewees that academics may have inputs into the knowledge production or policy-making process but cannot necessarily know the outcome of this. In some cases they do not know what impact their input has had, and even if there has been an impact, it may not emerge immediately, or it could be indirect, for example the following: 'I was giving lectures and advice to government ... I have been writing reports to the government ... hopefully we have had some kind of impact, I don't always find [out].' [NO10]. These indirect or impacts over time are more difficult to assess than immediate impacts, but it does not necessarily mean the impact will be less.

Other interviewees spoke of more direct impacts. In the following case, there appeared to be a direct impact on a large number of people: 'I have published something about the acceptability of soil modification measures that has changed the policy of the region ... which had 17 million people.' [DE02]. But more often, direct impacts are likely to affect smaller numbers of people in one organisation, such as the following two examples: 'So during the workshops we teach librarians how to prepare a development strategy for their library ...' [PL23]. 'Then the impact with companies, when I work with companies I hope I do have an impact and I help the managers I am working with think differently about their business.' [FR06]. Even in these cases, it is difficult to evaluate impacts.

The spatial context of impact

The spatial context also influences the extent to which impacts are direct or indirect. A few researchers interviewed had completed research, written reports or distributed research findings to international organisations including the UN, the World Bank, the ILO, the British Council, the EU and other organisations. Although a number of researchers were working at this level, the impact of their work was in most cases unclear.

Many researchers were advising national governments. Several researchers mentioned that they felt they have an important influence on their own governments. It was also quite common for researchers to say they had an influence on regional or local policy. Here, a number of researchers were confident as to the extent of their impact at this level and in some cases could demonstrate cases of influence. One researcher, for example, speaks of having a significant influence on policymakers in the Azores, but only a small influence nationally, 'In the Azores, the impact of my work in opinionmaking of those with political responsibilities is quite significant. In national terms it may be existent but small.' [PT01]. Others also speak of local influences, such as a Swiss researcher who has advised the regional government on establishing a procedure to grant recognition to religious movements and an Italian researcher who speaks of a colleague who is very active at the local level, producing publications for local government.

#### The time scale of impacts

The results of various types of engagement activities can take many years to emerge. Many researchers spoke of the long time frames in research. It was pointed out by many interviewees that it takes years to produce results and to publish academic papers. The following two examples demonstrate that agenda setting impacts can take a long time to emerge: 'My PhD I think was important because it was really questioning the place of growth in the development project and ... if we do not integrate the environment ... we are going against the wall of ecological nightmare ... and if it takes 20 years, and I really only think it can be done by informing and education.' [CH12]. 'Because the political process is so long, so you say, you can say from white paper or NOU to something happens out there it can take many years ... I think the awareness of different problems and different ethnic groups for example is now more conscious among politicians and civil servants. But from there changed measures is a big step.' [NO17]. Impacts can be achieved at many levels, including by educating students, by influencing other academics through publications, advising policymakers and engaging with the media. It can be seen that to establish these agendas and have impacts at any of these levels takes time. Whereas the above felt that impacts were likely to take time, some topics were very high on the agenda and had an impact for this reason. For example, the following Swiss interviewee, 'I chose a topic which is quite high on the agenda currently, relatively high, of course, which is the reform of doctoral education ... I mean it is on the political agenda of the Rector's Conference of Switzerland.' [CH06]. Agendas change frequently and it cannot necessarily be known which agenda will be fashionable at the time of undertaking research.

#### Discussion and conclusions

Bastow et al. speak of four levels of direct and indirect impacts of SSH on society. This research also confirmed the distinction between direct and indirect influences. Direct one to one influences may emerge from activities such as consultancy, knowledge exchange or policy advice, where academics directly advise or share results with individual organisations. More indirect influences can impact at a number of levels, such as through teaching, publications and conferences papers, where the impact is one on many. Other impacts, as discussed by Bastow et al. stem from the influence of a range of academics on a community

of practice in academia or in other sectors but also more broadly on society. It is difficult to assess the level of impact, even when influences are direct or on one organisation.

The spatial scale has an influence on the extent to which the impact is direct or indirect. Generally, the more local the engagement, the more direct and easy to discern the impact. The extent to which the impact was immediate and direct was also influenced by the timing of the impact, which is very difficult to predict. Topics of current interest are more likely have a more direct influence, but the impact may be less wide-ranging. Broader, agenda setting topics may need more time and mediation to have an impact.

This abstract has given a brief overview of the main concepts, adding to the empirical base and incorporating the elements of time and place of impact. The full paper will involve further developing the conceptual framework and data analysis.

## References

- Ankrah, S.N., Burgess, T.F., Grimshaw, P. and Shaw, N. (2013) 'Asking both university and industry actors about their engagement in knowledge transfer: what single group studies of motives omit.', *Technovation* 13: 50-65.
- Bastow, S., Dunleavy, P. and Tinkler, J. (2014) 'The impact of the social sciences', Sage, Los Angeles, London, New Delhi, Singapore, Washington DC.
- Beyer, J.M. (1997) 'Research utilization bridging a cultural gap between communities.' *Journal of Management Inquiry* 6: 17-22.
- D'Este, P. and Patel, P. (2007) 'University-industry linkages in the UK: What are the factors underlying the variety of interactions with industry?', *Research Policy* 36
- Etzkowitz, H. (1998) 'The norms of entrepreneurial science: cognitive effects of the new university-industry linkages.', *Research Policy* 27: 823-833.
- Lam, A. (2010) 'From 'ivory tower traditionalists' to 'entrepreneurial scientists': academic scientists in fuzzy university-industry boundaries', *Social Studies of Science* 40 (2): 307-340.
- Lam, A. (2011) 'What motivates academic scientists to engage in research commercialization: 'gold' 'ribbon' or 'puzzle'?', *Research Policy*, 40: 1354-1368.
- Olmos-Peñuela, J., Castro-Martinez, E. and D'Este, P. (2014) 'Knowledge transfer activities in social sciences and humanities: explaining the interactions of research groups with non-academic agents', *Research Policy* 43: 696-706.
- Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A., Krabel, S., Kitson, M., Llerena, P., Lissoni, F., Salter, A. and Sobrero, M. (2013) 'Academic engagement and commercialisation: a review of the literature on university-industry relations', *Research Policy* 42: 423- 442.
- Siegel, D.S., Wright, M., and Lockett, A. (2007) 'The rise of entrepreneurial activity at universities: organizational and societal implications'. *Industrial and Corporate Change* 16 (4): 489-504.
- Shibayama, S. (2012) 'Conflict between entrepreneurship and open science, and the transition of scientific norms.', *Journal of Technology Transfer* 37: 508-531.



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***Internationalization and innovation in born global knowledge intensive services firms***

**Abstract:** The aim of this paper is to explore whether some key characteristics displayed by born global firms in the manufacturing sector are also exhibited by born global firms in the services sector. These features are related to entry mode, firm size, technology- and knowledge-intensity and qualification of staff. We focus on knowledge intensive services (KIS) and we will compare born global and not born global KIS firms.

The Uppsala model, the most widely recognized theories of international business, shows that the internationalization process of small firms has followed a gradual process (Johanson and Vahlne, 1980, 1977). This argues that firms start to internationalize by arm's length transactions in "physically" close markets. Managers are expected to increase foreign market commitment and market knowledge over time, which is expected to lead to further commitments in even more physically distant markets. Internationalization stages commence with sales to the home market and irregular exports, and is followed by regular export via agents and subsequently by the establishment of sales subsidiaries (Hashai and Almor, 2004).

Many recent studies argue explicitly that the "born global" phenomenon contradicts the Uppsala gradual process of internationalization (Bell, 1995, Coviello and Munro, 1995, Gankema, Snuit and Van Dijken, 1997, Jones, 1999, 2001, Knight and Cavusgil, 1994, 1996, MacDougall et al, 1994, Oviatt and McDougall, 1994, 1997). Since the beginning of the 1990 rapid internationalization has been observed in born global companies. As result, a huge number of papers have studied this phenomenon for manufacturing companies (Oviatt and MacDougall, 1994, 1999, Rialp et al, 2005, Sharma and Blomstermo, 2003, Hashai and Amor, 2004, Karlinic and Forza, Knight and Cavusgil, 2005). Oviatt and McDougall (1994) define an international new venture as a business organisation that from inception, seeks to derive significant competitive advantage from the use of resources and the sale of outputs in multiple countries. In a similar vein Knight and Cavulgi (1996) conceptualise born-global firms as "small technology-oriented companies that operate in international markets from the earliest days of their establishment". According to Knight and Cavulgi (2005) the born global firms are smaller, younger firms, and tend to lack the substantial resources of traditional multinational corporations and management, as more entrepreneurial firms may be more inclined than others to create and activate strategies and tactical maneuvers with a view to maintain or improve international performance. Likewise, several studies note the born globals are small and medium enterprises (Hashai and Almor, 2004, MacDougall et al, 1994; Oviatt and McDougall, 1995; Moen and Servais). An important part of the current literature in this field deals directly with new, technology-intensive companies (Bell, 1995, Coviello and Munro, 1995, MacDougall and Oviatt, 1996; Roberts and Senturi, 1996, Jones, 1999, Burgel and Murray, 2000; Autio and Sapienza, 2000, Autio et al, 2000; Sharma and Blomstermo, 2003; Zahra et al, 2000 and 2003). Indeed, Sharma and Blomstermo (2003,

745) consider that the competitive advantage of born global is embedded in their knowledge intensity.

Hashai and Almor (2004, p. 466) note that born global firms appear to have a number of unique features: they are relatively young and entrepreneurial in terms of ownership and management structure, they aim to cater to international markets from inception (McKinsey and Co, 1993) and their revenues are generated mostly in foreign markets rather than in their home market (Korot and Tosviga, 1999). Moreover, they are frequently characterized as knowledge-intensive organizations that sell mainly innovative, self-developed technology-based products (Almor, 2000; Bell, 1995, Bloodgood, Sapienza and Ameida, 1996, Oviatt and McDougall, 1994).

Most empirical studies conducted on the internationalization of born global firms focus on manufacturing companies. Less is known about the characteristics of born global firms in services sectors both from a theoretical and empirical point of view and especially in knowledge intensive services. We aim to fill that gap by exploring whether the characteristics of manufacturing born global firms apply to KIS born global, and, in particular, to explore the relation between born global firms and innovation.

A separate literature has explored the internationalization of services firms. As service firms assumed a greater role in international business in the 1990s, researchers began to ask how service firms enter into foreign markets and whether they differed from manufacturing firms. While some scholars suggest that the factors influencing the choice of entry modes by manufacturing firms are generalizable to services firms (see Agarwal and Ramaswami 1992, Terpstra and Yu 1988, Weinstein 1977), others suggest that they are not. For example, Erramilli (1990) argues that the inseparability of production and consumption in services is responsible for distinguishing entry modes for services and manufacturing firms, with “hard” services able to be exported, but “soft” services limited to contractual entry, licensing or franchising, and foreign direct investment. The development of ICT, however, is argued to have challenged the traditional inseparability of production and consumption in services, and has increased the entry and internationalization options available for services firms. Ball et al. (2008) propose a conceptual model that disaggregates certain value adding functions in the offshore provision of services, reducing the need for (resource intensive) foreign investment as market entry. In a similar vein, Toivonen et al. (2009) indicate that service firms (including KIBS) may also internationalize very rapidly, following a born global path, with ICT-enabled exports favoring this path.

We draw on an original survey of 256 knowledge intensive services firms in Southern Spain which have international operations, conducted in the months of April-July 2011. We have developed a number of hypotheses based on the literature of manufacturing born global firms:

Hypothesis 1: Exports are the most important entry mode of born global knowledge intensive services firms (compared to other entry modes)

Hypothesis 2: Born global knowledge intensive services firms are more technology-intensive compared to not born global knowledge intensive services firm.

Hypothesis 3: Born global knowledge intensive services firms are more knowledge intensive compared to not born global knowledge intensive services firms.

Hypothesis 4: Staff in born global knowledge intensive services firms have more



qualifications compared to not born global knowledge intensive services firms

Hypothesis 5: Born global knowledge intensive services firms raise more capital externally to finance R+D compared not born global knowledge intensive services firms

Hypothesis 6: Born global knowledge intensive services firms provide higher quality services compared not born global knowledge intensive services firms.

The majority of the data in our database is categorical and we propose in the first instance to use simple chi-squared test to see determine whether any difference in occurrences between born global and not born global is due to chance. We then propose a simple probit regression model where the dependent variable 'born global' is a binary outcome variable is regressed on entry mode, technology intensity, knowledge intensity, external finance and service quality using firm size and sector as controls .

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***Explaining the transition towards personalized health innovation systems. The case of personalized cancer treatment in the Netherlands***

**Abstract:** Problem analysis and main research objectives

Sociotechnical transitions are necessary to sustain economic welfare and societal well-being, at the same time tackling the grand societal challenges. These transitions embrace complex change processes including technical, organizational, economic, institutional, socio-cultural and political dimensions. The healthcare system is an area that faces these transition processes. Stakeholders in healthcare, ranging from policymakers, regulators to health insurers and the pharmaceutical industry need to deal with the increasing availability of advanced treatment options (e.g. personalized medicine), the increasing articulation of health needs by empowered patients and communities, and a growing demand of healthcare products and services due to ageing populations.

Much is expected from the emergence of personalized medicine. Personalized health systems tailor prevention, diagnosis, medical treatments, and self-management of diseases and chronic conditions to specific characteristics of each patient. Potential benefits of personalized healthcare systems are straightforward. The quality of diagnosis, treatment efficacy, safety and monitoring to track a patient's response to treatment might significantly increase, as it is only tailored to those patient for whom the treatment is safe and efficacious. However, the uptake of personalized health systems might become complicated due to rising healthcare costs, awareness raising, privacy issues, patient surveillance, treatment compliance and user acceptance of the new technology.

The Technological Innovation System (TIS) approach is a heuristic framework to study such emerging technologies. The approach recognizes that new technologies are key to realize societal transitions and that transitions do not easily occur because new technologies are often poorly aligned with established practices (Hekkert et al. 2007). The TIS approach focuses on this novelty, by studying the development of the innovation system supporting the emerging technology (e.g. Negro et al. 2008). Basic assumption is that innovations do not develop in isolation, but that a socio-technical system, including policy and perceived legitimacy, enables the development, diffusion and use of new technologies (Edquist 1997). An innovation system consists of actors that contribute to the innovation process in various ways, e.g. through knowledge development, supply of financial resources, standardization, and use of innovation. These actors are constrained and enabled in their actions by the structure of the innovation system that consists of network characteristics, technological artifacts and institutional settings (Bergek 2008; Hekkert & Negro 2009). The TIS approach zooms in on the key processes that take place in the health innovation system and that enable the actors to innovate.

We selected the transition towards personalized cancer therapeutics in the Netherlands as an empirical field. For a long time anti-cancer drugs were based on a 'one-size-fits-all' approach (Duffy & Crown 2008), leading to a rather low response rate and harmful side effects. Over the last years the underlying mechanisms of cancer are further unraveled. This has led to more efficient and personalized treatment approaches.

Personalized cancer medicine is often a combination of two products: a therapy targeting a specific genetic mutation and an accompanying diagnostic test determining whether the patient has the specific, associated biomarker (Regenold 2009). Personalized cancer treatments have high promises of improving cancer survivability, but until now progress towards personalized cancer treatments is slower than expected and uneven between European countries. Regulation, reimbursement, obsolete business models, and the current state of scientific knowledge are regarded as barriers (Bates 2010; Gonzalez 2010; Mittra & Tait 2012; Weldon et al 2012). This leads to the main research question of this paper: What are the hampering and promoting factors influencing the transition towards personalized cancer treatments systems in the Netherlands from 2000-2012?

Although technological innovation systems are defined by technological and not by country boundaries, in TIS studies it is quite common to confine the research to one region (e.g. Negro et al 2008). The Netherlands is selected because it has an above-average medical research and healthcare performance and infrastructure. Moreover, it has a biotechnology SME presence of which there is a proportion focused on diagnostics (Gaisser et al. 2008). Using the TIS approach, it is possible to systematically analyze the key processes essential for personalized health innovations over time and to identify mechanisms that hamper or stimulate the innovation process. An analysis over time is made of two personalized cancer treatment systems that entered the Dutch market: One of the first personalized medicines, Herceptin (trastuzumab) for breast cancer in 2000 and Tarceva (erlotinib) for lung cancer in 2005 (Schellen 2013), which makes it interesting to study whether the emerging personalized health innovation system for Herceptin improved the scene for Tarceva.

Prior work applied the TIS approach to transitions in the field of sustainable development and focused mainly on empirical studies in the field of energy and transport (e.g. Negro 2007; Suurs, 2009; Van Alphen 2011). Transitions in healthcare are expected to be different because the healthcare sector is highly institutionalized due to regulations and reimbursement procedures, which directly affect market formation by limiting the choice of the consumer/patient (Grit & Dolfisma 2002). In personalized medicine two sectors are involved. First, the pharmaceutical sector is science-oriented, characterized by profound and persistent uncertainty, and has a high degree of complexity and heterogeneity of knowledge (Pisano 2006). This leads to extensive product development timelines (average 13.2 years from discovery to regulatory approval) (Rang 2006) and a R&D process characterized by high attrition rates. In turn, this results into increasing development costs (DiMasi et al. 2010). Second, the diagnostics industry plays an important role, especially in oncology (Naylor & Cole 2010). Drugs and diagnostics traditionally develop in different systems: drugs are subjected to strict (approval) regulation while diagnostics regulation only requires CE marketing resulting in different investment plans and timelines (Demers et al 2004). The challenges for the pharmaceutical industry will be to find new business models,

based on 'niche-busters', integration of pharmaceutical and diagnostic industry, and smart co-evolving regulation (Mittra & Tait 2012). The implementation of personalized medicine also requires changes in the health care arena. Pricing and reimbursement policies, market access, infrastructure of testing, and user practices need to be (re-)aligned. All these unique aspects make healthcare transitions an interesting topic to study.

### Methodology

To gain detailed insights in the change towards personalized cancer therapeutics systems, we employed an explorative case study methodology. The two cases, i.e. the development and diffusion of personalized treatments of Herceptin and Tarceva in the Netherlands, are exemplary and provide insights valuable for transition studies in personalized healthcare in general.

A qualitative event history analysis was conducted to gain insight into the dynamics of the innovation process of personalized cancer treatments. This analysis focused on the seven key processes of the TIS, i.e. entrepreneurial activity, knowledge development, knowledge diffusion, guidance of the search, market formation, resource mobilization and creation of legitimacy. Subsequently, events were identified and related to the key processes. Event history data were collected retrospectively using scientific literature, reports and websites. The data were triangulated using 11 semi-structured interviews with experts from research institutes, patient organizations, the medicine evaluation board, and pharmaceutical, diagnostics, venture capital and health insurance companies.

### Results

The results show that most of the promoting and hampering factors of the emerging Herceptin and Tarceva personalized treatment systems in the Netherlands are overlapping. Generally, the Netherlands has a strong research background and knowledge development in genetics. Knowledge diffusion is taking place by already existing networks such as conferences and personal contacts. Furthermore, high expectations, a 'hype', exists for the personalized cancer treatment of both Herceptin and Tarceva, with the risk that if the promises are not realized that resources for personalized cancer treatment developments will be diminish. Main difference between the systems was the reimbursement principle, which led to unequal healthcare access for Herceptin as there was at that time no reimbursement system for expensive drugs as Herceptin yet. So strong lobbying activities took place for faster access to Herceptin treatment, which increased awareness and pressure on policy makers to establish reimbursement. The main difference in market formation between Herceptin and Tarceva was that Herceptin was reimbursed intramurally (hospitals only receiving 75% reimbursement) and Tarceva extramurally. As Tarceva was 100% reimbursed by the Exceptional medical Expenses Act (AWBZ), it put no additional pressure on hospital budgets. Furthermore, the current reimbursement of companion diagnostic tests is often not enough to compensate for the costs. Companion diagnostics are not reimbursed in consideration with their treatment.

After 5 years of market introduction around 50% of the eligible patients received a treatment with Herceptin in 2005 (BVN 2007) and the same holds for Tarceva in 2011 (Uyl-de Groot 2011). This implies that the personalized cancer treatment system has not improved significantly over the time period 2000-2012 and that some hampering factors such as a lack of standardization of the research infrastructure of personalized medicine still

exist.

This study showed that the TIS approach can be valuable tool in analyzing the dynamics of emerging innovation systems in the personal health innovation field. Further research should verify whether the observed patterns in the development of the innovation system of personalized cancer treatments can be generalized to the field of life sciences and health.

## References

Bates, S. (2010). Progress towards personalized medicine. *Drugs Discovery Today* 15 (3/4), 115-120.

Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. *Research Policy*, 37(3), 407–429.

BVN (2007). Beschikbaarheid van trastuzumab voor borstkankerpatienten met HER2-positieve tumoren (in Dutch), Report Borstkanker Vereniging Nederland.

DiMasi, J. A., Feldman, L., Seckler, A., & Wilson, A. (2010). Trends in risks associated with new drug development: success rates for investigational drugs. *Clinical Pharmacology & Therapeutics*, 87(3), 272-277.

Duffy, J. & J. Crown (2008). A personalized approach to cancer treatment: How biomarkers can help. *Clinical Chemistry*, 54(11), 1770-1779.

Edquist, C. (1997). *Systems of Innovation: Technologies, Institutions and Organisations*. London, Pinter.

Gaisser, S., M. Dreiling, J. Hartig, M.M. Hopkins, J. Ryan, D. Ibarreta (2008). Building effective institutional frameworks to support European pharmacogenetic research: an international empirical analysis. *Int. J. of Biotechnology* 10(6), 1-31.

Geels, F. (2002). Technological transitions as evolutionary reconfiguration processes: a multilevel perspective and a case-study. *Research Policy*, 31(8-9), 1257–1274.

Gonzalez-Angulo, A., Hennessy, B., Mills, G. (2010). Future of personalized medicine in oncology: A systems biology approach. *Journal of Clinical Oncology* 28. 2777-2783.

Grit, K., Dolfsma W. (2002). The dynamics of the Dutch Health Care System – A discourse analysis. *Review of Social Economy* 60 (3), 377-401.

Hekkert, M. P., Suurs, R. A. A., Negro, S. O., Kuhlmann, S., & Smits, R. E. H. M. (2007). Functions of innovation systems: A new approach for analysing technological change. *Technological Forecasting and Social Change*, 74(4), 413–432.

Hekkert, M. P., & Negro, S. O. (2009). Functions of innovation systems as a framework to understand sustainable technological change: Empirical evidence for earlier claims. *Technological Forecasting and Social Change*, 76(4), 584–594.

Markard, J., & Truffer, B. (2008). Technological innovation systems and the multi-level perspective: Towards an integrated framework. *Research Policy*, 37(4), 596–615.

Mittra, J., Tait J. (2012). Analysing stratified medicine business models and value systems: Innovation-regulation interactions. *New Biotechnology* 29 (6), 709-719.

Naylor, S., Cole T. (2010). Overview of companion diagnostics in the pharmaceutical industry. *Drug Discovery World*, Spring 200, 67-79.

Negro, S.O. (2007). Dynamics of Technological Innovation Systems: The case of biomass energy. Utrecht University, Faculty of Geosciences, PhD thesis.

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

Pisano, G.P. (2006). Science business: the promise, the reality and future of biotech. Harvard Business School Press.

Rang, H.P. (2006). Drug discovery and development: Technology in transition. Churchill Livingstone, Elsevier.

Regenold, G. (2011). Companion diagnostics – current regulatory status in Europe. *European Biotechnology News*.  
<http://www.eurobiotechnews.eu/news/messages-archive/archive/article/companion-diagnostics-current-regulatory-status-in-europe.html>.

Schellen, Frank (2013). Dynamics of the Innovation System of Personalized Cancer Treatments. A case study of Herceptin and Tarceva. SIM-Master thesis, Utrecht University, July 2013.

Suurs, R.A.A. (2009). Motors of sustainable innovation. Utrecht University, Faculty of Geosciences, PhD Thesis.

Uil-de Groot, C. (2011). Dure diagnostiek en kankergeneesmiddelen: de andere kant van ongelijkheid. Oratie. Erasmus Universiteit Rotterdam.

Van Alphen, K. (2011). Accelerating the development and deployment of carbon capture and storage technologies: an innovation system perspective. Utrecht University, PhD thesis.

Weldon, C., Trosman, J. Gradishar, W. Benson, A., Schink. J (2012). Barriers to the use of personalized medicine in breast cancer. *Journal of Oncology Practice* 8, 24-31.

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***Factors affecting start-up performance: The case of Spinner in Emilia-Romagna***

**Abstract:**

The creation of new high tech firms is considered an important vehicle of economic growth. Literature on the topic identified various factors that affect their creation, survival and performance. These factors are related to the features of the individual or team that undertake the entrepreneurial activity, on the characteristics of the environment in which the entrepreneurial phenomenon takes place, on the characteristics of the business and of the technology to be exploited, and on the presence of mechanisms of support and incentives. However new born firms exhibit high rate of failure (Bartelsman et al 2005), and often poor growth performance (Shane 2008, Mason and Brown 2013). Among the main constraints to the survival and performance of new high tech firms is lack of entrepreneurial culture and experiences (Colombo and Grilli 2005, Rasmussen et al. 2011). This applies in particular to the case of university spin-offs, an important subgroups of high tech firms, where the set of resources and competences important for developing and growing a business is often lacking because of the non-profit oriented nature of universities (Rasmussen and Borch 2010, Rasmussen et al. 2011). The literature has discussed extensively the existing differences between new high technology ventures and university spin-offs. Despite their differences, new high technology ventures and university spin-offs face similar problems in establishing a market presence and in achieving sustainable returns (Mustar et al., 2006). Spin-offs also face two fundamentally different problems (Vohora et al., 2004): First, emanating from what is historically a non-commercial environment, spin-offs encounter specific obstacles and challenges since the university environment typically lacks human capital with the commercial skills that are necessary to create viable ventures; Second, the venture's ability to develop commercially may be adversely impacted by conflicting objectives of key stakeholders such as the university, the academic entrepreneur, the venture's management team and suppliers of finance.

In order to respond to these challenges and promote high tech entrepreneurship, various policy tools have been implemented in industrialised countries in order to stimulate both the generation and development of high tech start-ups and academic spin-offs. These policies are of various nature, not only providing monetary incentives towards the creation of start-ups, but also providing to the team of founders coaching and mentoring support. Although some scholars criticise entrepreneurship policies, claiming that they only alter the natural market selection process, some studies argue that such policies respond to market-failures, responding to firms' demand for pecuniary and knowledge resources, and positively affecting the propensity of researchers to create spin-off and entrepreneurs to successfully develop their business (Degroof and Roberts 2004).

These policy instruments are especially relevant in the case of Italy, where several studies have stressed that policy initiatives in support of technology transfer are often inadequate (ProInno-Europe) and initiatives in support of entrepreneurship/start-up/spin-off are still rare with respect to other industrialised countries (EC, 2007; Mallone, 2008).



In the case of spin-offs, there is some evidence that university technology transfer to entrepreneurial activities is related to academic characteristics such as pay policies, but data show that this relationship is quite complex (Markman et al., 2004). Fini et al. (2009) empirically explore individual perceptions of factors affecting academics' decisions to start-up new companies and show that the most important factors are those accounting for "Environmental influences" and "Individual level related factors". However, there is little evidence about how policy intervention can increase the probability of start-ups and spin-offs' survival and performance.

In this work we investigate the effect of companies' participation in a business support scheme providing both monetary incentives and coaching instruments – on start-ups' survival and performance. The aim is to shed light on the different dynamics of start-up firms in respect to having benefited from policy incentives, and particularly from coaching support. The analysis is carried out in the context of the Emilia-Romagna region. Emilia-Romagna represents one of the richest regions in Europe in terms of GDP (Hollanders et al. 2009) and is one of most active Italian regions in terms of technology transfer activities from university to industry (Netval 2011). The regional government, under the third objective of the European Social Fund (ESF), activated in 2000 the "Spinner Programme" in order to promote employment in research and technology (Ramaciotti et al 2011). The objective of Spinner is to valorise human capital and promote research, technology transfer and innovation activities especially with the creation of new ventures. The initiative supported selected projects of business ideas via two main channels: firstly providing a direct monetary grant to the proponents of the project supporting a feasibility study of the idea of business; secondly, providing a series of specific complementary services, such as consultancy on IP protection, specialised services to redact the business plan, mentoring and technical consultancy. The total amount of the subsidy received by the team of proponents could have been allocated according to the team needs: it was the selected team who decided how much resources to allocate to the grant and how much to the services, and to select which type of services to acquire.

The empirical analysis was conducted on data for 117 firms in Emilia-Romagna. We collected data on all the firms constituted via the Spinner programme, and on all regional academic spin-offs established within this timeframe. The dataset contains data on human capital, technological endowments and performance of three groups of firms observed from the constitution of the firm up to 2012: start-up generated through Spinner (38 firms), academic spin-offs generated through Spinner (52 firms) and academic spin-offs generated without the Spinner support (37 firms). For each firm we gathered data on their performance, measured in terms of survival, size and sales, on human and technological capital.

Information regarding the performance has been collected through the Bureau van Dijk database and through the Chamber of Commerce Business Register; information about the human capital of the firms has been gathered from the managing institution of the Spinner programme, through queries to the regional TTOs and through the business register. Finally we gathered data on firms patenting activity from the Orbit portal.

We test the differences between the three groups of start-ups identified with multivariate analyses. We then test how start-up performance is correlated with the firms characteristics, and how these correlations differs across the three groups. The final aim of the paper is to shed light on the influence of policy tools, especially in the form of coaching services, in respect to the survival and performance of new high tech firms.



## References:

Bartelsman E., Scarpetta S., Schivardi F. (2005), "Comparative analysis of firm demographics and survival: evidence from micro-level sources in OECD countries", *Industrial and Corporate Change* 14, 365-391

Colombo M.G., Grilli L. (2005), "Founders' human capital and the growth of new technology-based firms: A competence-based view", *Research Policy* 34: 795–816.

Degroof J.J., Roberts E.B., (2004), "Overcoming Weak Entrepreneurial Infrastructures for Academic Spin-Off Ventures", *Journal of Technology Transfer* 29, 327–352

EC (2007), *INNO-Policy TrendChart – Policy Trends and Appraisal Report: Italy*  
Fini R., Grimaldi R., Sobrero M. (2009), "Factor fostering academics to start up new ventures: an assessment of Italian founders' incentives", *Journal of Technology Transfer* 34, 380-402

Hollanders H., Tarantola S., Loschky A. (2009), "Regional innovation scoreboard"  
Mason C., Brown R. (2013), "Creating good public policy to support high-growth firms", *Small Business Economics*, 40:211–225

Mallone M. (2008), "Incubazione... e dopo? - Sintesi presentazione al Workshop PNICube: Politiche industriali per le start up innovative: linee di tendenza e sviluppi futuri". Perugia, 30 May

Markman, G.D., Gianiodis, P.T., Phan, P.H., Balkin, D.B., 2004. Entrepreneurship from the Ivory Tower: Do Incentive Systems Matter? *Journal of Technology Transfer* 29, 353–364.

Netval (2011), "Rapporto sulla valorizzazione della ricerca in Italia", [www.netval.it](http://www.netval.it)

Ramaciotti L., Consiglio S., Massari S. (2011), "Competenze, innovazione, imprese" Il Mulino, Bologna

Rasmussen E., Borch O.J. (2010), "University capabilities in facilitating entrepreneurship: A longitudinal study of spin-off ventures at mid-range universities", *Research Policy* 39, 602–612

Rasmussen E., Mosey S., Wright M. (2011), "The Evolution of Entrepreneurial Competencies: A Longitudinal Study of University Spin-Off Venture Emergence", *Journal of Management Studies* 48

Shane, S. (2008). *The illusions of entrepreneurship*, Yale University Press.

Vohora, A., Wright, M., Lockett, A. (2004). "Critical junctures in the development of university high tech spin-out companies", *Research Policy*, 33, 147–175.

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***Exploring the boundaries of RRI in the international arena of European innovation initiatives***

**Abstract: Extended summary.**

The authors suggest to think at the implementation of RRI in European Initiatives as a reduced scale social innovation process focusing on how to make societally responsible the development of breakthrough technologies (digital, nano, material, bio, bio-nano, etc. as well as big data research and technology platforms). This scale is reduced since the process shall engage only the community of EU funded research and related societal stakeholders and policy makers. The innovation process can take the form of a stakeholder dialogue focusing on RRI, and adopt a “spiral process” model for stakeholders dialogue.

Relevance to the themes of the session. The proposed study suggests a methodology to support the implementation of RRI within the international arena of innovation activities by targeting at find and fill the gaps for cross-disciplinary cooperation among technology and social sciences, forecast the potential impact of new means and areas of cooperation. Bjoern Budde and Kornelia Konrad. Governing Fuel Cell Innovation in a Dynamic Network of Expectations

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***Benchmarking STI policy in developing countries: the system approach. Public R&D labs and industrial incentives for R&D***

**1. Introduction**

Innovation policies – as any other type of policy and indeed as any institution – are more or less efficient, more or less effective. Thus it makes sense to search for the most efficient and effective practices in terms of innovation policy. The most advanced private firms and government organizations search for the best practices in order to improve their own ones. Thus innovation policy, like other types of policy, can be benchmarked. Evolutionary and institutional economics have sometimes been criticised for not offering a clear set of policy recommendations (Krugman, 1999). I have argued that benchmarking is the solution to the apparent lack of policy recommendations in evolutionary and institutional economics. Benchmarking is compatible with evolutionary and institutional economics. It allows these twin currents to formulate policy advice: It does not postulate “one-size-fits-all” approaches to innovation policy. It does not imply that there is an optimum policy or set of policies. It assumes bounded rational agents searching for better solutions in complex adaptive economic systems. Evolutionary and institutional economics have been criticized for not having a clear public policy corollary. This paper illustrates the fact that benchmarking is implicitly at the core of the policy implications and recommendations of evolutionary and institutional economics. Benchmarking is “a tool to improve organisation’s performance and competitiveness in business life” (Kyrö, 2003). It has also been defined as “the search of superior performances with the goal of improving the practices of other organisations” (Niosi, 2002). Country innovation policies are sometimes benchmarked, as well as are routines in individual organizations.

**2. Benchmarking STI policies**

Among OECD countries some level of benchmarking exists in the area of STI policies. Among developing countries, benchmarking is often limited to immediate neighbour countries. Thus if Latin American countries do not push their benchmarking exercise too far away, it is because government officials lack knowledge of much better practices in countries of which they ignore the language, and the rationale of the policies. They often imitate the inferior practices of the neighbours.

**a. Tax credits for R&D: Argentina and Chile versus Canada**

STI policies can be organised in sort of continuum from the more market oriented to the more policy-oriented. Among the first one finds tax credits for R&D; on the opposite side are direct subsidies for R&D in small and medium-sized enterprises and sector-oriented innovation policies. Versatile policies, those that could be applied both for a pro-market economic industrial-policy free approach, and for a targeted industrial policy include human capital attraction policies, development banks, public research laboratories, and higher education policies. Let us see how they are applied in a variety of countries.

Tax credits for R&D are becoming increasingly fashionable in both industrial and emerging countries. In 1996, only twelve OECD countries provided R&D tax incentives; in 2008 they were twenty-one using such incentive. In addition, in the last two decades Brazil, China,

India and South Africa also have implemented generous fiscal incentives for innovation. If the goal of an industrial or industrialising country is to have a Business Expenditure on R&D (BERD) around 1% of GDP, if one dollar of foregone taxes stimulates one dollar of business R&D, and if tax credits are to represent a major incentive, then the fiscal cost of the stimulus should represent a fiscal cost of several billion dollars in most countries. Yet the policy mix of direct and indirect government funding for business R&D varies enormously from country to country within the OECD (see OECD, 2010). Canada and Korea, among OECD and emerging countries, are heavy users of R&D tax credits, while Spain and the United States are not. Finland, Germany, Italy and Sweden have no fiscal credits for R&D. The general trend though is an increasing use of such incentives. In 2008, Canada or South Korea spent some 0,2% of GDP on tax credits for R&D while Spain and the USA spent between 0,02% and 0,05% the median expenditure being close to 0,1% of GDP.

In 2011, Argentina invested just US\$2,9 billion in R&D. The federal government of Argentina allowed only US\$ 12 million every year to tax credits for industrial R&D, something like 0,001% of a GDP of US\$ 740 billion at PPP (or US\$ 465 billion at official exchange rates). In 2013, Canada spent C\$ 5 billion in tax credits for R&D, not taking the provincial contribution to this incentive (another C\$ 1 billion). Canada's GDP at PPP is US\$ 1,5 trillion (or \$1,485 trillion at official rates). The amounts involved thus show impressive difference in investment: Canada's GDP is three times Argentina's; yet Canada spends 400 times more funds in R&D fiscal credits (not taking into consideration provincial tax credits).

Equally impressive is the difference in the way tax credits funds are allocated. In Argentina, like in Chile, companies must submit a plan to use these funds, and some public officers decide which firms will get the funds and which ones will not. An agency within the Ministry for science, technology and productive innovation (MINCYT) runs the credit. In Argentina, the average tax credit allocates the candidate companies some \$50,000 for their application. The opportunities for corruption are obvious, because Argentinean tax credits are not automatic. In addition, companies must disclose some of their most intimate technical secrets to public servants. These procedures, as well as the small amounts of the credit discourage many companies to compete for the fund.

In Canada, the first country to establish this incentive in 1977, any company can request the tax credits for R&D every year. The credit is managed by Canada Revenue Agency. Small firms can request up to 35% credit out of taxable company income. Large firms may request up to 20% of their R&D expenditures. There are no ceilings either to the amounts requested or to the number of companies requesting the credit. Companies request the credit when they make their annual tax declaration, and up to 18 months after they made the expense. Firms must only disclose to government officials their figures about taxable benefits and R&D expenditures, not their R&D strategy or specific projects like in Argentina or Chile. Such a system has been able to attract large foreign laboratories to Canada, including 5 of the 10 largest spenders. In 2011, for instance, IBM Canada, P&W Canada, Ericsson, Alcatel Lucent and AMD spent well over 200 million in R&D in Canada. (Table 1 here) It may thus be the case that Argentina and Chile (with similar figures as Argentina) spend too little in this industrial incentive; thus both countries should multiply by a factor of 50 to 100 (increasing to US\$ 0.5 to US\$1.2 billion) their tax credits in order to reach the OECD median expenditure. Argentinean and Chilean tax credits for R&D inefficiency comes from several sources. First, the amounts of the tax rebates are too low, and the cost for the firms of requesting the grant are sometimes higher than the grant itself; also, the tax credit granting system is prone to suffer from bad decisions made by government officials: the tax credit is

not automatic, but requires a selection process. As a consequence, these Latin American countries are unable to attract foreign R&D laboratories and learn through them. The gap between private sector R&D in the BRICS and other emerging countries is growing very fast, with tax subsidies becoming an increasing part of the explanation (Warda, 2007).

b. Benchmarking public research organizations (PROs):

Public research technology organisations (PROs) are important components of the national system of innovation, and particularly so in developing countries, where industrial firms lack their own internal innovation capabilities. In the mid 19th century, Germany was the first country in the world to create national research laboratories in different disciplines, mainly agriculture and industry, to supplement the weak capabilities of its private sector. These institutions were complemented with the Von Humboldt research university system, replacing the teaching only “Bologna docent” system of Latin Europe (France, Italy, Portugal and Spain). The PRO institutional model was imitated in Anglo-Saxon countries, and only later in Latin Europe, with an important difference: the main mission of Latin Europe’s universities remained teaching, not research. And the PRO remained mostly devoted to science. In the 20th century, after WWII, Latin American countries copied the academic and public laboratory system developed in Latin Europe: large public and free of charge universities whose mission was teaching (Bologna docent) and PROs in the CNRS/CSIC model of France, Italy, and Spain. These European institutes were pale of copies of the German and Anglo-Saxon laboratories: they were (and are) smaller, with much smaller budgets and producing less technical novelty. In addition, they were more aimed at scientific research, instead of industrial knowledge. (Tables 2 and 3 here)

In Anglo-Saxon countries, governments had established advisory councils for scientific and technical research during WWI, as first movements towards national laboratories. Thus, in Australia and Canada these councils were created, followed a few years later by scientific and industrial public laboratories aimed at assisting agriculture, mining and manufacturing. Today, government strategies widely diverge in terms of their intramural R&D activities. In 2009, public R&D laboratories represent over 20% of gross expenditure on R&D (GERD) in Greece, Mexico, New Zealand, Slovenia, Slovak Republic, South Africa and Poland, but less than 10% in countries like Austria, Belgium, Denmark, Finland, Ireland, Israel, Japan, Switzerland, the United Kingdom, and the United States (OECD, 2011). The European Union is somewhere in between with almost 14%. Canada’s government performs 10% of GERD in its own research laboratories. Yet, the amounts spent, and the distribution among a few or many public laboratories, tell only part of the story. As important, if not more, are the internal routines of the organizations. How many technologies do they produce? How many articles? How many spin-offs do they launch? And what are the costs of these PROs with their technologies and spin-offs? Our benchmark industrial laboratory (best practice) is the Industrial Technology Research Institute (ITRI) of Taiwan. Founded in 1973, ITRI has close to 6000 employees in early 2014, and has been granted over 5500 US patents since 1976. ITRI has spun off some of the more remarkable industrial corporations in Taiwan, including United Microelectronics Corporation (UMC, 1976), Taiwan Semiconductor Corporation (TSMC, 1987), the largest OEM IC foundry, Taiwan Mask Corporation (1989), Mirle Automation Corporation (1989), Phalanx Biotech (2002), and DelSolar Co. (2004) among many others. Thus ITRI has been a major factor in the development of the semiconductor, the automated machinery, the biotechnology and the solar cell industries in Taiwan (Breznitz, 2008; Chang & Hsu, 1998; Chu et al, 2006; Hung & Chu 2006; Lin et al, 2009). ITRI’s key mission is to foster Taiwan’s technological development. For that purpose, ITRI conducts

applied research and transfers its results to Taiwan's private sector, originally through the acquisition of foreign technology, its mastering through R&D and its cession to Taiwanese firms, later through R&D consortia and spin-offs (Intarakumnerd, 2011). ITRI's large budget (US\$658 million in 2011) comes more or less equally from government and from private sector research contracts and technology services. In contrast, Argentina's INTI, established in 1957 has long been underfunded and understaffed. Its annual budget is around 90 million USD. Its revenues come from three different sources: government appropriations, a percentage of import taxes and the sale of services to industrial firms. Its agricultural counterpart, INTA, founded in 1956, presents similar organizational structure, personnel and budgetary constraints. Both produce some scientific articles, but almost no new-to-the world technology. INTI runs 30 R&D centres in the country, in technological areas such as Aerospace, Chemicals, Electronics, Energy, Environment, Food, Garments, Industrial Biotechnology, Industrial Design, Plastics, Rubber, and Textiles. INTI provides as well such services as training, metrology and quality certification. Yet the institute has just one US patent, has spun off no new firms and remains an organization whose main mission is industrial extension. Similarly INTA runs several dozen agricultural stations conducting agricultural extension, but has one US patent.

**Conclusion and policy implications** The two cases of innovation policy just analysed reveal a circular, feedback process in Latin American innovation policy: weak industry does not require industrial R&D laboratories; and existing agricultural and industrial extension organizations do not stimulate agricultural or industrial innovation. Weak innovation policies do not stimulate industrial innovation and development; in return, weak industry does not demand more sophisticated innovation policies. In spite of larger internal or regional markets, abundant natural resources, medium to high human development indexes, even the most advanced of Latin American countries are unable to break free of the vicious circle of agricultural and industrial retardation and underdevelopment. But Taiwan, with a smaller population and market, has taken off from a much more backward economic, social and scientific departure point, and is now joining the ranks of developed countries. ITRI illustrates the policy opportunity that can break the vicious circle: creating advanced public laboratories that nurture industrial development. In both cases, increasing budgets without a complete revision of the policies, the routines involved and the government procedures is key. It would be counterproductive to increase research institutes budgets without getting sure that the advanced research personnel is hired, R&D project management is incorporated into the institutes, and the links between industry and the PROs are established. Similarly, maintaining the present procedures to allocate tax credits for R&D in the way they are allocated in Argentina or Chile would lead to another policy failure.

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***The emergence of the modern science policy in Colombia: policy transfer and learning from international models***

**Abstract:** At the end of the sixties most Latin-American countries established similar governmental agencies for coordinating scientific and technological activities. These agencies were called National Science and Technology Councils (NSTC). Its appearance is commonly attributed to a “plain transfer process” of policy models available in the international arena. In contrast to this position, my study takes NSTCs in Colombia as a starting point to demonstrate the complexities of “policy transfer” at the levels of both conceptualization and implementation and to suggest the significance of this recognition.

The literature on policy diffusion associates the establishment of NSTCs with policy convergence or isomorphism. Some literature about the institutionalization of science and technology in Latin America also states that NSTCs adhered to long-standing, tested models diffused by international organizations like the OECD and UNESCO. However my work shows that different trajectories were followed by the various national NSTCs after their creation. Moreover, although the NSTCs became the most visible expression of one international policy model, so-called science policy, this study demonstrates that the OECD constructed this normative model based on input collected from the most industrialized countries. Thus, rather than a well-defined, structured program, “science policy” is a set of best practices theorized from the experiences of different countries that was disseminated as a single model through various international organizations.

Colombia was one of the Latin-American countries that first implemented the NSTC structure in 1968. Although it did not have a robust institutional tradition of promoting research, its policy-makers played active roles in implementing the guidelines provided by the “science policy” model. The openness to international expert advice, the training of its political elites abroad and the high level of funding received from international cooperation agencies also contributed to implementation. Nevertheless, there is no clear evidence that Colombia demanded this policy. The weakness of its scientific community, the low governmental investment in the promotion of science and technology, and the poor national visibility of science and technology suggest that the country adopted the NSTC through a process of learning through the transfer of international policy models like “science policy”. How exactly did this process occur? Was the proffered model simply copied?

To answer these questions, my study employs a middle-range theory called “policy transfer” to facilitate the assessment of empirical evidence on the institutionalization of “science policy” in Colombia between 1968-1991 in order to reconstruct and to understand how institutionalization took place. The study examines the following topics in particular: voluntary vs. coercive transfers; the relative success or failure of transfers; the role of international expert networks; the power of international organizations in defining the



parameters and boundaries of acceptable action in one specific policy field; and how Colombian policy-makers used the experience developed in other countries for solving similar national problems.

Three transfer mechanisms explain the influence of international organizations in the design of Colombian scientific and technological policy: transnational communication; international harmonization; and imposition. These mechanisms operated simultaneously between 1968 and 1991 and informed local policy-makers about policy options that accorded with the interests of the international organizations that supported them. Notably, UNESCO and the International Development Bank (IDB) emphasized building scientific infrastructure and improving the status of scientists, while the Organization of American States (OAS) and the Andean Pact pushed for control of technology imports and transfer of industrial knowledge oriented towards solving “real problems” in Latin-American countries.

This case study based on Colombia calls into question three commonly accepted theoretical aspects of policy transfer. The first one relates to the motivation of local policy-makers to engage in a policy transfer process. According to the theory, policy-makers identify dissatisfaction with a given situation based on rational analysis and assessment and then begin a voluntary transfer process with the aim of improving the situation. The Colombian case shows that policy-makers have the will to begin transfers even when they do not have a reliable diagnosis of the policy problem. Furthermore, my work suggests that limited governmental capacity to identify dissatisfaction leads to significant increases in the influence of individuals embedded in international professional networks on policy transfer decision-making.

The second aspect relates to the verification of transfer processes. In the literature on policy transfer the result of a given process is generally categorized as a “success” or “failure”. The Colombian case confirms that when the transfer consists of policy instruments and broad policy goals (e.g., the science policy model), these binary categories are inadequate. Most obviously, success or failure depends on the period of time in which the process is observed. For instance, in the short term the creation of the Colombian NSTC was a success because policy-makers acted quickly and caught the attention of national politicians. But in the long term, NTSC had limited success because it did not reach the goal of coordinating a national policy. Furthermore, it is difficult to identify transfer success or failure without a clear comparative yardstick. Since the NTSC structure was a synthesis of the best organizational practices observed in different OECD countries, a “real” successful experience did not exist.

The third characteristic relates to transfer intentionality. Generally, policy transfer theoretical models focus on the intentionality of the country that borrows a policy, while the intentionality of the country that lends the policy is largely ignored. My study suggests that “lender intentionality” also plays an important role within the transfer process. This aspect of exchange should be considered more extensively in future research.

On the other hand, my case study confirms two additional aspects of the policy transfer literature: the importance of international networks of experts in framing the local objectives of the international policy and the weakness of this theoretical approach for analyzing how policy-makers learn from the observation of other political systems. The first aspect is reflected in the Colombian case through the existence of one “epistemic



community” created around the American States Organization (OAS), which was the most significant network of experts for the Colombian policy-makers between 1970 and 1982. The second affirmation is based on the difficulty of finding analytical categories for defining the degree of learning of the Colombian policy-makers. Although it is evident that the information they received from the international organizations influenced their perceptions on the science policy value, it was not possible to associate one specific information input with one specific policy outcome.

In summary, this study finds that the theory of policy transfer can be useful in reconstructing the origin and development of a “modern” policy for the promotion of science and technology in Colombia. Its focus on the local policy-makers as agents of learning helps to explain the strong, lasting relationships between international policy models and local policy decisions. Nevertheless its excessive emphasis on the transfer process as a rational policy-making activity risks ignoring the institutional asymmetries that exist between an ideal model constructed by one international organization (OECD) and the real institutional situation of less developed countries like Colombia. This problem was faced through the incorporation of theoretical insights coming from “new institutionalism”, which provide a framework for understanding incremental institutional changes in the local setting during a transfer process. Finally, study of the actual transfer of ideal models to developing countries challenges some basic concepts of this theoretical approach and demands more research about the intentionality behind the construction of these models, in order to understand, for instance, why common understandings imply that they are accepted without resistance in many local arenas.

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***Exploring relationships between societal engaging activities and research: evidences from a Spanish Public Research Organization***

**Abstract:** Research topic, objectives and research questions

The shift towards the new social contract between science and society (Martin, 2003), in parallel with the criticism to the image that portrays some researchers in an 'ivory tower', have given an increasing relevance to establishing strong links between public research organizations and society. The traditional portfolio of researchers' activities (research projects, publications and teaching) has been expanded with other activities including societal dimensions of the research, such as knowledge transfer and exchange (KTE) (OCDE, 1996; OCDE, 1999, Mitton et al., 2007) and public engagement – popularization or dissemination activities – (Commission of European Communities, 2000; FECYT, 2003; Royal Society, 2006). In a context where researchers are asked to participate in a wider diversity of activities, little is known about how their participation in some of these activities can affect their performance on the others. Likewise, for managerial and policy purposes aimed at increasing research excellence and societal impact, it is crucial to know how this diverse activities are related and whether they could be complementary, substitutes or independent.

Previous researches have addressed the relationships between some of these scientific activities. Findings support that researchers' engagement in entrepreneurial activities coincide with an increase of academic publications (Van Looy et al., 2006), and that academic engagement is positively related to researchers' academic productivity (Gulbrandsen and Smeby, 2005; Bekkers and Bodas Freitas, 2008; D'Este and Perkmann 2011; Haeussler and Colyvas, 2011); although some studies alert that this positive relation only appears under certain conditions, when university-industry relationships are enough to provide complementary resources –cognitive, technical or financial – for research activities (Manjarrés-Henríquez et al., 2009). A study about researchers' portfolio of knowledge transfer activities find substitution effects between publications and teaching, whereas publications go 'hand-in-hand' with consultancy and informal knowledge transfer, being independent from spin off formation and granted patents (Landry et al., 2010).

Despite the importance of scientific culture within science policy strategies (Commission of European Communities, 2000), studies addressing researchers' engagement in dissemination activities and how this can be related to their engagement in other scientific activities has received less attention in the literature. An exception is the study conducted by Jensen et al. (2008) which concludes that researchers' that participate more in wider dissemination (popularization activities and industrial collaboration) perform better academically.

In this study, the portfolio of activities undertaken by researchers encompasses four scientific activities: academic research (hereafter publications), KTE and dissemination, and we differentiate between individual dissemination and institutional dissemination (Olmos-Peñuela et al., 2014). The aim of the paper is to analyse to what extent researchers from different fields are engaged in these four scientific activities and to explore what are the relationships between them and its determinants. In so doing, we address the following research questions: a) Do the patterns of engagement of researchers in diverse scientific activities differ across fields?; b) What are the relationships between these scientific activities? Are they complementary, substitute or independent?; c) What are the factors underlying the engagement in the different activities? and; d) What are the managerial and policy implications that can be derived from the study?

#### Data and methodology

The empirical analysis has been conducted on a population corresponding to 3,167 tenured researchers of the Spanish Council for Scientific Research (CSIC) belonging to the eight areas of knowledge in which the organisation is structured. Data collection took place between 7th April 2011 and 24th May 2011 and was gathered via an online questionnaire sent to the researchers. Respondents were asked about their personal and group characteristics, their previous experiences and their scientific activities including their involvement in KTE and dissemination. Additionally, information about researchers' publications has been obtained from the Thomson Reuters' ISI Web of Science. We have obtained a final sample of 1,285 permanent researchers corresponding to a net response rate of almost 41%.

We have conducted a multivariate path analysis allowing to simultaneously estimating four OLS regressions to explore the correlates of the dependent variables referring to the four researcher's activities considered in this study and to its determinants. As determinants of researchers' engagement in these activities, we have included variables related with organization assets, financial assets, career characteristics, motivations or knowledge attributes (Landry et al., 2010). Additionally, a one-way ANOVA (multiple-range test) is used to analyse whether there are differences across the research fields with regard to the involvement of the researchers in the four scientific activities considered.

#### Emerging results

The empirical results indicate the existence of complementarities between three of the four activities analyzed: individual dissemination, institutional dissemination, and KTE. This means that all the activities related with a wider societal engagement go 'hand-in-hand' since they are positively correlated. Conversely, academic research (i.e. publications) emerge as an activity which performance is independent from the other three activities, which indicates that to be engaged with society do not harm research performance (in terms of publications) neither it improve it. The way in which these activities relates points to the existence of two independent groups of activities: traditional research activities and activities involving any kind of societal engagement (KTE and dissemination). The regressions to be included in the final paper will provide insights about organizational and social mechanisms shaping the practices and scientific outputs of researchers. We can

anticipate that we find differences in the factors explaining researchers' participation for each of the different activities, being the research unit size the only variable positively related with a higher researchers' involvement in all the four types of scientific activities considered. Finally, the one-way ANOVA show differences across fields regarding researcher's engagement in each of the four activities (e.g. social sciences and humanities researchers are the highest ranked in individual dissemination and KTE whereas they are the lowest ranked in institutional dissemination and publications). This suggests the existence of different scientific and societal practices across researchers from different fields.

Our findings have implications at the managerial and policy levels, since a better understanding about the synergic effects between the researcher's portfolio of activities is necessary for the implementation of measures aimed at promoting both the research and societal engagement of researchers within their academic institutions.

## References

- Bekkers, R., Bodas Freitas, I.M., 2008. Analysing knowledge transfer channels between universities and industry: To what degree do sectors also matter? *Research Policy* 37, 1837-1853.
- Commission of European Communities, 2000. Science, society and the citizen in Europe. Commission Working Document SEC (2000) 197, Brussels, 14.11.2000.
- D'Este, P., Perkmann, M., 2011. Why do academics engage with industry? The entrepreneurial university and individual motivations. *Journal of Technology Transfer* 36, 316-339.
- FECYT, 2003. Memoria de actividades 2002, Madrid.
- Gulbrandsen, M., Smeby, J.-C., 2005. Industry funding and university professors' research performance. *Research Policy* 34, 932-950.
- Haeussler, C., Colyvas, J.A., 2011. Breaking the ivory tower: academic entrepreneurship in the life sciences in UK and Germany. *Research Policy* 40, 41-54.
- Jensen, P., Rouquier, J.B., Kreimer, P., Croissant, Y., 2008. Scientists who engage with society perform better academically. *Science and Public Policy* 35, 527-541.
- Landry, R., Saihi, M., Amara, N., Ouimet, M., 2010. Evidence on how academics manage their portfolio of knowledge transfer activities. *Research Policy* 39, 1387-1403.
- Manjarrés-Henríquez, L., Gutiérrez-Gracia, A., Carrión-García, A., Vega-Jurado, J., 2009. The effects of university-industry relationships and academic research on scientific performance: Synergy or substitution? *Research in Higher Education* 50, 795-811.
- Martin, B.R., 2003. The changing social contract for science and the evolution of the university, in: Geuna, A., Salter, A.J., Steinmueller, W.E. (Eds.), *Science and innovation: Rethinking the rationales for funding and governance*. Edward Elgar, Cheltenham. Edward Elgar Pub., Cheltenham, UK, pp. 7-29.
- Mitton, C., Adair, C.E., McKenzie, E., Patten, S.B., Perry, B.W., 2007. Knowledge transfer and exchange: review and synthesis of the literature. *Milbank Quarterly* 85, 729-768.
- OCDE, 1996. *The Knowledge-based Economy*, Ref. N° OCDE/GD(96)102, París.
- OCDE, 1999. *University research in transition*, OCDE, París.
- Olmos-Peñuela, J., Castro-Martínez, E., Fernández-Esquinas, M., 2014. Differences between scientific fields in social dissemination practices: an empirical study of the CSIC. *Revista Española de Documentación Científica*.

Royal-Society, 2006. Science Communication: Excellence in Science. Survey of Factors Affecting Science Communication by Scientists and Engineers. The Royal Society, London.

Van Looy, B., Callaert, J., Debackere, K., 2006. Publication and patent behavior of academic researchers: Conflicting, reinforcing or merely co-existing? *Research Policy* 35, 596-608.

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***Understanding researchers' openness to external parties influencing academic research***

**Abstract:** Ambiguity surrounding the effect of external engagement on academic research has raised questions about what motivates researchers to collaborate with third parties. This paper contributes to this debate by progressing beyond the idea that researchers engage with society simply because of direct benefits. We argue that what matters for society is research that can be absorbed by users. We define 'openness' as a willingness by researchers to make research more usable by external partners by responding to external influences in their own research activities. We ask what kinds of characteristics define those researchers who are most 'open' to creating usable knowledge. Our empirical study analyses a sample of 1583 researchers working at the Spanish Council for Scientific Research (CSIC). Results demonstrate that it is personal factors (primarily academic identity and past experience) that determine researchers' 'openness' (to societal involvement). The paper concludes that policies to encourage external engagement should focus on both the academic formation stage and ongoing opportunities to engage with third parties alongside providing direct incentives and benefits within individual projects and funding programmes.

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***The co-evolution of technology, infrastructure and policy: Reflections on mobile money innovation in Kenya***

**Abstract:** Sociotechnical systems in recent science and technology literature consider firms and technologies as being embedded in wider social and economic systems consisting of guiding principles, existing technologies and infrastructures, industrial structure, user relations and markets, policy and regulations, the knowledge base for the regime, and cultural, symbolic meanings underpinning practices (Geels, 2002; Rip and Kemp, 1998; Schot, 1998). These elements or ‘regimes’ interact in a manner that brings about sociotechnical change.

Among these sociotechnical regimes, dominant infrastructures and technologies form the (material) selection environment imposed on new innovations, for example, through articulated technical standards and infrastructural arrangements (Smith and Raven, 2012). Over time, technologies and infrastructures stabilise with other elements of the sociotechnical system through mechanisms of path dependence and lock in, thus creating a structural disadvantage for path-breaking innovations. For instance, infrastructure-related cognitive routines blind engineers and inventors to developments outside the bounds of current regulations and standards, competencies and sunk investments (Geels and Schot, 2007; Nelson, 1982). Therefore, the role of existing infrastructures on sociotechnical change cannot be overstated. Graham (2002) however observes that too often the materialities of infrastructure and technology remain marginal in social science, cast as purely “technical, and rather dull and banal installations which deserve scrutiny only when they fail or collapse” (Graham, 2002, p. 175).

Because of these inflexibilities, path-breaking innovations have historically been developed in ‘niches’ consisting of a few pioneering organisations, technologies and users, where factors such as long development times, uncertainty about market demand and low price/performance ratios are tolerated (Kemp et al., 1998). Additionally, niches provide locations for learning processes in a shielded environment where actors have the freedom to deviate from the rules prevailing in the sociotechnical regimes (Smith and Raven, 2012). Once niche innovations become sufficiently robust to develop markets, they branch out and attract wider interest from the mainstream, a process referred to as ‘translation’ (Smith, 2007). However, given the existing path dependencies and lock-ins of dominant technologies and infrastructures at the regime level, how do niche innovations breakthrough? What translation mechanisms facilitate the diffusion of niche innovations into the wider sociotechnical regime? Can existing market infrastructures evolve to facilitate such diffusion? What governance challenges are associated with market infrastructure evolution?

In an attempt to address these questions, we investigate the breakthrough and diffusion of M-PESA, a mobile phone-based money transfer innovation in Kenya. Originally developed to foster the financial inclusion of low income and marginalised communities, M-PESA has

gone on to disrupt and cause the reconfiguration of the banking and telecommunications industries (Hughes and Lonie, 2007; Omwansa, 2009)—two network industries whose development in technological standards and physical infrastructure tend to be inherently path dependent. Considered an alternative medium of payment and personal banking, M-PESA has been adopted pervasively not only among the unbanked segment of the population, but also in the ‘mainstream’ market, i.e. the middle- and high-income segment, with the current subscriber base standing at 73% of the adult population (FinAccess, 2013). Therefore, M-PESA is an exemplar of an innovation that not only successfully translated from the niche to the sociotechnical regime, but also triggered the evolution of existing infrastructures.

More specifically, we explore the coevolution of the technology, infrastructure and policy during the development, implementation, adoption and diffusion of M-PESA over the period between 1998-2013. We find that several interactive processes explain the development of the market infrastructure supporting mobile money transfer innovation: concerted effort by various actors and institutions—both formal and informal—to develop a product that addresses the financial exclusion of 73% of the Kenyan population (FSD Kenya, 2007); the use of existing telecommunications infrastructure to facilitate access to financial services via a simple, menu-driven, SMS-based application running on a basic SIM-based mobile phone (Hughes and Lonie, 2007); the liberal stance of policy makers from the highly-regulated banking sector that allowed the testing and launch of the product, in spite of its ambiguous character in relation to existing regulation (Mas and Ng’weno, 2010); the risks and uncertainties arising as the product diffused rapidly, and as user innovation became evident; the competition between the traditional banking business model and the new mobile phone-based banking model (Kendall et al., 2011); and the subsequent convergence of banking and telecommunication infrastructure and business models, and the resulting policy responses (Porteous, 2009). Our analysis enables us to explore the tension between the societal demand for change towards social inclusion and the inherent limitations to rapid change in large scale sociotechnical systems, particularly across the infrastructure and policy regimes. We explore the political discourse surrounding the governance of impending industry convergence, and reflect on the challenges and opportunities presented to the mobile money innovation trajectory by the policy strategies adopted.

We use multiple data sources to allow for triangulation in our study (Yin, 2009), including published journal articles, reports from Kenyan regulatory authorities, company annual reports, reports prepared by donor agencies, research institutes and consulting firms, major Kenyan newspapers, video clips, documentaries, advertisements and websites. Evolutionary theory and social constructivism provide the ontological basis of analysis, and the multilevel perspective of sociotechnical change (Geels, 2002) is adopted as the overarching framework.

#### Selected References

- Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Res. Policy* 31, 1257–1274. doi:10.1016/S0048-7333(02)00062-8
- Hughes, N., Lonie, S., 2007. M-PESA: Mobile Money for the “Unbanked” Turning Cellphones



- into 24-Hour Tellers in Kenya. *Innov. Technol. Gov. Glob.* 2, 63–81.  
doi:10.1162/itgg.2007.2.1-2.63
- Kemp, R., Schot, J., Hoogma, R., 1998. Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. *Technol. Anal. Strateg. Manag.* 10, 175–198. doi:10.1080/09537329808524310
- Kendall, J., Maurer, B., Machoka, P., Veniard, C., 2011. An Emerging Platform: From Money Transfer System to Mobile Money Ecosystem. *Innov. Technol. Gov. Glob.* 6, 49–64.  
doi:10.1162/INOV\_a\_00100
- Mas, I., Ng'weno, A., 2010. Three Keys to M-PESA's Success: Branding, Channel Management and Pricing. *J. Paym. Strategy Syst.* 4.
- Porteous, D., 2009. Mobilizing Money through Enabling Regulation. *Innov. Technol. Gov. Glob.* 4, 75–90. doi:10.1162/itgg.2009.4.1.75
- Rip, A., Kemp, R.P.M., 1998. Technological Change. In: Rayner S., Malone E.L. (editors)., in: *Human Choice and Climate Change. Vol. II, Resources and Technology.* Battelle Press, Columbus, Ohio, pp. 327–399.
- Schot, J., 1998. The usefulness of evolutionary models for explaining innovation. The case of the Netherlands in the nineteenth century. *Hist. Technol.* 14, 173–200.  
doi:10.1080/07341519808581928
- Smith, A., 2007. Translating Sustainabilities between Green Niches and Socio-Technical Regimes. *Technol. Anal. Strateg. Manag.* 19, 427–450. doi:10.1080/09537320701403334
- Yin, R.K., 2009. *Case study research: design and methods.* Sage Publications.

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***Understanding STIP in Developing Countries: Another Dance?***

**Abstract:** This paper is work-in-progress in the framework of the introductory chapter of the edited book “International Research Handbook on Science, Technology and Innovation Policy in Developing Countries: Rationales and Relevance,” Kuhlmann, S. and Ordóñez-Matamoros, H.G. (Eds), to be published (hopefully) this year by Edward Elgar. It proposes a systemic view of innovation policy in developing countries as resulting from dynamic interactions (or the lack thereof) between innovation theory, policy and practice which, seen as three diverse and changing “poles,” influence and/or respond (or not) to each other, leading to a variety of innovation, policy-practice-theory configurations. In so doing, the Innovation Policy Dance Metaphor proposed by Kuhlmann, Shapira and Smits (2010) is used, adapted and expanded, as a device to analyse the cases of Brazil, Colombia, India and South Africa. According to this approach, “ideas, rationales and instruments of innovation policy emerge as a result of interactive learning among actors involved in innovation practice (I), innovation-related public intervention strategies (P), and innovation research and theory (T), where mutually learning (by interacting), they constantly create and change IPT configurations, and where sometimes innovation practice is the driving force in a configuration, sometimes theory, sometimes public or private policy. The dancers may happen to bump into each other or may enjoy phases of pure harmony.”

Preliminary conclusions regarding the rationales and relevance of science, technology and innovation policy in developing countries are proposed based on text analyses studying innovation policy in the selected set of countries. The aforementioned metaphor is used to interpret ITP trajectories in these countries and by so doing to identify voids or systemic failures. The instrumental value of the metaphor is also assessed.

‘Dancers’ and their ‘moves’ include: a) entrepreneurs, who tend to think in terms of market success and strategic advantages or, in the case of NGOs, they have their issues to pursue (e.g. health improvement, clean environment, etc.); b) government agencies, who have overall goals like security, quality of life, sustainability, etc., under which a variety of actions are implemented; and c) researchers, who strive for understanding the world around them, and for creating original or applicable ideas. These dancers, are not homogeneous “poles”, however, as “conflicts” or tensions exist and change overtime (for example between innovations theories, between roles assigned to governments, and between strategies for learning, adopting and innovation practices).

Types of ‘learning-by dancing’ include a) first-order learning: reacting to observed changes in a conservative manner, and b) second-order learning: adopting or developing new assumptions, targets and measures. Forms of learning are: a) formal learning (FL) in “classrooms,” particularly fruitful for entrepreneurs and policymakers; b) learning by using (LU) in applying policy measures (key for entrepreneurs) and using performance and impact

evaluations (key for policymakers); c) learning by interacting (LI) in working with consultants, exchanging ideas, attending workshops, etc. (valuable for all dancers); learning by searching (LS) in desks, labs, interviews, evaluations, etc. (typical among researchers); and learning by anticipating (LA) in strategic intelligence forums and observation activities (presumably/potentially present among all).

Preliminary findings about the role of theory from the cross country analyses include: a) explicit innovation policies (discourse + action) emerged by mid-90s, led by western/northern (OECD-type of) reasoning (capitalist systems of innovation). However, in some countries such “policies” continue to be more fancy discourse-framing devices than facts; b) loans from international financial organizations (e.g. IDB, WB, etc.), play important roles into transferring ideas to actions (for good and for bad...); c) during the 2000s, innovation policy rationales continued to be mostly “imported” and discursive, but new indigenous ideas (and to a lesser extent programmes) surfaced (e.g. social innovation, innovation for inclusion, etc.); d) overall, innovation practice lags behind, mostly due to ‘rentism’/shorttermism, lack of learning opportunities and support; and d) those sectors ‘connected’ to the rest of the world, improved fast, leading to increased inequality.

Preliminary findings about the role of policy include: a) innovation “policies” are more “documents” and intentions/desires than actions/programmes/projects (\$€?); b) they are mostly ‘elitists’; and c) they are more focused on innovation than on learning. Lack of policy impact evaluations makes difficult to judge their actual role, however.

Regarding the metaphor as analytical device, it a) proved useful for better understanding theory, practice and governance issues around STI; b) helps in looking at (rival) explanations, and in making ‘visible’ logical connections that can be overlooked, mostly due to lack of information or dedicated reflection. In fact, although “logical connections” do not explain “reality”, they do help in creating plausible stories and narratives, which not only nurtures relevant debates, but that can also become latter hypotheses and objects of study in future STI policy research; c) helps finding theoretical lacunae, systemic failures, policy voids, and room for further exploration, experimentation or advocacy; and d) allows the analysis of national systems as “dynamic objects” from a historical and contextual perspective, something that the traditional National of Innovation System approach fails completely.

However, the metaphor exhibits some weaknesses as well. These are: a) it can mislead understanding if it is not applied correctly. In fact, it may lead to overemphasizing the role of theory, as the device can be used as an ex-post facto framing tool, therefore overlooking the “real” role of both political opportunistic/innovative governments, or entrepreneurs. For example, in the case of Colombia, it is possible that the new STIP configuration (resulting from the SGR scheme since 2011) has no relation with a specific theory/model/concept/idea inspiring it (this is in fact an open question today), but that it resulted from debates on corruption involving the royalty producing regions, or after claims made by left-wing movements and armed groups, or more plausible, a combination of all these factors; b) by emphasizing on the learning outcome, it does not allow capturing truly disconnected ‘events’: cases where the partners do not seem to ‘learn’ (e.g the Sisyphus tragedy referred elsewhere), which seem common in some developing countries. For example, in the case of Colombia, as Salazar claims, Colciencias’ capabilities and experience in managing R&D built

the least 50 years is today completely ignored, where in the regions the people seem to be sort of “re-inventing the wheel.” Policymakers do not seem to have learned from theory and practice; and c) as Kuhlmann et al acknowledge, “although at first sight industry, academia and the politico-administrative system appear clearly different in terms of membership, constituency, relevance criteria and reward mechanisms, taking a closer view one would face a more blurred picture.” For example, the role of key people affiliated with the OECD who belong to both types of dancers of government and theory. Or the role of government research organizations, which may be both policy and practice dancers.

This paper is relevant for the current Manchester EU-SPRI Conference as it points to contribute to better understand a) policy dynamics and policy impacts in developing countries; b) the rise of goal, challenge or mission orientation in science and technology policies in these countries; and c) questions and claims of responsible governance in science and technology policies increasingly debated in these countries.

In particular, it explicitly addresses topics such as a) policy emergence, implementation, diffusion and transfer; b) national science policies and the global scientific enterprise; and c) one size does not fit all? STI policies for less-developed and emerging economies.

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***Foreign knowledge, absorptive capacity, and cluster evolution: Evidence from the salmon cluster in Chile and the software cluster in Costa Rica***

**Abstract:**

Beyond regionally bound factors, the emergence and evolution of clusters is codetermined by the manner in which they link with international production networks and foreign sources of knowledge. Such international connections are deemed to be of special importance for clusters in developing countries, as they form the only sources for catching-up with the latest technologies in order to compete and upgrade (Herstad et al., 2010).

Models for analyzing the evolution of clusters like Porter's diamond (Porter, 1998) or the cluster life cycle framework (Menzel and Fornahl, 2010) are widely used and some of their weaknesses have already been brought forward in the literature (Martin and Sunley, 2011). Our main concern with existing models lies at their emphasis on localized learning and competence building that somehow overlooks clusters' connections with foreign knowledge. This paper aims to address this gap by better linking the literature on cluster evolution (Boschma and Fornahl, 2011) with the literature on the globalization of innovation (Archibugi and Iammarino, 2002; Chaminade and Vang, 2008; Pietrobelli and Rabellotti, 2011) in order to analyze how clusters link with foreign sources of knowledge throughout their evolution and adaptation to changing conditions.

In this analysis of local-global knowledge interfaces we distinguish between science linkages (i.e. with foreign universities or R&D institutes, in research and training) and business linkages (i.e. with foreign firms, through FDI and exports), in an attempt to explore their complementarity and their relative importance along the cluster's evolution. Furthermore, we introduce the concept of cluster absorptive capacity, to emphasize that the acquisition, assimilation, adaptation and utilization of foreign knowledge is not automatic but requires the development of local capabilities. This concept was first developed at the firm level (Cohen and Levinthal, 1990) and was later used at the national level (Criscuolo and Narula, 2008), so its application at the (intermediate) cluster level represents another potential contribution of this paper. Finally, we use this analytical framework to discuss the role of public policies in better linking clusters with foreign sources of knowledge and their potential contribution to building the cluster's absorptive capacity.

These conceptual considerations are explored by means of two cases studies in Latin American countries based on secondary data and interviews. We present and combine evidence from the Chilean farming salmon cluster and the software industry cluster in Costa Rica. The selection of these cases guarantees the existence of certain key features that can realistically constitute the basis for common policy recommendations: two clusters in developing countries with similar socioeconomic backgrounds that became targets and

promoters of intensive FDI in parallel to the adoption of science and technology strategies to reach out in search of specialized knowledge and develop absorptive capacity. Still the two clusters under study differ substantially in terms of their age, technological intensity of the residing industries, and the sequences and modes in which foreign knowledge impinged upon their development.

Our analysis tracks in both cases the science and business linkages that appear in different stages and explores the degree to which foreign knowledge was assimilated locally. Absorptive capacity, or actually the lack of it, becomes a crucial issue regardless of the “success” of the cluster in terms of size, production volume and earnings. In the Chilean case, which has been commonly treated in the literature as a success story of industrial specialization, overreliance on foreign knowledge and the lack of local knowledge for the comprehension and production of key technologies resulted in the acquisition of well established Chilean firms by foreign parties and the overall concentration of the industry. In the Costa Rican case the lack of absorptive capacity at local level prolonged dependence on foreign knowledge and delayed the assimilation of benefits stemming from the inflow of new knowledge. In both cases, global-local tensions remain controversial. In particular, the attraction of FDI has been positive for the cluster’s development in many respects but it has also produced a crowding-out effect on local firms, not only through increased competition in the product market but also in the labor market and in the access to public funding and support.

Taken together, these cases are useful to illustrate how different strategies to connect with foreign knowledge are possible and how the sequence in which such strategies are matched with the development of absorptive capacity is of critical importance. Our preliminary analysis suggests that the market driven objectives dominating business linkages seem to make knowledge exchange faster than science linkages, but the existence of the latter are more prone to improve the cluster’s absorptive capacity and its longer term sustainable competitiveness.

## References

- Archibugi, D., Iammarino, S. (2002) The globalization of technological innovation: definition and evidence, *Review of International Political Economy* 9: 98-122
- Boschma, R., Fornahl, D. (2011) Cluster Evolution and a Roadmap for Future Research, *Regional Studies* 45: 1295-1298
- Chaminade, C., Vang, J. (2008) Globalisation of Knowledge Production and Regional Innovation Policy: Supporting Specialized Hubs in Developing Countries, *Research Policy* 37: 1684-1696
- Cohen, W., Levinthal, D. (1990) Absorptive capacity: a new perspective on learning and innovation, *Administrative Science Quarterly* 35: 128-152
- Criscuolo, P., Narula, R. (2008) A novel approach to national technological accumulation and

absorptive capacity: aggregating Cohen and Levinthal, *European Journal of Development Research* 20: 56-73.

Herstad, S.J., Bloch, C., Ebersberger, B., van de Velde, E. (2010) National innovation policy and global open innovation: exploring balances, tradeoffs and complementarities, *Science and Public Policy* 37: 113-124

Martin, R., Sunley, P. (2011). Conceptualizing cluster evolution: beyond the life cycle model?, *Regional Studies* 45: 1299-1318

Menzel, M. P., Fornahl, D. (2010) Cluster life cycles: dimensions and rationales of cluster evolution, *Industrial and Corporate Change* 19: 205-238.

Pietrobelli, C., Rabellotti, R. (2011) Global value chains meet innovation systems: are there learning opportunities for developing countries?, *World Development* 39: 1261-1269.

Porter, M. E. (1990) *The competitive advantage of nations*. Boston MA: Macmillan.

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***Reconceiving Responsibility for Responsible Innovation Governance***

**Abstract:**

This paper discusses the possibility of developing a new model of responsibility that can be applied as a central concept in the theory of Responsible Research and Innovation (RRI). The paper consists of three main parts. In the first part, the existing debate around RRI is examined to assess the evolution of the responsibility concept in the RRI field. In this discussion, parameters for an appropriate conception of responsibility for RRI are identified. In the second part of the paper, it is argued that Iris Marion Young's formulation of a 'social connection' model of responsibility happens to meet many of the requirements for a conception of responsibility for RRI. In the third part of the paper, however, it is argued that Young's conception of responsibility is itself problematic for RRI in at least two ways. On the one hand, it possibly commits RRI advocates to a more demanding conception of responsibility than they had anticipated. On the other hand, Young's description of the way responsibilities are divided up in her social connection model needs further elaboration and reflection if it is to be successfully developed, particularly in the context of RRI.

This paper has been submitted for the 'Understanding and Addressing the Governance Challenges of Responsible Research and Innovation' of the EU-SPRI conference because the paper attempts to connect the reformulation of the responsibility concept to the problem of the institutional and social division of responsibilities. This is particularly relevant in relation to governance issues because governance includes a wide range of formal and informal rule- and decision-making structures: governance involves a move away from simpler top-down institutional divisions of responsibility in which responsibility can be attributed relatively clearly. Similarly, research and innovation is also a complex process with a range of different actors. The governance of research and innovation thus requires a model of responsibility that can take account of this complexity.

The first part of this paper will assess some of the main contributions to the development of a theoretical framework for RRI. This will include both explicitly theoretical work on RRI and work that develops or implies a theoretical framework for RRI as part of a larger project. Examples include (Directorate General for Research and Innovation, 2013), (Fisher & Rip, 2013) (Guston, 2006) (O'Sullivan, 2009) (Owen & Goldberg, 2010) (van den Hoven J. , 2013) (von Schomberg, 2013). It is argued in the paper that these sources reveal that there is some agreement that traditional 'liability' models of responsibility are inadequate to deal with the kinds of problems and issues RRI is supposed to address. To give a simple example: the precise consequences of adopting or developing a new technology are often highly uncertain, so it is unreasonable to attribute liability to those who contributed to the early development of the technology for its later (often unforeseen) consequences. However, if the liability model of responsibility is inappropriate in the RRI context, this may leave us with a 'responsibility gap' in which nobody is responsible for the outcomes of adopting or



developing a particular innovation.

Besides the point that the liability model of responsibility is inadequate for RRI, the paper will investigate what parameters for an alternative conception of responsibility can be identified in the existing RRI literature. For example, many of the existing discussions of RRI emphasise that RRI should be deliberative in character: clearly, an important parameter for a theory of responsibility is that it should explain why deliberation is necessary. More generally, research and innovation is generally theorized as a social activity in many of the theoretical discussions: research and innovation is a socially complex activity involving a number of different actors. However, this very complexity makes the governance of RRI more difficult: the distribution of responsibility to different actors is more difficult in socially complex situations.

In the second main section of the paper, it will be argued that Iris Marion Young's social connection model of responsibility is a useful basis for a conception of responsibility that can be applied to RRI. This conception of responsibility has been developed in Young's book *Responsibility for Justice*.

The social connection model of responsibility has five main features that make it a relevant conception for RRI:

- 1) Non-isolating: the model does not seek to attribute responsibility to individual agents
- 2) Judges background conditions: the model judges background conceptions of what is considered normal and acceptable, rather than assuming such conditions
- 3) More forward than backward looking: the social connection model focuses on ongoing problems that can be addressed in the future, rather than trying to isolate actions that have already occurred
- 4) Shared responsibility: the social connection model does not assume that the particular part an individual actor has played in generating an outcome can be identified, but instead focuses on shared responsibilities
- 5) Discharged through collective action: the responsibilities in the social connection model are discharged through collective rather than individual actions

It will be argued that these features match with the parameters for a new conception of responsibility identified in the first section. The value of Young's model is that it provides a coherent outline of a conception of responsibility that is different from the liability model, and which is explicitly developed to deal with complex social problems (Young uses sweatshops and labour standards as an example, but clearly intends her model to be applied to other cases as well). A further benefit of Young's model is that its focus on collective action rather than individual action may provide a basis for a more appropriate governance model for RRI: because it is difficult to attribute responsibility to particular individual actors in research and innovation, it also seems appropriate to distribute responsibilities more broadly. Young's collective action approach can thus provide a model for governance rules and frameworks that distribute responsibility on a more collective basis.

In the final section of the paper, a more critical perspective on Young's model will be developed. Although Young's model seems to fit very well to the requirements of RRI, it can

be argued that it imposes more rigorous ethical demands than many advocates of RRI would envisage: Young developed her model to address cases of injustice from local to global levels, yet advocates of RRI do not generally discuss their model as a tool for addressing injustice or unfairness. A second issue is that Young seems to envisage her model as mainly being applicable in situations in which political institutions are unwilling or unable to address the social problems in question. It will be argued that the first problem can be addressed by stressing that the collective action Young proposes is not necessarily restricted to cases of outright injustice or unfairness, while the second problem can be address by specifying a clearer division of institutional responsibilities than Young provides.

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***Valuing Health Technology. New Value Spaces for Personal Health Systems to Support Active Ageing***

**Abstract:** In this paper, we strive to unravel in how far current practices of Health Technology Assessment (HTA) are suitable to guide health policy decisions about personal health systems (PHS). We focus on the implicit representations of users and their position in the innovation process that underly established HTA practices, and explore in how far these representations are conducive to health technology decisions that support older people in meaningful and active lives. Our analysis builds on Callon's recent distinction between prosthetic and habilitation social policies [M. Callon, Economic Markets and the Rise of Interactive Agencements: From Prosthetic Agencies to Habilitated Agencies, in: T. Pinch, R. Swedberg (Eds.), *Living in a Material World: Economic Sociology Meets Science and Technology Studies*, The MIT Press, Cambridge, 2008, pp. 29-56]. We revisit the results of two case studies that we conducted in the fields of Point-of-Care Diagnostics, set in the domains of primary and secondary care, and care robot service platforms operating in domestic environments. By contrasting these cases we demonstrate how a different logic of addressing values in innovation feeds into either prosthetic or habilitation policy decisions about health technology. Based on this analysis, we argue that HTA practices in the context of PHS need to incorporate a logic of valuing health technology in order to fully deliver the potential of PHS to the lives of older persons.

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***New methods in STI policy analysis***

**Abstract:** The policy literature is rife with efforts attempting to explain how policy is developed and, more importantly, to define Simon's (1947) 'ends-means' relationships as it contributes to successful outputs and outcomes. The science technology and innovation policy space is of particular interest because the conventional literature on policy design fits poorly with the scale and scope of the challenges presented by transformative technological change (Phillips 2007). The emergence of networked science, big data, explosive entrepreneurial activity and disruptive changes in technologies, products, services and organizational structures all exhibit aspects of complexity: they cannot be understood by reducing them to their component parts, and as such they may demonstrate power log distributions or emergent properties. We assert that the processes of STI are complex, while the policy responses to these phenomena continue to be based on traditional simple, reductionist approaches. While reformulation of policy theory is underway, many of the efforts to adapt and adopt new methods are yet in the early stages (Jones 2003). This paper offers a survey of a range of new methods that attempt to bridge the gap between new theories of complexity as they relate to both institutions and decision making and explores specific applications of these methods to particular aspects of the STI policy agenda.

The ideal type of policy-making system in the literature is characterized as 'evidence based' and imbuing a "'modernist' faith in progress informed by reason" (Sanderson 2002). Whether policy activities follow cycles, phases, rounds or stream (Teisman 2000), the assumption is that the actual systems are posited to face well-ordered and clear problems or opportunities, to be authoritatively structured arrangements, to be populated with individuals trained, skilled and incentivized to apply the best available evidence in the public choice rubric, to produce clearly delimited and well-defined options, and to deliver decisions based on a consistent set of rules in a clear and transparent way. Any resulting measures are assumed to be implemented as intended, and that outcomes are easily measurable by evaluation, which is then used in refining and improving policy. More recently we have talked of making the policy system—which under the conventional framing is often quite insular and aloof from outside stimuli—more responsive and reflexive. Nevertheless, the decision architecture of most policy systems remains consistent with the modernist enterprise of policy making, and the most common analytical tools we use are designed to support these ideals: cost-benefit analysis; polling; aggregate statistical indicators; impact assessment; audits and assessments of the authorities and practices of hierarchies and devolved processes.

Recently, a range of social scientists have worked to advance our understanding of emerging difficulties in this approach. Agenda setting is a major focus. The general view that problems, whether found or socially constructed, are bounded and known has been challenged. This has occurred especially in the STI policy space, where each problem presents a bit like a matryoshka nested doll: each element of a problem is a thin shell

wrapped around a more narrowly-defined but equally thin problem. This nesting defies easy definition. The emerging theoretical view is that as the problems facing decision-makers grow increasingly complex and interconnected they cannot be solved by reducing them to their component parts (Hoppe 2011; Rittel and Webber 1973). One effect is the unpredictability of what parts of particular policy areas will emerge as public problems. Baumgartner and Jones (2005) have shown that the agenda often exhibits significant leptokurtosis, as decision makers overreact after long periods of stasis. The timing and location of these punctuated equilibria cannot be identified or predicted through the current methods of economic forecasting, polling or focus groups. Some assert more reflexive engagement models, such as citizens' juries and consensus conferences, might overcome this weakness, but there is no positive evidence that these improve prediction.

In order to make progress on many STI problems, the study of complexity must be operationalized. For quite a while now scholars (and practitioners) have mused about the incomplete and artificiality of these relatively simple theories and methods. Atkinson and Coleman (1992) summarized and projected the importance of horizontally managed relations in contrast to the more formally-structured, Weberian hierarchies that dominate our architecture and our studies. They posited that policy networks and communities, engaging formal policy actors in government but extending well beyond policy shops and beyond government itself, generated significant pressures. Rhodes (1995) and others have contributed to this debate, but few have gone beyond using the concept to show the gaps between policy aspiration and implementation.

A range of new tools have been developed and beta tested in the policy space that could represent a 21st century tool kit for understanding the impacts complexity and the policy alternatives that may arise. We know of and have applied a range of statistical tests and approaches on the artifacts of government decision making systems to diagnose, analyse and simulate situations where there may be complex phenomena in order to better understand and advise on policy options.

The first challenge is to assess where the new, complexity framing might more appropriately fit. Jones and Baumgartner (2005) used the kurtosis test to show how the agenda setting system in the US exhibited profound and sustained leptokurtosis; most previous work assumed and worked on the principle that human events exhibit standard, normal Gaussian distributions, with stable means and well-ordered distributions that would allow for statistical inference using regression. In contrast, the kurtosis test investigates the data itself, offering insights into whether the data is distributed normally. Many STI policy issues exhibit leptokurtosis, which is variously described in the complexity literature as power log or long-tail phenomena, with too many events in a long tail, so that the mean has little practical meaning. A few individuals often have high power and influence, which undercuts the ability to use regression and other statistically based analyses. In our work (Clark and Phillips 2013) we applied the kurtosis test to the inputs and outputs of the Canadian regulatory system that assessed plants with novel traits and identified significant leptokurtosis in the outputs (regulatory decisions), outside the statistical bounds of what appeared to be normally distributed flows of inputs into the system. While not proof of a complex system, this offers evidence in support of further investigation into the institution and its decision making practices.

Where complexity has been detected through diagnostic tests such as kurtosis, new social networking analytical tools, based on math and graph theory, may be used to relationally map the systems to look for feed-back and choke points that may trigger these complex events. We can look at two levels. First, government policy makers and regulators focused on STI are organized in standard Weberian administrative hierarchies, with power agglomerated at the top and the functions of bureaucracy divided up into the smallest effective and efficient units to do the work. When one looks at the decision pathways promulgated by the regulators of new biotechnology crops in Canada (Clark and Phillips 2013), one is left with the impression that Weberian principles hold, with what looks like a linear pathway through the multitude of regulatory tests and checks. When the actual decision pathway was mapped, we learned that new subroutines, feedback loops and choke points were added at the administrative and operational levels to 'manage' the flow of work. The net result was that the relatively simple and linear model was transformed into a process of simultaneous choice involving more than six agencies, each with their own epistemologies and processes; this suggests at least a *prima facie* case for administrative review. A second way SNA can be used is to unpack the networked science itself. Many scholars have done this (Leydesdorff 2001, Wagner 2008). Our work has focused on understanding how research systems emerge (Ryan 2007), how research systems function (Boland et al. 2012) and ultimately whether networked science generated incremental outputs and outcomes (Sharma 2012, Ryan St. Louis and Phillips 2014).

Finding a complex problem and unpacking and mapping the architecture of the system are good first steps, but they are a bit upstream of policy formulation. Two emerging theories can and are being adapted and adopted in the STI policy space. In the first instance, agent-based simulation, in effect growing complexity in a model 'from the bottom up' by explicitly allowing for heterogeneity and learning-by-doing (Epstein & Axtell 1996), allows us to see how systems detected through kurtosis and mapped in the SNA space emerged and, more importantly, allows us to simulate how they may evolve and respond to different stimuli. One highly innovative application of this tool is by (Pyka, Gilbert, and Ahrweiler 2007) who have mapped and then modeled the European research space incentivized by the EU Framework Programmes. They are able to use the baseline model to simulate how the networked science system would respond to changed financial support. In Canada, we have used ABM to simulate the regulation of food safety, integrating inspection systems, industry and citizens as they respond to uncertain scientific evidence of risk (McPhee-Knowles 2014). While ABM is an exciting tool for exploring complex phenomena, many models often somewhat artificially impose decision rules for the actors and agents in the model. To address that, many ABM builders are looking to generate real-world evidence of how individuals might respond in specific contexts. This data can be generated by real-time, large-scale data gathering (such as through telephone apps that are geographically and time coded, e.g. Osgood) or through simulated decision making in social science research laboratories. In the experimental space, it is possible to simulate decisions and then to change treatments to discern the relative and absolute impact of risk domain framing, when and how individuals and groups tip between system 1 (intuitive) and system 2 (rules based) thinking and how different biases and heuristics (e.g. group think, anchoring, representativeness, confirmatory bias and over confidence) affect choices (Kahneman 2011).

At one level, all of these new tools could be used to simply examine policy from afar. But there is a real opportunity to use them to diagnose problems in real time, unpack the contexts using relatively objective SNA tools, replicate the decision problem in the context of its complex structure and ultimately to simulate the impact of alternate decision architectures. The coordinated application of these complementary tools offers the potential to develop timely and appropriately contextualized options and strategies based on the nature of the problem itself, rather than relying on arm's-length, comparative approaches that may have little direct relevance to an emerging STI policy issue.

#### References:

- Atkinson, M. and W. Coleman 1992, Policy networks, policy communities and the problems of governance, *Governance*, 5(2), 154-180.
- Clark, L. and P. Phillips. 2013. Bioproduct Approval Regulation: An Analysis of Front-line Governance Complexity. *AgBioForum* 16(2), 1-14.
- Boland, W., P. Phillips, C. Ryan and S. McPhee-Knowles. 2012. Collaboration and the generation of new knowledge in networked innovation systems: a bibliometric analysis. *Social and Behavioural Sciences*. Volume 52. Pps: 15-24.
- Epstein, J. and R. Axtell. 1996. *Growing Artificial Societies: Social Science from the Bottom Up*. The MIT Press.
- Hoppe, R. 2011. *The Governance of Problems: Puzzling, Powering, Participation*. The Policy Press.
- Jones, B. and F. Baumgartner. 2005. *The Politics of Attention: How Government Prioritizes Problems*. University of Chicago Press.
- Jones, B. 2003. Bounded Rationality and Political Science: Lessons from Public Administration and Public Policy. *Journal of Public Administration Research and Theory*, 13(4), 395-412.
- Kahneman, D. 2011. *Thinking Fast and Slow*. Toronto: Doubleday Canada.
- Leydesdorff, L. 2001. The challenge of scientometrics: The development, measurement, and self-organization of scientific communications. Universal-Publishers.
- McPhee-Knowles, S. 2014. What's on the Menu: Investigating Manufactured Risk in Restaurant Inspection Systems using Agent-Based Models. Paper presented at the Mapping the Global Dimensions of Policy 3 conference at McMaster University, January 27.
- Phillips, P. 2007. *Governing transformative technological innovation: Who's in charge?* Oxford: Edward Elgar,
- Pyka, A., N. Gilbert and P. Ahrweiler. 2007. Simulating Knowledge-Generation and Distribution Processes in Innovation Collaborations and Networks. *Cybernetics and Systems* 38, 667-693.
- Rhodes, R. 1995, The new governance: governing without government, The State of Britain Seminar II of a joint ESRC/RSA seminar series, January 24.
- Rittel, H. and M. Webber. 1973. Dilemmas in a General Theory of Planning. *Policy Sciences* 4(2), 155-169.
- Ryan, C. 2007, Performance of Public-Private Collaborations in advanced technology research networks: Network Analyses of Genome Canada Projects. Unpublished PhD Thesis, University of Saskatchewan.
- Ryan, C., M. St. Louis, and P. Phillips. 2014. Incorporating network analysis into evaluation of

- 'big science' projects: An assessment of the Canadian Light Source Synchrotron. *International Journal of Technology and Globalization*.
- Sanderson, I. 2002. Evaluation, Policy Learning and Evidence-Based Policy Making. *Public Administration* 80(1), 1-22. <http://onlinelibrary.wiley.com/doi/10.1111/1467-9299.00292/pdf>
- Sharma, P. 2012. Social Capital in Large-Scale Projects and their Impact on Innovation: A SNA Analysis of Genome Canada (2000-2009). Unpublished MPP Thesis, University of Saskatchewan.
- Simon, H. A. 1947. *Administrative Behavior: a Study of Decision-Making Processes in Administrative Organization* (1st ed.). New York: Macmillan.
- Teisman, G. 2000. 'Models for Research into Decision-Making Processes: On Phases, Streams and Decision-Making Rounds.' *Public Administration*. 78(4): 937-956.
- Wagner, C. 2008. *The new invisible college: Science for Development*. Washington, DC: Brookings Institution Press.



**Romulo Pinheiro, Francisco Ramirez and Jarle Trondal. Loose- or tight- coupling?**<sup>1</sup> University of Agder & Agderforskning, Norway.<sup>2</sup> Stanford University, UK.<sup>3</sup> University of Agder, Norway.***Loose – or tight – coupling? Exploring the interplay between decoupling, slack and resilience in universities*****Abstract:** Aim & Focus

This paper contributes to this special track by critically exploring a major (taken for granted) assumption in today's strategic debates on universities, i.e. the prevalent notion that, in today's complex higher education environment, 'fit for purpose' is a function of the degree through which strategies, structures, activities and academic norms and values ought to be tightly coupled with one another, and the idea that this tight coupling is to enhance universities' abilities to respond to an increasing complex set of external demands and expectations, including but not limited to their generative and/or developmental role at the national and regional levels.

**Decoupling, slack and organizational resilience**

There is a burgeoning interest on the notion of resilience within the organizational science literature (Coutu 2002; Gittell et al. 2006; Hamel and Valikangas 2003; Prada 2007).

Similarly, neo-institutional scholars have recently re-discovered the relatively unexplored domain of decoupling both within and across organizational boundaries (Boxenbaum and Jonsson 2008; Crilly et al. 2012; Fiss and Zajac 2006; Han and Jasook 2008; Mascia et al. 2011), a topic going back to the seminal work of Karl Weick (Weick 1976). Further, management theorists have long argued for the criticality of organizational slack on firms' performance, innovation, the sustainability of competitive advantages, etc. (Geiger and Makri 2006; Herold et al. 2006; Huang and Chen 2010; Su et al. 2009).

The paper explores the interplay between these three relatively distinct yet not necessarily dissociated organizational dimensions – decoupling, slack and resilience – within the context of an external, global interconnected environment characterized by volatility, financial austerity and increasing competitiveness on the one hand (Hemsley-Brown and Oplatka 2006; Karanikolos et al. 2013), and the gradual erosion on the levels of trust and legitimacy enjoyed by governments in general and publicly-run and funded organizations in particular (Christensen and Lægreid 2005; Stevenson and Wolfers 2011).

Following Weick (1976) and others (Cohen and March 1986; Covalleski and Dirsmith 1988; March and Olsen 1979), we have chosen to focus on public educational institutions (i.e. universities) as the object of analysis. The rationale for this choice is twofold. First, universities, the world over, are facing increasing pressures to respond, more efficiently, to a wide range of societal demands and stakeholder groups; from governments to industry to local communities (Benneworth and Jongbloed 2010; Jongbloed et al. 2008). Second, professionalization and managerialism (Deem et al. 2007; Gornitzka and Larsen 2004) have led to the rise of strategic science regimes in higher education (Rip 2004), manifested in an attempt – by the steering core of universities (central and unit levels) – to more tightly

couple internal structures and activities as a means of responding to the manifold challenges posed by drastic changes in their technical (operational) and institutional (regulative) environments (Pinheiro 2013; Pinheiro and Stensaker 2013).

One of the ways in which universities have attempted to cope with these new set of environmental demands lies on de-institutionalizing (Oliver 1992) traditional structures and practices (e.g. collegial decision making) and, in turn, replacing them - re-institutionalization (Kwiek 2012) - with features associated with more entrepreneurial (i.e. 'fit for survival') models, characterized by a tighter internal coupling amongst strategic aims, internal structures, primary activities and behavioral postures (Clark 1998; Etzkowitz et al. 2008).

Following the notion, and solid empirical evidence that requisite variety which suggests that the internal diversity of an organization (in terms of its information, operations, and mental models) should match the external variety of the environment for effective adaptation (Gray 2000; Popadiuk and Choo 2006), our main argument in this paper is that ongoing efforts to enhance tight-coupling across university structures, functions and activities have the potential for reducing (rather than enhancing) adaptive capacity at the organizational level. This is due to the fact that decoupling (e.g. different academic groups with similar interests doing different things) has the potential to generate organizational slack – defined here as internal repositories of knowledge, solutions, technologies, and world views - which, when/if “managed” in a proper manner, can become a valid strategic asset for universities whilst coping with drastic environmental change and/or while facing serious performance and/or legitimacy- related crisis (Geiger and Makri 2006; Huang and Chen 2010). Moreover, in this paper we contend (and empirically demonstrate) that the levels of organizational slack within a given university are directly associated with the degree of resilience to external events and stakeholders’ demands, e.g. increasing calls for a more direct contribution of university groups and primary activities to local, regional and national socio-economic needs and circumstances.

### Structure

The paper is organized as follows. After presenting the three theoretical constructs and the relationships between them, we review the literature on organizational change and adaptation in higher education, providing evidence of a general move towards a tighter coupling of strategies, structures, activities, and behavioral postures. We then move on to suggest an integrated (novel) conceptual model depicting the relationship amongst the three constructs or variables and, consequently, the potential and realized (synergic) effects on internal university dynamics on the one hand and processes of adaptability to the external environment on the other. Despite its strong conceptual focus, the paper has immediate consequences for the ongoing discourses, strategic postures and managerial practices surrounding the modernization of (European) higher education.

### References

Benneworth, P., and Jongbloed, B. (2010). "Who matters to universities? A stakeholder perspective on humanities, arts and social sciences valorisation." *Higher Education*, 59(5), 567-588.

Boxenbaum, E., and Jonsson, S. (2008). "Isomorphism, diffusion and decoupling. ," in R.

Greenwood, C. Oliver, R. Suddaby, and K. Sahlin-Andersson, (eds.), *The Sage handbook of organizational institutionalism*. London & New York: Sage, pp. 78-98.

Christensen, T., and Lægreid, P. (2005). "Trust in government: The relative importance of service satisfaction, political factors, and demography." *Public Performance & Management Review*, 28(4), 487-511.

Clark, B. R. (1998). *Creating entrepreneurial universities: organizational pathways of transformation*, New York: Pergamon.

Cohen, M. D., and March, J. G. (1986). *Leadership and ambiguity: the American college president*: Harvard Business School Press.

Coutu, D. L. (2002). "How resilience works." *Harvard business review*, 80(5), 46-56.

Covaleski, M., and Dirsmith, M. (1988). "An Institutional Perspective on the Rise, Social Transformation, and Fall of a University Budget Category." *Administrative Science Quarterly*, 33(4), 562-587.

Crilly, D., Zollo, M., and Hansen, M. T. (2012). "Faking It or Muddling Through? Understanding Decoupling in Response to Stakeholder Pressures." *Academy of Management Journal*, 55(6), 1429-1448.

Deem, R., Hillyard, S., and Reed, M. (2007). *Knowledge, higher education, and the new managerialism: the changing management of UK universities*: Oxford University Press.

Etzkowitz, H., Ranga, M., Benner, M., Guarany, L., Maculan, A. M., and Kneller, R. (2008). "Pathways to the entrepreneurial university: towards a global convergence." *Science and Public Policy*, 35(9), 681-695.

Fiss, P. C., and Zajac, E. J. (2006). "The Symbolic Management of Strategic Change: Sensegiving Via Framing and Decoupling." *Academy of Management Journal*, 49(6), 1173-1193.

Geiger, S. W., and Makri, M. (2006). "Exploration and exploitation innovation processes: The role of organizational slack in R & D intensive firms." *The Journal of High Technology Management Research*, 17(1), 97-108.

Gittell, J. H., Cameron, K., Lim, S., and Rivas, V. (2006). "Relationships, Layoffs, and Organizational Resilience: Airline Industry Responses to September 11." *The Journal of Applied Behavioral Science*, 42(3), 300-329.

Gornitzka, Å., and Larsen, I. M. (2004). "Towards professionalisation? Restructuring of administrative work force in universities." *Higher Education*, 47(4), 455-471.

Gray, P. H. (2000). "The effects of knowledge management systems on emergent teams: towards a research model." *The Journal of Strategic Information Systems*, 9(2-3), 175-191.

Hamel, G., and Valikangas, L. (2003). "The quest for resilience." *Harvard business review*, 81(9), 52-65.

Han, J., and Jasook, K. (2008). "Institutional Isomorphism and Decoupling among Korean Firms: Adoption of Performance Compensation System." *Korean Journal of Sociology*, 44(3), 27-44.

Hemsley-Brown, J., and Oplatka, I. (2006). "Universities in a competitive global marketplace: A systematic review of the literature on higher education marketing." *International Journal of Public Sector Management*, 19(4), 316-338.

Herold, D. M., Jayaraman, N., and Narayanaswamy, C. R. (2006). "What is the relationship between organizational slack and innovation?" *Journal of Managerial Issues*, 18(3), 376-392.

Huang, Y.-F., and Chen, C.-J. (2010). "The impact of technological diversity and organizational slack on innovation." *Technovation*, 30(7-8), 420-428.

Jongbloed, B., Enders, J., and Salerno, C. (2008). "Higher education and its communities: Interconnections, interdependencies and a research agenda." *Higher Education*, 56(3), 303-324.

Karanikolos, M., Mladovsky, P., Cylus, J., Thomson, S., Basu, S., Stuckler, D., Mackenbach, J. P., and McKee, M. (2013). "Financial crisis, austerity, and health in Europe." *The Lancet*, 381(9874), 1323-1331.

Kwiek, M. (2012). "Changing higher education policies: From the deinstitutionalization to the reinstitutionalization of the research mission in Polish universities." *Science and Public Policy*, 39(5), 641-654.

March, J. G., and Olsen, J. P. (1979). *Ambiguity and choice in organizations*: Universitetsforlaget.

Mascia, D., Morandi, F., and Cicchetti, A. (2011). "LOOKING GOOD OR DOING BETTER? PATTERNS OF DECOUPLING IN THE IMPLEMENTATION OF CLINICAL DIRECTORATES." *Academy of Management Proceedings*, 2011(1), 1-6.

Oliver, C. (1992). "The Antecedents of Deinstitutionalization." *Organization Studies*, 13(4), 563-588.

Pinheiro, R. (2013). "Bridging the local with the global: Building a new university on the fringes of Europe." *Tertiary Education and Management*, 19(2), 144-160.

Pinheiro, R., and Stensaker, B. (2013). "Designing the Entrepreneurial University: The Interpretation of a Global Idea." *Public Organization Review*, 1-20.

Popadiuk, S., and Choo, C. W. (2006). "Innovation and knowledge creation: How are these concepts related?" *International Journal of Information Management*, 26(4), 302-312.

Prada, M. J. (2007). *Schools as Resilient Organizations: Supporting the Mathematical Resilience of Latino Eighth Graders*, Berkeley, California: University of California, Berkeley.

Rip, A. (2004). "Strategic Research, Post-modern Universities and Research Training." *Higher Education Policy*, 17(2), 153-166.

Stevenson, B., and Wolfers, J. (2011). "Trust in public institutions over the business cycle" Working Paper No. w16891. City: National Bureau of Economic Research: Washington.

Su, Z., Xie, E., and Li, Y. (2009). "Organizational slack and firm performance during institutional transitions." *Asia Pacific Journal of Management*, 26(1), 75-91.

Weick, K. E. (1976). "Educational Organizations as Loosely Coupled Systems." *Administrative Science Quarterly*, 21(1), 1-19.

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***A review of the regional heterogeneity impacts for science, technology and innovation development in Mexico. A spatial analysis of policy making from 2007 to 2012***

**Abstract:** The macroeconomic view of the Innovation policy in Mexico pointed out to pursue the political, economic and social objectives; 1) Build a more powerful, firm centred innovation system by significantly increasing public (financial and other) support to innovation which can then leverage private investment in market-pulled innovation; 2) Ensure that basic and mission-oriented research is supported only in areas in which critical and excellence can be achieved, and use regulatory reforms and competitive founding more effectively to strengthen public research on well-defined priority socio-economic needs, and 3) pursue the decentralization of innovation policy while reinforcing state level management capabilities and carry out strict evaluations, based on a consistent national model, of programs using federal resources. The 32 mixed funds, jointly administrated by CONACYT and State government bodies and progressively developed since 2001, were meant to foster research and/or innovation capacity at the regional level and to help articulate federal and regional S&T-I policies and support programs

As a result, Mexican S&T-I policy has a heterogeneous knowledge production, impacts and growth due to spatial characteristics of economic regions. Thus spatial pattern of knowledge flow has become a central research issue in the last decade due to geography might become crucial factor in technological change and economic growth for three main reasons: 1) The role of space could be essential in accessing knowledge in innovation that is know as the proximity effect; 2) Agglomeration can possibly be determinant in the accumulation of technological knowledge (the agglomeration effect"); 3) the cumulative growth mechanisms these agglomeration economies might initiate the cumulative causation effect (Varga, 1172:2006).

The positive relationship between agglomeration and technological development is related to innovation that is crucial in economic growth explanation. The work of Marshall (1890) indicated that at least economists are aware of the role spatial externalities play in production. Positive agglomeration economies such as localized knowledge spillovers, labor pooling or input sharing decrease production costs resulting from the fact that firms and people concentrate in space. As such spatial structure of economic activities is itself a factor of production.

Moreover, it is in Marshall's work, along with that of Schumpeter, provides a convincing structure in which to focus on the self transforming as well as the self organizing nature of capitalism. It is a system in which processes of innovation play central transforming role when they are combined with the adaptive properties or markets to resolve variations of economic practice into patterns of economic change. According to Metcalfe (2006) the modern tools of evolutionary theory can give the representative firms its dynamic substance. The representative firms does have a clear role in the economic dynamics of long

period adjustment, these representative firm is the moving attractor for long run values but in turn is attracted to the best practice firm. If this comes at a price, the competitive process leads to concentration. Thus, Marshall's competition is not working on given firms but on firms that evolve in an industry that evolves, through innovations in organization, technique or product, in a population that is shaped by entry and exit and the differential growth of the firms. (Metcalf, 30:2006)

According to Foster and Metcalfe (2001) the accumulation of practically useful knowledge is perhaps the most important kind of joint production to economics. The endogenous nature of knowledge accumulation is the most powerful source of dynamic increasing returns. The accumulation of knowledge allied with increasing returns makes innovation an endogenous evolutionary process. Thus we have a sequence...(economic variety + market coordination)→ Differential growth→ structural change→ differential accumulation of knowledge→ renewed economic variety.

Metcalf's Adaptive Growth Model, where the technical progress function is formulated in the following form

"This is precisely Fabricant's Law, with less than one, output growth results in productivity growth and productivity growth is consistent with employment growth provided the industry's market is growing quickly enough. The coefficient  $\alpha$  is the measure of the degree of dynamic increasing returns in the industry, whereas the coefficient  $\beta$  is the measure of all those influences on technical progress that do not depend on the immediate expansion of the market...The Fabricant Law stands up remarkably well as a robust empirical descriptor of the relation between technical progress, investment and the growth of the market" (Metcalf et al, 13-16:2002).

On the other hand, the Griliches-Jaffe [Jaffe, 1989] formulation of the Knowledge Production Function (KPF) has become a leading approach to analyze the extent to which knowledge externalities are geographically localized at the regional level. At the empirical level, the choice of spatial econometric models in a cross-regional framework is usually, strongly motivated by the detection of spatial autocorrelation in data. On the other hand, at the theoretical level, a spatial extension of the KPF is justified by the presence of Localized Knowledge Spillovers (LKS) [Audretsch and Feldman, 2004], that can be summarized in a linear relationship between regional patent applications, the output of innovative activity, and R&D expenditures by private firms and universities, both in the region and in the neighbors.

In order to apply the role of the spatial heterogeneity into the evolutionary perspective is as follows: innovative activity at the regional level is not only a result of specific investments, but also and even depends on characteristics with impact R&D investments productivity at the regional level. Being these characteristics linked with the evolution of the region, with the technological path, with the level of human capital and others. Thus patents and research investments at the regional level are both positively correlated with the productivity of research investments because higher productivity of inputs means higher levels of outputs and, on the other hand, because higher productivity further attracts investments in research.

Therefore, the implications for a regional S&t-I policy is that manufacturing is the key determinant of economic growth and a tendency for growth rate differences in technical progress function above, then higher productivity growth implies lower price in turn means the extension of the market for the region's product which translates directly to higher output, further growth in labor productivity that leads self transformation due to innovation and technical change.

The spatial lag form of the technological progress function is as follows:

$$q_j = \alpha_j + \beta_j g_j + \epsilon$$

Where spatial dependence is embodied in the error term  $\epsilon$  (defined as  $\epsilon = \lambda \beta_j \epsilon + \xi$ ). In the spatial lag technological progress function, a state's growth is directly affected by growth in neighboring states. If  $\lambda$  is large, implying substantial spatial dependence, states have a strong interest in economic conditions of the neighbor's growth. In the context of high manufacturing growth in one state would exert a positive influence on its neighbor's growth, even if the neighboring states did not experience high growth in manufacturing output. Hence growth, technical progress and the competitive process are inseparable due to genuinely adaptive evolutionary processes driven by microeconomic diversity and coordinated by market and other institutions to generate emerging, ever changing patterns of economic structure. The implications for regional S&t-I policy could be oriented on the one hand, to the delegation of the administration of certain programs and agencies, and on the other hand, to foster regional economic development, via the support of regional innovation systems and clusters.

Therefore, considering the regional dimension to S&T-I, the paper focused on the idea that Mexico S&T-I policy has a heterogeneous impact among regions that leads to S&T-I inequity growth. The aim is to empirically tested the regional S&T-I heterogeneity in Mexico using the adaptive spatial growth model,  $q_j = \alpha_j + \beta_j g_j + \epsilon$ , that is proposed in this paper. The structure is as follows: Evolution of Mexico's regions economic growth; theoretical and conceptual approaches to S&T-I policy at the regional level of analysis; an empirical spatial analysis of S&T-I policy in the Mexican regions, and conclusions.



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***Reinforcing the Foresight Triple-Helix: Aligning prospective, participatory and policy approaches to the European STI policy arena.***

**Abstract:** Scholars have long described foresight as a process intertwining prospective, participatory and policy approaches (Georghiou et al, 2008; Popper and Miles, 2010). However, in practice, the actual alignment of this “triple-helix” has become a ‘black box’ that has yet to be opened. This paper explores how one of the most common results of prospective and anticipatory activities (i.e. scenarios) have been integrated into participatory and strategic debates aimed to influence science, technology and innovation (STI) policy design at European level. The study is based on preliminary findings of the European Commission funded project on Forward Visions on the European Research Area (VERA).

The VERA project was commissioned to provide strategic intelligence for the future governance and priority-setting of the research, technology, development and innovation (RTDI) system in Europe and for better adapting STI policy to the shifting global environment and upcoming socio-economic challenges. To do so, five complementary research activities have been conducted: (Phase 1) Stocktaking of forward looking studies on research and innovation inside and outside of Europe; (Phase 2) Identification of key factors shaping the future of STI policy in ERA; (Phase 3) Development of four scenarios for the governance of ERA; (Phase 4) Top-down identification of critical issues associated to the different ERA scenarios in terms of the capability of ERA to make Europe more innovative and more capable of solving the challenges ahead; and (Phase 5) Designing a multi-stakeholder ERA strategy map and a set of STI policy recommendations, which take into account key ideas and bottom-up critical issues emerging from strategic debates across Europe.

The phase that will be analysed is that of the recommendation generation (Phase 5), namely, the effective organisation of highly participatory and policy design oriented activities (i.e. multi-stakeholder ‘strategic debates’) to generate the policy intelligence. This phase was informed and influenced by four ERA scenarios: (1) Global market coordination for jobs and growth – assuming that today’s ERA gradually evolves into what one might call a Global Innovation Area, where research is mainly legitimized by its contribution to innovativeness, competitiveness and growth; (2) Intergovernmental action for Grand Challenges – assuming that today’s ERA has developed its research and innovation capacities incrementally as efficient responses to the Grand Challenges; (3) Public participation for human well-being – assuming that today’s concept of progress is transformed into a human-centred rationale, where e.g. happiness and quality of life are operationalized into new measures of progress; (4) Integrated expertise for sustainability – assuming that today’s economic rationales (jobs and growth) have been transformed into an approach where a sustainable development path is viewed as the main rationale of progress (see Teufel et al, 2013).

The need for an effective transition from the anticipating to the recommending phase of foresight processes has already been highlighted in Popper and Teichler (2011). However, far too little efforts have been made to codify such transition. This study provides practical examples and guidance on how to effectively align prospective, participatory and policy approaches in European STI policy design. The types of results that will be considered will be those that reveal the role of multi-stakeholder strategic debates in the co-development of actor-specific strategies and forward looking policy options for ERA.

The study will directly explore the use of scenario-informed ideas from multiple stakeholders and how this is shaping European STI policy design. A total of seven ERA strategic debates have been organised with very specific focus groups of 12-15 stakeholders representing civil society actors (Vienna workshop), university and research technology organisation actors (Manchester workshop), industry actors (Helsinki workshop), research funding actors (Berlin workshop), and policy actors at national and EU-level (Barcelona workshops).

In terms of the process for generating multi-stakeholder-informed recommendations, the study introduces a five-step interactive approach to facilitate the transition from ERA scenarios to European STI policy options. The methodology consisted of: (1) Identification of scenario-specific opportunities and threats where participants imagined their institutions operating in 2030 and tried to identify the sort of opportunities and threats under each ERA scenario. The same exercise was done under the perspective of the RTDI system. (2) Elicitation of stakeholders' strategies in the context of each scenario; (3) Stakeholders' assessment of ERA Objectives and identification of additional stakeholder-specific objectives; (4) Association of the stakeholders' strategies with the ERA Objectives; and (5) Plenary discussion on the actions that, in relation with ERA, could be initiated by the society stakeholders in the short term.

As for contributions for STI policy-making, the study produced three types of results, showing a complete consonance and alignment with the elements of the 'foresight triple-helix': (1) a range of bottom-up critical issues (derived from the participatory focus groups) that can affect key actors' behaviour by 2030, (2) the mapping of those critical issues against the three main priorities of the EU Framework Programme for Research and Innovation 2020, namely 'Excellence science', 'Industrial Leadership', and 'Societal challenges', and (3) a set of strategic implications that, drawing on the information provided in the bottom-up critical issues, calls for either immediate governmental actions or longer-term policy initiatives.

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***When Horizon Met Strategy: long-term thinking about health technologies, challenges and workforce issues in an ageing society.***

**Abstract:** Active and healthy ageing has become a major societal challenge in Europe. In its Innovation Union flagship initiative the European Commission urges all EU Member States to support innovative ways to address it (see EC, 2013). In the UK the Department of Health has recently commissioned the Centre for Workforce Intelligence to produce the Big Picture Challenges (BPC) report (CfWI, 2013), which opens up a debate on how the future health and social care workforce can meet the growing demand for high-quality care services in an ageing population. Of the eleven BPC identified in the report there is one focused on the “double challenge” of (a) planning to meet the needs of an ageing population with (b) an ageing workforce.

While there are many tools and techniques that are grouped together as part of the Foresight approach, it is striking that in biomedical areas the terminology most frequently encountered is that of “horizon scanning”. In part this may reflect the (relatively) short-term horizon scanning activities carried out as part of health technology assessment and regulation for emerging medical treatments. But the strategic intelligence also makes use of much longer-term horizon scanning tools for informing decisions about critical investments, workforce planning and infrastructural development. The paper will discuss one such approach, and outline the implications of the results of using this approach for health innovation.

The case that will be examined is that of the horizon scanning activities being undertaken for the CfWI, and that are designed to inform workforce planning in health and social care in England and Wales. The paper will contrast three approaches to explore how emerging technologies, models of care and broader issues can inform different type of strategies associated to health innovation, understood not only as product and service innovations but also as governance and organisational. Lessons will be drawn on how the organisation and orientation of such horizon scanning can shape the type of information provided on health innovation trends and policies. The specific results that will be considered will be those that reflect the potential intersection of technology trends with the challenges that an ageing society presents in the health and social care arenas.

In the first approach, five ‘megathemes’ were identified in an appraisal of horizon scanning activities across a range of health agencies, reports and policy briefs. These ‘megathemes’ are: (1) Community-oriented interventions – including two megatrends: shifting care from

hospital to integrated community-based services; and strengthening the role of informal and non-professional care-givers. (2) Need-driven innovation– including two megatrends: using patient/citizens expectations to improve health/social care delivery; and raising patients' health literacy and health self-management capacity. (3) Technology-driven innovation– including one megatrend: fostering innovation and adoption of health technology systems. (4) Quality-driven management – including three megatrends: developing and reorienting health/social care workforce competences; monitoring and benchmarking quality of care and productivity indicators; and accelerating access to and delivery of specialist services. (5) Sustainable system governance– including two megatrends: reshaping the governance and sustainability of health systems; and increasing health systems efficiency and financial sustainability.

The second approach involved a systematic review of health technology assessments and gave rise to the identification of five major sets of technology trends: (1) Therapeutic technology– technologies used in the treatment of disease and injury, including pharmacological, surgical and psychological therapies (and regenerative medicine and minimally invasive procedures). (2) Diagnostic technology – technologies for identifying diseases and other conditions. This includes nanotechnology and point-of-care diagnostics. (3) Enabling technology – technologies that mitigate the impact of disease or disability. This section discusses mobile technology, wearable health monitors, and assistive technologies. (4) Preventive technology – technologies that reduce the risk or severity of illness and injury, including genomics but also the use of gaming and education. (5) Organisational technology – technologies supporting alternative health and social care delivery configurations and organisational design (and also including integrated "big data").

Finally, a third approach drew on health and social care stakeholders' contributions, bringing about a set of critical ageing-related issues. A web-based knowledge hub plays a key role in this approach to horizon scanning, where health stakeholders are encouraged to use the CfWI 'ideas bank' to share their opinions on technological, economic, environmental, political, social and ethical (TEEPSE) issues, as well as to use them to feed or enrich their own strategies. Analogously to the other approaches, a systematised process of opportunities and threats distinction has informed a series of ageing-related policy recommendations.

While the study was undertaken with particular concern to assess emerging ways of organising health innovations and related workforce issues, the results are highly relevant to technology decision-making and innovation policy. The work illustrates how horizon scanning may provide consistent long term strategies and policy recommendations. The study does not only present emerging technologies and new models of care as a potential solution to problems of ageing. It also considers how emerging and future technologies and new ways of delivery may pose challenges in terms of new skills and competences that the health workforce would need to gain, especially in a world where elderly patients are increasingly active and techno-savvy.

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***Policy convergence in Research Governance: The example of alignment of national research programmes to societal challenges in the European Research Area***

**Abstract:** 1. Introduction and Background

Policy convergence can be defined as any increase in the similarity between one or more characteristics of a certain policy (e.g. policy objectives, policy instruments, policy settings) across a given set of political jurisdictions (supranational institutions, states, regions, local authorities) over a given period of time. In the course of this, some aspects of national policies will change to create a new joint policy. Policy convergence thus describes the end result of a process of policy change over time towards some common point, regardless of the causal processes.

European research policy is not a domain where the Treaty of Lisbon (TFEU) empowers the European Union to legislate. Research policy is mainly handled at the national level. The EU Framework Programmes (FPs) have always had structuring effects on the national research systems but it was with the introduction of “ERA instruments” as of FP 6 (ERA-NETs, Art. 185 initiatives) that this structuring influence became more evident and moved from the project level (involving researcher and/or research unit level) to the Member State/funding bodies – the programme - level . With the FP, the Commission disposes of a tool that can incentivise this coordination financially. Only 1% of GBOARD is transnationally coordinated funding, financed by Member States. Broadly speaking, about only 5% of the overall available European GBOARD is funded by the FP. Around 80% is locked in Member States, 15% is implemented by longstanding European intergovernmental organisations such as ESA, CERN, etc.

With the introduction of the European Research Area, the Open Method of Coordination and many other soft law approaches, the Union has started to coordinate national research policies and (eventually also national research programmes) since 2000. There are several favourable gains from the move from collaboration within a project to cooperation and coordination of programmes. Most importantly a programming approach provides for joint vision development and strategic agenda setting. It also ensures a longer-term period of available funding and is more likely to build critical mass.

Whilst programme cooperation remained to be done ex-post for ERA-NETs and Art. 185 initiatives (existing programmes joining up), a more ex-ante approach was introduced with Joint Programming, where new programmes addressing societal challenges were jointly created by Member States at the EU-level and where no EU funding was involved a priori. Joint Programming is a process designed to ensure the optimisation of existing and future research efforts at the level of the Member States and by doing this, contributes to the structuring of research efforts in the ERA. Amongst many other positive effects, a coordinated approach in public research policy making can enhance national and overall European efficiency and effectiveness, avoid unnecessary duplication in research funding, create critical mass by pooling funds and enhance the level of scientific excellence by streamlining and standardising research evaluation practices.

Grand societal challenges have been introduced as a vehicle and catalyst to capture political and public imagination for larger efforts that also engage Member States resources. The idea was to bring together national programmes to tackle grand societal challenges, as defined in the Strategic Research Agenda (SRA) of the JPI. Optimisation means reinforced cross-border cooperation, improved coordination and better alignment of publicly funded research programmes in Member States in a limited number of fields – the identified societal challenges by the Groupe de Programmation Conjointe (GPC).

Areas selected for JPIs could have been those where national funding predates FP funding and where the FP only adds topics rather than being an important driver and coordinator of the agenda as a whole. Another option would have been for a JPI to pick up a field where the FP has created strong research networks and built capacity. Alternatively, a JPI could have been launched in the periphery of a research field that already has historically very strong European integration, such as Space Research. However, some of the challenges addressed by the 10 Joint Programming Initiatives (JPIs) are overlapping with the societal challenges funded under Horizon 2020. Even though the issue of synergies between joint national programmes and the Framework Programme deserves elaboration, the focus of my contribution will be restricted to the domain of joint programming between Member States and the alignment of national competitive project-based and institutional funding for participation in a JPI.

## 2. Characteristics of research programmes as instruments of research coordination

Research policy-makers and funders tend to see programmes as a means of focusing scientific endeavour and maximising the value of otherwise separate projects. They constitute one amongst a number of methods through which principals (state/funders) seek to ensure that agents (research institutions, researchers) in fact engage with the principals' problems and priorities not just on a one-to-one basis but as a shared endeavour. They are instruments of collective influence and one of their defining features is that they concentrate attention and draw together otherwise separate fields, theories, issues and research providers. Principals use programmes as a means of influencing the actions of multiple agents.

These targeted research programmes represent a directive way through which research funders seek to channel the course of scientific enquiry. Research programmes have the potential to change relationships between research funders and principals (acting on behalf of state or societal interests), and across research groups and agents (the individual researchers). In short, they are instruments with which to configure the environment in which ideas are produced and in which research relations and networks are built. Research programmes come in all shapes and sizes, each having their own histories and purposes. In the context of the joint programming process, a "virtual programme" is created by joining various existing national programmes into one at supranational level. In many ways, JPIs are more than "programmes" because a lot more than the typical research funding activities are undertaken by a JPI. They engage with policymakers, researchers and stakeholders, they provide policy advice, they act as global focal point (eg JPND) etc. JPIs could be described as political supranational bodies or international organisations, bundling Member States' powers into one body which usually takes the form of a secretariat in one of the participating states or in Brussels.

Each of the 10 JPIs is very different in terms of the research field, the funding volume, the type of research it funds, but also in terms of the existing science base in the participating



states (research community and available programmes in the same domain). The difference of the national research system as regards the internal governance in each of the 28 Member States is also substantial.

The national level (from below: the responsible ministries and funding bodies) and the supranational level (from above: the JPI) create a complex multi-layered landscape in which it is very difficult to develop a common approach for aligning national research programmes to a JPI and its joint strategic research agenda.

Three possible dimensions of added value can be identified: First, the quality and output of individual projects might be improved by virtue of their being part of a larger programme, for example, through the sharing of knowledge and ideas or through interaction with other disciplinary perspectives. Second, by concentrating resources and effort, programmes have the potential to shape research careers, develop capacity in some fields rather than others, and draw researchers' energies and attentions towards topics of agreed societal importance. Third, the fact of funding a number of projects in a particular field promises to give that field greater visibility and a higher profile within academic and non-academic communities alike.

### 3. Alignment

Alignment is a bi-directional process: it can be generally defined as the strategic approach taken by Member States' programming authorities to modify their national programmes, priorities or activities as a consequence of the adoption of joint priorities at the EU level and as the approach taken by JPIs to enhance alignment of Member States' programmes to their SRA by using specific programmatic tools and instruments. As such, alignment is a fuzzy concept and encompasses many different types of alignment that differ depending on the research field and type of research of a JPI and are very different depending on the national research governance of a given participating Member State .

Being a crucial element for the success of Joint Programming, alignment of national strategies and research programmes with the jointly elaborated Strategic Research Agendas (SRAs) of JPIs, is necessary to increase the interconnectedness of national programmes.

"Full" Joint Programming should eventually lead to the alignment of national research programmes in order for a JPI to implement its SRA. Alignment between national, transnational and European research programmes was also commonly recognized as key in order to best possibly address societal challenges . The JPIs' SRAs often throne above national programmes (or are apart from any existing national programme) and are not mainstreamed into a national programme. This however, instead of creating alignment of national and transnational research funding and in the long run research policy, creates an additional layer and risks to increase already existing fragmentation even further.

Alignment also varies depending on the stage the JPI is in. Certainly, the adoption of an SRA required some sort of alignment already, but it becomes evident with the implementation of the SRA that alignment comes back into the picture. In other words, it is difficult to discern where alignment in the context of joint programming starts and where it ends.

#### 3.1. Types of alignment in the JPIs

In order to reach alignment at the level of the JPI, several activities can be differentiated:

- Alignment leading to a joint call (e.g. Member State-funded and or EU-co-funded by an ERA-NET) or resulting from a joint call – several JPIs have developed tools and actions that lead to alignment funding streams in national programmes are aligned to the joint call;

- Sharing of work– some countries stop activities in certain areas, which are only carried out by others. Results are shared amongst JPI members;
- Areas are established where no one country can do the work alone – all will work in common with little purely national activities in that area;
- Sharing of resources (e.g. research infrastructures as in Oceans JPI) or common prioritisation of institutional funding (without joint calls) as in the European Energy Research Alliance of the SET-plan.

### 3.2. Types of alignment within Member States

Depending on the Member State's internal research governance structure, practices for alignment will look different in the various Member States and there is no one size fits all approach for Member States to tackle alignment. A significant amount of research on societal challenges is already taking place within the countries. Alignment of these activities will increase the impact of Member States' individual efforts to resolve the global societal challenge that the JPIs are addressing. However, alignment is challenging as it requires collaboration between stakeholders nationally in the first instance, and a recognition of the value of that collaboration, before any coordination of research programmes at a European level can occur.

Alignment might be increased by the existence of a national action plan and adequate national commitment or by the creation of national "mirror" research programmes/strategies in the domain of the JPI, coordinated by interministerial platforms. But it is not only the national governance that plays a role here, national representatives in the JPI Governing Boards as well as the national representatives in the GPC should all ensure high-level political commitment to ensure the success of the joint programming endeavour at all levels.

In order to achieve alignment nationally for a JPI, three levels have to be addressed:

#### 1. The transnational level:

The first step surely is the adoption by the Member State of the JPI's SRA. This SRA has of course been influenced ideally by most of the Member States involved in a JPI during creation.

#### 2. The national political level:

The idea being that JPIs operated ex-ante and define SRAs for a selected societal challenge also implies that not all Member States involved in JPIs have a national programme in the same domain as the JPI's SRA. Mostly, the challenge-approach of JPIs is interdisciplinary and is the political responsibility of a variety of ministries. Not in all countries is the research ministry the coordinating ministry in research policy in all domains.

#### 3. The research funding agency (RFO)/research performing organisation (RPO) level:

Full alignment of national research programmes to a JPI's SRA would ideally mean that no separate pots are created for transnational and national activities. For an RFO, this would mean that the launch of a joint call for transnational consortia and a national call for individual researchers in the area of the societal challenge of the JPI is essentially the same thing. For an RPO, this would mean that its institutional funding in the societal challenge in question is aligned to the SRA of the JPI as in-kind contribution.

#### 4. Research question

Participation in JPIs by Member States has always been very much focused on cash contributions that are usually being contributed by a national programme into a virtual



common pot (no money crosses borders). Especially in times of crises, this can be very difficult for Member States, even if these cash contributions are simply a redirection of existing research project funds. Not enough emphasis has been put on alignment of institutional funding into the JPI. We know that a lot of strategic research relevant to JPIs is being carried out by institutions which receive considerable parts of block funding, part of which is purely institutional funding and part of which is earmarked funding based on performance contracts and/or formula-based funding for certain research topics. We also know that many national RPOs are programme owners as well, entirely or partially executing themselves a national research programme. Few studies so far have looked into the potential in Europe that could be achieved by coordinating the parts in institutions that are linked to a specific national programme. This could also improve the national lock-in that many RPOs are a victim of. It has been calculated that Research and Technology Organisations (RTOs) have an annual turnover 20 billion/year. The structuring effect and the impact on the EU research landscape could be strongly enhanced if the institutional funds were aligned as well.

At the same time, national buy-in eventually leading to alignment for JPIs can be created if national stakeholders (researchers, RPOs and the science policy and administration level) actively engage in creating national SRAs for participation in a JPI.

The question I would like to address is twofold: Can national alignment to a JPI be better achieved:

- by engaging institutional funding of RPOs?
- by engaging national stakeholders to develop national research strategies/SRA mirror programmes in the domain of the JPI?

To tackle my research question, I will – in addition to exploring literature on the theory of policy convergence (Knill 2007, Holzinger/Knill 2007, Drezner 2005) as developed in the political sciences - build on some lessons learnt by looking into country case studies (e.g. Norway, Italy) and into JPIs (e.g. JP Neurodegenerative Diseases, Agriculture, Food Security and Climate Change JP) as well as the European Energy Research Alliance of the SET-plan. Valuable lessons for the research question can also be drawn from the FP 6 instrument of Network of Excellence.

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***Learning from failure: The case of the Andalusian furniture technology centre (CITMA)***

**Abstract:** Background

In the last two decades, almost all EU member States have implemented a large number of policies and initiatives in support of clusters fuelled by the success stories of the so called holy trinity: Silicon Valley, the third Italy and Baden-Württemberg. In order to foster and support the development of these policies, the European Union incorporated in the Lisbon strategy, launched in 2000, recommended several explicit cluster-related actions under the priority of improving knowledge and innovation for growth. More recently, in the Europe 2020 strategy, cluster development is considered an important tool of regional smart specialisation strategies for improving the business environment, especially for SMEs. This increasing involvement of the EU in innovation policy has reinforced the ongoing process of regionalization of policy arenas, leading to a multilevel governance system characterized by the continuous interaction in the policy process of national governments, sub-national actors, EU institutions, public-private organizations, private interests and other actors (HOOGHE and MARKS, 2001; CHARLES and BENNEWORTH, 2002).

Despite this complex multi-actor and multilevel framework, surprisingly, policy research has been given little consideration to constraining and enabling factors on the effective formulation, implementation and evaluation of policies (PERRY and MAY, 2007; BORRAS and TSAGDIS, 2008; STERNBERG et al., 2010; UYARRA and RAMLOGAN, 2012), what may help to explain the little progress made with regard to learning in cluster policy making and cluster policy learning (NAUWELAERS and WINTJES, 2008). Indeed, the majority of studies assume a 'linear model' of policy-making, characterised by an objective and rational analysis of options and a clear separation among the different stages process. Once the policy decision is made, there is simply execution or implementation. This way, in case of failure, the blame is often not laid on the policy itself, but rather on a lack of political will, poor management or shortage of resources in implementing it (JUMA and CLARKE, 1995). However, policies are the outcome of politics and cannot be analysed separately (KAY, 2006), as one cannot expect the policies which emerge to be independent of the processes by which they are formed (METCALFE, 1994).

**Aim**

In contrast to this trend in policy analysis, this article explores the policy process and thus the underlying politics involved in the emergence, development and closure of a cluster initiative: "The Andalusian Furniture Technology Centre", (CITMA). Our main objective is to open the black box of the organization in order to understand how and why is created, and which factors may explain its failure. Our working hypothesis is that politics strongly influence policy formation to the extent that determine the success or failure of policies.

**Methods**

The inherently political nature of the policy process craves for a relational understanding of power in policy analysis much in the line outlined by actor-network theory (ANT) (CALLON, 1986a and 1986b; LATOUR, 1987).

Using ANT to open black boxes means to trace and discover how the actor-networks are formed and to analyse how overcome resistance and strengthen internally, or fall apart. In short, it is to explore the process called translation, that is, the ability of actor-networks to keep other actor-networks involved in the project by translating and interpreting their interests, needs, values, and efforts into their own language. To this end, we have conducted 22 semi-structured, in-depth interviews with the key actors from the technology centre (5), regional and local government (6), cluster firms (2) and sectorial organizations (9).

## Results

The case of CITMA illustrates that policy processes are inherently political and far more complex than portrayed in conventional accounts based on the lineal model. Policies are in fact unpredictable and fraught with uncertainty, opportunity, and local specificity. Acknowledging this complexity is not enough, it has to be unpacked to foster policy learning.

The opening of CITMA's black box has allowed us to explore how and why was created and why has failed this initiative. Through this narrative we have witnessed how this cluster initiative, climbed up the political agenda due to the joint efforts of the alliance formed by the wood consortium-school of Encinas Reales (CEMER), The city council of Lucena and the furniture entrepreneurs association of Cordoba, who took advantage of their window of opportunity.

It has also enabled to understand how CITMA, initially conceived and approved as a public funded organization aimed at raising SME's absorption capacity by providing technological services, turned into a semi-public consulting focused in selling business services to big companies. This outcome was the consequence of a top-down policy approach in which regional Ministry failed to take into account the needs, interests and the resistance of the different stakeholders by changing unilaterally the project and the funding model approved by its predecessor. The unexpected shift in its financing triggered the dissolution of the alliance and CEMER's exit from CITMA's management. In this context and in the absence of any support from stakeholders, CITMA's employees were not able to build a solid and durable actor-network, becoming trapped in the vicious circle of low demand and poor supply.

## Conclusions

CITMA's is a paradigmatic case that highlights the main features of the Andalusian cluster policy over the last decade, namely the absence of any structured strategy and long term commitment from policy makers. Cluster policy in Andalusia has mainly focused, in a context of abundance of European funds, on the provision of technology centres aimed to act as catalyst of the local production systems as well as to support the innovative activities of cluster firms by providing advanced services. However, to achieve these goals these organizations have lacked since its creation the necessary long-term investments and

support from stakeholders. The main implication of such approach is that once European funding is over, these organizations are heading for closure as regional government is not willing or cannot afford to support them.

This short-termism, despite socialist party has ruled uninterruptedly since 1983, may be explained by the continuous changes in the approved strategic priorities as a result of the frequent restructuring in the ministries in charge of innovation and the picking winner's strategy followed by the regional government since 2004, who in contrast to current trend smart specialisation principles, prioritized the high-tech sectors while disregarding traditional low-tech industries which constitute an essential part of the Andalusian economy.

### Limitations

It is worth stressing that opening black boxes using ANT comes with an unavoidable set of drawbacks. While it's true that describing "how" macro-actors are assembled is straightforward, however the answer to the "why" question, remains somehow more elusive. We have to keep in mind that in the context of a failed initiative, most actors will be willing neither to acknowledge their own mistakes nor to share their thoughts to avoid problems as well as to keep out of the public debate possible hidden agendas.

### References

- BORRAS, S. and TSAGDIS, D. (2008). Cluster policies in Europe: Firms, institutions and governance, Edward Elgar Publishers, Cheltenham.
- CALLON, M. (1986a). The sociology of an actor-network: The case of the electric vehicle, in CALLON, M., LAW, J. and RIP, A. (Eds) Mapping the dynamics of science and technology, pp. 19-34, Macmillan Press, London.
- CALLON, M. (1986b). Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St Brieuc Bay, in LAW, J. (Ed) Power, action and belief. A new sociology of knowledge?, pp. 196-229, Routledge and Kegan Paul, London.
- LATOUR, B. (1987). Science in action: How to follow scientists and engineers through society, Harvard University Press, Cambridge (MA).
- CHARLES, D. and BENNEWORTH, P. (2002). Evaluating the regional contribution of an HEI: A benchmarking approach, HEFCE, Bristol.
- HOOGHE L. and MARKS G. (2001). Multi-level governance and European integration, Rowman and Littlefield Publishers, Lanham, Boulder, New York and Oxford.
- JUMA, C. and CLARK, N. (1995). Policy research in sub-Saharan Africa: An exploration, Public Administration and Development 15, pp. 121-137.
- KAY, A. (2006). The dynamics of public policy: Theory and evidence", Edward Elgar Publishing, Cheltenham.
- NAUWELAERS, C. and WINTJES, R. (2008). Innovation policy, innovation in policy: Policy learning within and across systems and clusters, in NAUWELAERS, C. and WINTJES, R. (Eds) Innovation policy in Europe: Measurement and strategy, pp. 225-268, Edward Elgar Publishing, Cheltenham.
- METCALFE, J.S. (1995). The economic foundations of technology policy: Equilibrium and evolutionary perspectives, in P. Stoneman (Ed), Handbook of the Economics of Innovation

- and Technological Change, pp. 409-512, Blackwell Publishers, Oxford (UK)/Cambridge (US).
- PERRY, B. and MAY, T. (2007). Governance, science policy and regions: An introduction, Special issue of *Regional Studies* 41, pp. 1039-1050.
- STERNBERG, R., KIESE, M., STOCKINGER, D. (2010). Cluster policies in the US and Germany: Varieties of capitalism perspective on two high-tech states, *Environment and Planning C: Government and Policy* 28, pp. 1063-1082.
- UYARRA, E. and RAMLOGAN, R. (2012). Cluster policy: A review of the evidence, Working Paper No. 12/05, National Endowment for Science, Technology and the Arts (NESTA), London.

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***Evaluating the effectiveness of public support on inbound open innovation: evidence from Spanish manufacturing SMEs***

**Abstract:** Objectives: Our study contributes to the evaluation literature by providing the first empirical findings on the impact of public innovation support on cooperative behaviour in SMEs (behavioural additionality), and on two additional inbound open innovation practices: outsourcing R&D; and acquiring other external knowledge (e.g. patents and know-how). The treatment effects are reported for two separate sources of funding: regional and national support programmes. Following the literature on the determinants of R&D cooperation, we explicitly take into account incoming spillovers, knowledge flows from different sources (suppliers, customers, competitors, government and Higher Education Institutions) and include barriers to innovation and to cooperation in our methodological framework. Finally, particular features of this study are the conduct of sensitivity analysis to assess the impact of unobserved heterogeneity on the estimated effects of public support programmes; and, moreover, that the conclusions of this study take into account the evidence and implications of unobserved heterogeneity.

Prior work: Compared to a large number of empirical studies on input additionality and to a lesser extent on output additionality, behavioural additionality has been the subject of few studies. Among the first studies to explore behavioural additionality is Fier et al. (2006), who found a positive behavioural additionality in German manufacturing firms. Busom and Fernández -Ribas (2008) used a subsample of Spanish manufacturing firms participating in the CIS survey in 1999 to explore the impact of national support programmes on vertical cooperation (with suppliers and customers) and with private- public partnerships (cooperation with universities or public laboratories). National programmes have a positive effect on both types of cooperation, but the effect on private-public partnership is more prominent; the Average Treatment Effect of the Treated (ATT) on this type of partnership is twice the effect on vertical cooperation. Fernández - Ribas and Shapira (2009) investigate how local and national support programmes affect cooperation with international partners among manufacturing firms in Catalonia. The estimated ATT effect is positive, but fairly small (8 percentage points).

Afcha Chávez (2011) explores behavioural additionality using the Spanish ESEE survey of business strategy for the period 1998-2005. The treatment effects are estimated for vertical cooperation and private-public partnerships while separating regional from national programmes. Estimated programme effects are significant only for private-public cooperation for both sources of funding, but not significant for vertical cooperation. Marzucchi (2011) provides a comparative analysis of the forth CIS survey for Spain and Italy. They found no effect of Italian regional policies on any type of cooperation (horizontal, vertical, and private-public); but report a positive effect of national policies on each type of cooperation. Findings from Spanish data indicate a positive impact of both regional and national policies on each type of cooperation. Antonioli et al. (2012) investigate the impact of a specific regional innovation policy (PRRITT) in the Italian region of Emilia-Romagna. The

results are contrary to previous studies – the authors report no effect of public support on regional cooperation. Furthermore, regional policy shows a negative effect on horizontal cooperation. In summary, most studies report behavioural additionality, i.e. a positive impact of public support on firms' cooperation. However, the magnitude and significance vary depending on sources of funding and types of cooperative partners.

**Approach:** Our study employs Spanish CIS2006 survey data covering the period 2004-2006. The sample consists of 8,022 small and medium-sized enterprises (SMEs) in manufacturing sectors, from which 5,115 are small and 2,907 are medium-sized firms. For the estimation of the Average Treatment Effect on the Treated (ATT), we apply three matching estimators: Nearest Neighbour (NN) matching with Mahalanobis metric, kernel matching and Inverse Probability of Weighting Treatment (IPWT) estimator. The main advantage of matching estimators, compared to selection models and IV approaches, is that they do not require any distributional assumptions regarding the error terms in the selection equation and in the outcome equation. However, matching estimators control only for firms' observed characteristics. In cases when unobserved characteristics of firms influence treatment assignment, matching yields biased estimates of treatment effects. For that reason, we conducted a sensitivity analysis using a Rosenbaum bound approach (Rosenbaum, 2002).

**Results:** Our study reports a positive, but heterogeneous impact of public support on open innovation in Spanish SMEs. However, sensitivity analysis suggests that many of the programme effects could be overestimated due to unobserved heterogeneity, which matching estimators cannot account for. Notably, the results for two cooperative partners - cooperation with suppliers and with HEIs - seem to be highly sensitive to hidden bias.

Taking into account the results of sensitivity analysis, we proceed with the concluding remarks. In total, 18 treatment effects were estimated from the whole sample and the same number from the subsample of innovative SMEs. Five estimated effects in the whole sample are rather robust to selection bias; and six estimates in the subsample (perhaps due to a more homogenous sample). In total, out of 36 treatment effects, only 11 are not likely to be overestimated. Finally, across both the whole sample and the subsample of innovative firms, five ATT effects are robust to hidden bias:

- For local/regional support, three effects on the following open innovation activities - aggregate cooperation, cooperation with government institutions, and outsourcing R&D;
- For national (government) support, two effects - on horizontal cooperation and cooperation with government institutions.

Overall, we find that public support most robustly increases SME cooperation with government institutions; only slightly less robust is that the largest treatment effects of public support - both regional (a robust finding) and federal (borderline robust) - are for outsourcing R&D activities. Yet there is not so much robust evidence that public support increases cooperative and innovative behaviour more generally. Recent work on cooperation failure can help us to make sense of this contrast, suggesting that it may be of systematic rather than merely contingent significance.

**Implications:** By analysing treatment effects of different types of inbound open innovations, our study discriminates between the effects of public intervention on cooperation for



innovation and on R&D and innovation outsourcing (extramural R&D investments and acquiring other external knowledge). The results suggest that, depending on the source of funding, SMEs are more likely to respond to public support by increasing either their cooperation with government institutions or their investment in extramural R&D than by establishing and maintaining cooperative networks. Acquiring external knowledge through cooperation could be subject to cooperation failure. In this case, compared to cooperation with other firms, either increased cooperation with government institutions may be facilitated by greater trust that these are unlikely to appropriate the firm's intellectual property; or/and R&D subcontracting is a more viable option. This issue deserves further attention from both practitioners and policy-makers. For example, to increase the effectiveness of public support for cooperation between firms – including customers and suppliers – policy makers should place particular emphasis on measures designed to attenuate cooperation failures (Zeng et al., 2010).

**Value:** Our study is the first to investigate the impact of public innovation measures on open innovation practices other than cooperative behaviour. Applying matching estimators in evaluating the treatment effects implies that unobserved heterogeneity cannot be taken into account. Thus, it is of high importance to conduct sensitivity analysis to test whether the estimated treatment effects are robust to unobserved firm characteristics. However, most empirical studies in a domain of additionality of R&D and innovation policies do not report the results of sensitivity analysis, which raises a concern whether their empirical findings are robust to unobserved factors. The results reported in our study indicate that unobserved heterogeneity could be pertinent to investigating behavioural additionality. The conclusions of this study take into account the evidence and implications of unobserved heterogeneity.

## Reference

Afcha Chávez, S. M. (2011): "Behavioural additionality in the context of regional innovation policy in Spain", *Innovation: Management, Policy & Practice*, Vol. 13, No. 1, pp. 95-110.

Antonioli, D., Marzucchi, A. and Montresor, S. (2012): "Regional innovation policy and innovative behaviours. A propensity score matching evaluation", *INGENIO Working Paper No. 2012/05*.

Busom, I. and Fernández-Ribas, A. (2008): "The impact of firm participation in R&D programmes on R&D partnerships", *Research Policy*, Vol. 37, No. 2, pp. 240-257.

Fernández-Ribas, A. and Shapira, P. (2009): "The role of national and regional-level innovation programs in stimulating international cooperation in innovation", *International Journal of Technology Management*, Vol. 48, No. 4, pp. 473-498.

Fier, A., Aschhoff, B. and Löhlein, H. (2006): "Behavioural Additionality of Public R&D Funding in Germany", in: OECD (Eds.), *Government R&D Funding and Company Behaviour: Measuring Behavioural Additionality*, OECD Publishing, Paris, pp. 127-149.

Grimpe, C. and Sofka, W. (2008): "Search patterns and absorptive capacity: Low- and high-



technology sectors in European countries", *Research Policy*, Vol. 38, No. 3, pp. 495-506.

Marzucchi, A. (2011): "Multi-level innovation policy in southern EU countries: An additional evaluation of the Italian and Spanish public interventions", *OPENLOC Working Paper No. 10/2011*.

Mohnen, P. and Hoareau, C. (2003): "What type of enterprise forges close links with universities and government labs? Evidence from CIS 2", *Managerial and decision economics*, Vol. 24, No. 2-3, pp. 133-145.

Rosenbaum, P.R. (2002): *Observational Studies*, (second edition), New York: Springer.

Spithoven, A., Teirlinck, P. and Frantzen, D. (2012): *Managing Open Innovation: Connecting the Firm to External Knowledge*, Edward Elgar Publishing.

Zeng, S. X., Xie, X. M. and Tam, C. M. (2010): "Relationship between cooperation networks and innovation performance of SMEs", *Technovation*, Vol. 30, No. 3, pp. 181-194.

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***Development of an evaluation framework to investigate the behavioural additionality of the Knowledge Transfer Partnerships programme***

**Abstract:** Nowadays, national and international policy agendas have positioned innovation as one of the key factors which will enhance or encourage economic growth (the others being education, infrastructure development and health, OECD, 2014; TSB, 2014).

Despite their endeavours, policy makers face several difficulties when trying to foster innovation because, as occurs with many social processes and interactions, it is a complex issue. Policy complexity can have several causes: it originates from involving many stakeholders who hold different (and often conflicting) values, interests and positions, their relationships are constantly evolving, and their effects often have a non-linear causality (Patton, 2011).

In innovation policy, under a knowledge-based perspective, networking and collaboration are viewed as important components of the system. These occur because knowledge is socially constructed (Calaghirou, Kastelli and Tsakanikas, 2004). Thus, interaction could potentially generate new ideas, which, in the long-term, might help to modify the behaviour of the participants of the innovation process.

Given the strategic role these public actions have in enhancing the innovation capabilities and performance of the involved stakeholders (Edler, et al., 2011), policy makers have strong incentives to try to encourage collaboration.

At the same time, scholars in the field (e.g. Cunningham and Gok, 2012), have found that the evaluation of collaboration entails certain challenges related to the measurement of timing and periodicity of impacts and the scope of the achieved effects. Similarly, the methods used to compare the aggregated effects of policies (benchmarking) and the use of counter-factual scenarios is plagued with difficulties. Finally, the authors describe a generalised problem with the attribution (causation) of effects.

It can be argued that the previous challenges can also be found when policy makers try to evaluate the long-term effects brought by innovation policies. Thus, measuring sustained long term behavioural changes (which are usually referred as behavioural additionality, Buisseret, Georghiou and Cameron, 1995) is difficult.

Once these challenges have been identified, an evaluation framework is suggested. It is constructed to offer the following potential solutions:

1. The first task is to understand the logic of an intervention and to suggest a possible location for its behavioural additionality components. This would be accomplished by developing the programme logic. Several tools can be suggested, among them using the Logical Framework Approach (Team Technologies, 2005). It is expected that modelling the programme would help to decrease the rate of un-anticipated effects. This solution is

proposed in order to move from a 'black-box' type of evaluation to provide a holistic and systemic perspective (Miles and Cunningham, 2006).

2. It is believed that adopting a theory-of-change and a utilisation-focused evaluation approach (Patton, 2001) will help to produce a framework which matches the populations targeted by the programme, the indicators used to monitor their changes, the thresholds for such indicators and the expected time lines with a) a relevant theory (in this case behavioural additionality) and b) oriented towards the needs of the stakeholders involved in the programme.

3. By adopting a case study approach, with a focus towards participatory techniques, it is expected to increase the range of anticipated effects and provide logical links between propositions. In order to increase the validity of the exercise, interviews with supported agents and policy makers are suggested.

4. Using prior knowledge from the programme's performance (evidence-based approach), to determine its rationale and actor performance.

A second research step includes performing an analysis of innovation policies using the framework proposed by Georghiou, et al., (2003) which serves to analyse the type of deficiency different innovation policies address. It consists of a matrix containing, on the first column, the types of policies under examination (e.g. support for basic research, grants for industrial R&D or Network measures).

The rows contain four deficiencies: Opportunities, resources, capabilities and incentives. Opportunities refer to those efforts to open new areas of investment, resources to the allocation of (mostly) monetary benefits, incentives refer to those mechanisms generated to motivate the actors in the innovation system to invest in specific areas and finally, capabilities refer to the efforts to generate skills and competences in the players in the system. Georghiou, et al, (2003) and Georghiou (2004) consider that those policies which try to generate capabilities (related to the innovation strategy, competitive advantages, or specifically knowledge) are especially suited to generate changes in the behaviours of the participants.

According to the previous argument, and after applying the framework to a group of UK policies, the Knowledge Transfer Partnerships can be categorised as a promising policy to detect behavioural additionality since it deals with knowledge and its transfer mechanisms, collaboration and explicitly aims to generate related capabilities on its participants.

Knowledge Transfer Partnerships (KTP) is a UK programme, managed by the Technology Strategy Board, in operation since 2003. It is a programme which facilitates knowledge transfer through the establishment of collaborative projects or partnerships, between a firm (referred as company based partners) and an academic institution (referred as knowledge base partner). The programme also includes a third actor, referred as the associate, who serve as the selected agent to transfer knowledge between the other partners.

KTPs have the objective to "strengthen the competitiveness, wealth creation and economic performance of the UK by the enhancement of knowledge and skills and the stimulation of

innovation through collaborative projects between business (including social enterprises) and the knowledge base” (KTP, 2014)

In specific, the programme was selected since it seems to addresses four different deficiencies from Georghiou’s et al., (2003) framework:

- Increase the opportunities firms have to become competitive.
- Provide access to additional resources to enable firms to continue with their strategy (as grants)

Generate additional incentives to cooperate, to solve firm specific problems.

- Generate internal capabilities in the participant firms.

In conclusion, the paper aims to test the framework as part of a pilot evaluation for the KTP programme in order to overcome the three challenges found in the evaluation of behavioural additionality. The overall goal is to generate policy learning mechanisms by studying how the careful design of an innovation policy aids the identification of broader effects in complex policy settings, such as a collaboration policy, and ultimately enables a better explanation of what works, for whom and under which conditions? (Pawson and Tilley, 1997)

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***Cross-sector Cooperation among Scientific Research Groups: Analysing Motives and Barriers***

**Abstract:**

Public sector research organisations (PSROs), including universities and government research centres, are driven to collaborate with external partners by a variety of factors. These include external demands for new knowledge (Meyer-Krahmer & Schmoch, 1998; Schartinger et al., 2002) and the need for financing (OECD, 1999; Santoro & Gopalakrishnan, 2000). Both these drivers can generate interdependent relationships (Geisler, 1995). However, the intermingling of such interactions between research organisations and their collaborative partners means that they do not fit in a single specific pattern (Thune, 2007).

According to a traditional model, diverging logics can characterize collaboration relationships between researchers and external partners. On the one hand, scientists direct their activities inspired by a reputation-based scientific reward system, whereas, on the contrary, the productive sector is guided by the imperative of producing tradable results (Dasgupta & David, 1994). The main limit to cooperation on the part of researchers lies in the tension between maintaining an individual career trajectory and the requirement to contribute to the social relevance and economic viability of the organization in which they perform their activities. In this traditional model, an important mediating factor is the perceived impact that collaboration with industry or government agencies may potentially have on individual research freedom and task priorities. A perception of potentially negative impacts on individual or collective research agendas can prove to be a barrier to establishing or furthering interactions with private sector partners.

Despite the perception of such potential disadvantages, the rendering of services and the participation in cooperative interactions with private sector partners continues to take place and, in some cases, strengthen. A plausible explanation for this could be found in individual responses to specific incentives, in the diversification of trajectories of professional science careers, or in the presence of disparate scientific and/or technological goals (Perkmann & Walsh, 2007). Scientists can obtain benefits from this exchange, for example the awarding of funds that they can employ in acquiring equipment and materials or in the training of new researchers, together with a business sector perspective on the problems they may face in their research lines (Lee, 2000). It has also been empirically demonstrated that a combination of basic research activities and cross-sector cooperation can prove profitable, both in terms of scientific production and in accessing finance from competitive public sources (Manjarrés-Henríquez et al., 2008).

However, this approach lacks an understanding of the underlying factors that may

contribute to boosting links between researchers and external partners and, precisely, what binds different agents together (D'Este & Patel, 2007; Lam, 2011; D'Este & Perkmann, 2011). An improved understanding is desirable in order to better assess the effects produced by current policies designed to facilitate cross-sectoral cooperation between PSROs and the end-users of research (Turpin & Fernández-Esquinas, 2011; Woolgar, 2007). Two main gaps are covered in this study: on the one hand, there is a need to investigate the way cooperation-fostering measures operate and to pay closer attention to the incentives that push PSROs towards cooperation (McLellan et al., 2006); on the other hand, it is also important to identify the barriers that prevent collaborative relationships, in order to be able to mitigate their effect.

Insufficient attention has also been paid to the importance of research groups, which are the fundamental collective unit of much scientific activity. At the research group level, little is understood about how motivations and barriers may impact on research groups' propensity to collaborate with external partners. This is despite the fact that these factors are keys to a better understanding of the dynamic of knowledge transfer practices and relations (Bozeman et al., 2013). Research groups represent the backbone of the research system in Spain. They are organisational units of a functional nature but with dynamic characteristics, representing advantages for the development of research activity due to the complementary nature of their components and the availability of an optimal critical mass (Rey Rocha et al., 2008). Then, the core of the study is a survey among the heads of research groups, who are used as a proxy for the experiences of the collective. The survey population is constituted by the total of active research groups in PROs (universities and public research centers) following up-to-date official sources for four Spanish regions to achieve a final sample of 851 research groups.

The rationale for cooperation and the barriers that restrain it may also differ depending on the type of collaboration partner (D'Este & Patel, 2007). The main aim of this study is to investigate research group leaders' motivations to collaborate and the barriers to collaboration they perceive, which can help us explain patterns of cooperation with both firms and government agencies. The paper makes two main contributions to the literature. First, it addresses the perceptions of research group leaders. The importance of this methodological choice derives from the fact that group leaders exert an important influence on the attitudes and behavioural patterns of co-workers (Bercovitz & Feldman, 2008) and, at the same time, they are widely informed about the accumulated experience of the collective. Second, the paper observes whether scientists who cooperate with firms are driven by distinct sets of motivations, or confront different barriers, as compared to those who interact with government agencies.

Likert-type scales were used to assess the importance of eleven motivations and seven barriers for cooperation. A factor analysis was performed showing that motives for cooperation cluster in three main groups: furthering research; searching for knowledge applications; and accessing financial resources. At the same time, barriers can be grouped in two: risks to scientific autonomy, and risks to scientific credibility. In addition, patterns of collaboration exhibit significant differences when we take into account the scientific field of the research group. In relation to different types of external partners, the results show that Spanish researchers tend to cooperate more with government agencies than with the

private sector.

Subsequently, we generate a logistic and multinomial regression models. The first model allows the identification of factors influencing patterns of collaboration with external partners. The second model identifies differences between collaboration by partner type: motives and/or barriers to collaborate only with the private sector, only with public agencies and with both. In this case no-cooperation is our reference category. Our main results show that motivations have a positive effect on collaboration whilst barriers are associated with a negative impact. However, there are some differences in these results depending on the collaboration partner type. Research groups looking for financial resources are more likely to collaborate with firms. Advancing research goals acts as an inducement to collaborate mainly with government agencies, while searching for opportunities to apply knowledge expands the likelihood of exchanges with firms or with both partner types. In relation to barriers, research groups tends to consider the risk to scientific autonomy a higher impediment when they collaborate with government agencies, and the risk to scientific credibility becomes a problem when the collaboration occurs with firms.

In summary, this study enables us to assess how researchers' opinions on, and attitudes towards, cross-sector cooperation affect the degree of participation of their groups in knowledge transfer activities. It also facilitates better identification of barriers to collaboration and how these may affect research groups in their relationship with different partner types. It appears that Spanish government administrations and agencies are very important counterparts of research groups. Of course, the evaluation of both interaction processes and outputs are needed to improve the quality of information that can guide future strategies and policies. However, what is clear is that Government sector actors are important components of 'triple helix dynamics' in the contemporary Spanish research system. To profit from these established links, the framework conditions and strategic actions that promote cooperation between PSROs and other innovation system actors thus need to operate in a double direction; promoting knowledge application incentives addressed to social challenges and economic opportunities, whilst also seeking to neutralize barriers associated with perceptions of the potential negative impact of external collaboration on scientific autonomy or credibility. Reducing such barriers could contribute to the goal of enlarging the pool of research groups seeking to collaborate with private and/or public sector end-users of the knowledge they produce.

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***Evaluation processes in research grant allocation: what is the relevance of scientific quality?***

**Abstract:** Background and aim of the paper

This paper wants to go inside one of the most important funding scheme in Italy, the Project of National Interest (PRIN), which is devoted to support the university research. PRIN traditionally represents a mean for providing resources for collaborative research at the University, either curiosity driven or applied, in all the disciplinary fields. Using the case of PRIN, the paper wants to demonstrate that competitive funding schemes represent an important mean for the government to steer the research at the university; under certain conditions, the steering is likely to impact the evaluation processes producing a more prominent role of factors besides the scientific quality driving the research grant decisions. From the nineties government in Italy used the PRIN lever to steer the university toward improving the quality and the competitiveness of the research activities: on the one hand the rules for the assessment of the proposals changed in the considered years, on the other hand, the PRIN success rate (number of PRIN proposals positively assessed on the number of PRIN proposals submitted) became in mid nineties a component of the formula for the allocation of the institutional university funding (FFO, Reale and Potì, 2009). Thus, in Italy the government allocates PRIN funding on the base of a competitive assessment that is supposed to be driven by scientific quality (quality of the principal investigator and the research team, quality of the proposal); at the same time, government uses the PRIN success rate as an output indicator of the university fund raising capability, in order to allocate the research quote of the institutional funding. In this way, PRIN is likely to produce a strong self-reinforcing effect of the universities that are able to get the highest success rates (Reale, 2008); this fact can also influence the process of grant assessment, reinforcing the weight of criteria that are not linked to the scientific quality of the proposals (Gillet, 1991).

**Conceptual framework**

Allocation of resources in R&D is a central concern for policy makers, due to the budget constraints and to the need to get higher economic returns from the R&D investment. During the last fifteen years, governments in many European countries pushed public research institutions, including higher education institutions, to develop research activities with growing external commitment. The reasons for this trend are specific to the various countries, but it is possible to identify within all the European member states a general reorganisation of the science systems towards more flexible and competitive project funding schemes (Lepori et al., 2007). Moreover new instruments have been created for supporting private research and for getting more social return from R&D funding. Several papers have analysed biases and constraints affecting the grant allocation procedures based on peer review. Langfeldt (2006) pointed out the problems of interdisciplinary of research proposals, and of unfair competition between groups and research organizations; Laudel (2006a) highlighted that the quality of the principal



investigator and the quality of the research proposal although important, are not the main criteria influencing the final judgement, since other factors not controlled by scientists –as local conditions, field characteristics and institutional rules- play a very important role; similar results are also discussed by van den Besselaar and Arensbergen analysing grant for talented researchers of the Dutch Research Council (2013). The Matthew effect is thus a key component of grant acquisition, hindering the possibility of new entry and continuously rewarding the same groups. Lamont (2009) pointed out the emotional, cognitive and social dimensions that go with the quality judgement, so that subjectivity cannot be completely eliminated from the peer assessment. A recent paper outlined the problems of researchers performing as evaluators with many different tasks and playing different roles (Langfeldt and Kyvik, 2011). Among them, the “grant distribution” is a key one: being part of panels set up to distribute research grants or acting as peer in charge of assessing the quality of a research grant proposal are essential components for the correct functioning of the scientific system, due to the increasing amount of money that has been transferred to researchers by the way of competitive funding. Several problems can affect the good performance of the researchers in the mentioned role, namely: a) cognitive biases of the reviewers, b) fair or unfair negotiations inside the panels, c) a limited amount of resources that pushes for a high rejection rate (see also on this point Hornborstel, 2001), d) lack of precise expertise of the reviewers. Conflicts can also emerge among scholars, such as: i) the time conflict (not enough time to make a sound analysis of the proposal); ii) the conflicts of interests in case of people being part of competitive research group, a fact that very often applied to domestic researchers for evaluation in their own field; iii) the impartiality of the judgement and the impact that a research proposal might have in the reviewers’ activity; iv) the role of criteria different from the scientific quality of the proponent and of the proposal, which can play a strong role (e.g. fitness for purpose to the program, gender issue, socio-economic impact assessment, ethical issues, geographical or institutional considerations, etc.).

Based on the quoted results, the paper investigates the extent to which scientific quality is at the core of the selection process of PRIN grant, and how its prominence changed along the time according to the transformation of the PRIN rules for funding assessment. The analysis also wants to understand how is scientific quality operationalized by peers (originality, methodological soundness, clearness of objectives and scope, interdisciplinarity, etc.), and what factors influenced the importance of other concerns than scientific quality. Is the prominence of concerns different from scientific quality a result of the changes the government introduced in the PRIN scheme in order to steer research at the university, or an adaptation of the academics to the need of maintain a fair distributive principle in the PRIN funding allocation (Laudel, 2006b)?

#### Methods and empirical evidences

For the purpose of the paper we use:

- a) documentary analysis of the different PRIN calls from 2000 to 2011, the policy and administrative documentation describing the rationales guiding the changes in the PRIN funding scheme, and the expected outcome as to the changes of the university research;
- b) data collected on 4.321 researchers from 98 universities that have been selected for PRIN allocation from 2000 to 2011.

The sample refers to four research fields: physics, chemistry, economics and business, social sciences. Data collected on PRIN grants allocated in the considered period allow to

understand the amount of funding transferred, the characteristics of the proponents, either the principal investigators and the responsible of the research units, as to gender, academic position, scientific quality, role in the PRIN, number of grant allocated, network of collaborations.

The documentary analysis and the data analysis are combined with the results of 20 interviews to a sample of principal investigators in the four selected fields, which have been involved in several PRIN projects; the PIs were asked about the evaluation process of the proposal submitted in the different years, and conversely their experience in the PRIN evaluation processes in which they acted as peers or panellists.

#### Expected results

We expect to find out a clash between the government will to steer research at the university and the behaviour of academics acting as reviewers. We expect to see that the Matthew effect is growing along the years, with the emergence of mechanisms of locking out for some groups, and repetitive PRIN funding for other groups. Groups are more or less stable; coalitions of scholars dealing with research activities coordinate themselves under a common research design, in order to get funding for research activities. The final judgements of the evaluation processes are mainly driven by the way in which panellists and peers perform the grant assessment, the main preoccupation being to maintain the existing distribution of research resources beside the scientific quality. This trend is basically due to the fact that only national scholars have been involved for a long time in the PRIN assessment; in recent time the quoted trend has been challenged by a larger use of non-national peers, and by the emergence of other competitive R&D funding streams (first and foremost the EU-based ones) entering the university funding formula, and allowing groups to differentiate the project funding portfolio.

#### References

Besselaar, P. van den & Arensbergen, P. van (2013). Talent selection and funding of research. *Higher Education Policy*, 26: 421-427

Gillet R.,(1991). Pitfalls in assessing research performance by grant income. *Scientometrics*, 22

Hornbostel S., (2001). Third party funding of German universities: an indicator of research activity?. *Scientometrics*, 50

Lamont, M. (2009). *How professors think. Inside the curious world of academic judgment*. Cambridge: Harvard University Press

Langfeldt L., (2006). The policy challenges of peer review: managing bias, conflict of interests and interdisciplinary assessments. *Research Evaluation*, 15, 1

Langfeldt L. and Kyvik S. (2011). Researchers as evaluators: tasks, tensions and politics. *Higher Education* 62:199-212

Laudel G. (2006a). The 'quality myth': Promoting and hindering conditions for acquiring research funds. *Higher Education*, 52:375-403

Laudel G. (2006b). The art of getting funded: how scientists adapt to their funding conditions. *Science and Public Policy*, 33:489-504

Lepori B., van den Besselaar P., Dinges M., Potì B., Reale E., Slipersaeter S., Thèves J., van der Meulen B. (2007), Comparing the evolution of national research policies: what patterns of changes?. *Science and Public Policy*, 372-388

Reale E. (2008). *La valutazione della ricerca pubblica*. Angeli, Milano

Reale E., Potì B. (2009). Italy: Local Policy Legacy and Moving to an 'In between' Configuration. in Paradeise C., Reale E., Bleiklie I., Ferlie E. (eds.). *University governance. Western European Comparative Perspectives*. Springer, Dordrecht, 77-102

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***Simultaneous embeddedness in different networks and its effect on scientific knowledge generation: evidence from Spanish scientists***

**Abstract:** Introduction: research topic

Interactions between Public Research Organisations (PROs henceforth) and Industry are at the forefront of policy agendas world-wide as they are instrumental to foster technological development and economic competitiveness. Interactions between PROs and industry can also help attenuate the pressures that the current global economic crisis place on public sector research budgets – especially in countries with high levels of debt –by providing external private funding, directly oriented to the generation of marketable innovations. The scope of this paper is to deepen the understanding of PROs-Industry links with reference to the antecedents of their formation and the impact of these links on the world of scientific knowledge production. In broad terms this endeavour involves the analysis of the process through which knowledge producers (i.e. scientists) both organize within their own community and interact with industry to generate scientific knowledge.

Main research questions

Although previous research has studied topics such as the process by which the different incentive structures of scientists and industry staff align to produce different instances of PROs-Industry links (Arvanitis et al., 2008; Landry et al., 2010) and the effect of PROs-Industry links on scientific productivity (Azoulay et al., 2009; Toole and Czarnitzki, 2010), extant literature has concentrated to a lesser extent on how the complex organisational structure of the scientific community affects scientific productivity (Uzzi et al., 2007). In particular, two main gaps are worth noting.

First, former studies have focused on a limited set of mechanisms of knowledge generation and transfer, mostly including patents, publications and academic spin-offs while almost completely disregarding others such as R&D contracts and consulting (D'Este and Patel, 2007). This gap is particularly unfortunate, because they are more frequent compared to other means of engagement in knowledge transfer activities; they are often critical channels through which public research can impact on industrial R&D and they are also appreciable as streams of income (Perkmann & Walsh, 2007).

Second, not only single relationships between scientists and external agents are important but also the overall structural properties of the network of relationships are essential in nurturing the generation of knowledge. Although a large literature in organization science, economics and management of innovation has analysed the structure and characteristics in the organisation of science, to our knowledge only Breschi and Catalini (2010) have tried to model the simultaneous embeddedness of scientists in different networks. In particular, they combined data on scientific co-authorship with data on patent co-invention to assess the extent of the overlap between the two communities and to identify the role of key individuals in the process of knowledge transfer. They show that the extent of the connectedness among scientists and inventors is rather large, and that authors-inventors

act as gatekeepers and bridge the boundaries between the two domains, are fundamental to ensuring this connectivity.

Overall, our contribution tries to address the gaps outlined above by answering to the following research questions: (i) What is the effect of a more complete range of knowledge transfer activities – such as contract R&D and consulting – on the generation of scientific knowledge? (ii) Is the simultaneous embeddedness in multiple networks (i.e. scientific co-authorships, patent co-inventions, collaboration on contract R&D and collaboration in consulting activity) influencing knowledge creation? (iii) how different structural network properties – such as brokerage position within a network of relationships (e.g. network of collaboration in consulting activity) and brokerage position between different networks (e.g. between the network of patent co-inventions and the network of collaboration in consulting activity) – affect the generation of scientific knowledge?

#### Data and method

The empirical analysis exploits a unique dataset containing detailed project/contract level information on PROs-Industry links in Spain. The database contains information on the population of scientists (i.e. 4757) working at the Spanish Scientific Research Council (CSIC) over the period 1999-2008. CSIC is the main publicly funded research organisation present in Spain and the third in Europe. It is composed of 135 institutes covering all fields of science (Physics, Chemistry, Biology, Medicine, Mathematics, Computer Science, Humanities, Social Sciences) and comprises about 3200 scientists (permanent staff). Several unique features of the database are worth mentioning. First, the data comes from the administrative records of the CSIC and, thus, they are not affected by usual concerns relative to survey-based measures, i.e. self-report bias. Second, the longitudinal nature of the data allows the exploitation of recent advancements in econometrics to tackle endogeneity issues. Thirdly, the data is characterised by a richness of details at: (i) scientist level providing information on age, affiliation, position, experience, scientific field and the highest degree attained and (ii) the contract/project level providing comprehensive information on the typology of the contract (i.e. collaborative grant, R&D contract or consulting), duration, the amount contracted and the content of the contract. Moreover, information on the publication and patenting activity of the scientists contained in the dataset for the period 1999-2008 has been retrieved from PATSTAT and ISI-WEB. From a methodological viewpoint, we aim at exploiting the longitudinal nature of the data to address our research questions. In particular, we will employ non-linear panel data models with fixed effects and quasi-experimental procedures (in particular, conditional difference-in-differences) in order to identify whether the research productivity (measured in terms of quality weighted number of publications) changes along different characteristics (e.g. within and between structural constraints, measures of centrality, age, experience, etc.).

#### Expected contributions

We believe that the paper will contribute to uncover the conditions that favour (or hamper) an optimal organisation of scientific activity, as well as to shed new light on the effect of different kinds of structural holes on the extent of research productivity at the individual level. The results of this paper should therefore contribute to fill an important gap in the existing literature on university-industry knowledge transfer and organisation of science, as well as providing valuable suggestions to improve the effectiveness of policies oriented to favour university-business interactions.

## References

- Arvanitis, S.; Kubli, U. & Woerter, M. (2008), 'University-industry knowledge and technology transfer in Switzerland: What university scientists think about co-operation with private enterprises', *Research Policy* 37(10), 1865 - 1883.
- Azoulay, P.; Ding, W. & Stuart, T. (2009), 'The Impact Of Academic Patenting On The Rate, Quality And Direction Of (public) Research Output', *Journal of Industrial Economics* 57(4), 637-676.
- Breschi, S., & Catalini, C. (2010). Tracing the links between science and technology: An exploratory analysis of scientists' and inventors' networks. *Research Policy*, 39(1), 14-26.
- D'Este, P. & Patel, P. (2007), 'University–industry linkages in the UK: What are the factors underlying the variety of interactions with industry?', *Research Policy* 36(9), 1295-1313.
- Landry, R.; Saihi, M.; Amara, N. & Ouimet, M. (2010), 'Evidence On How Academics Manage Their Portfolio Of Knowledge Transfer Activities', *Research Policy* 39(10), 1387-1403.
- Perkmann, M. & Walsh, K. (2007), 'University–industry relationships and open innovation: Towards a research agenda', *International Journal of Management Reviews* 9(4), 259-280.
- Toole, A. A. & Czarnitzki, D. (2010), 'Commercializing Science: Is There a University "Brain Drain" from Academic Entrepreneurship?', *Management Science* 56(9), 1599-1614.
- Uzzi, B., Amaral, L. A., & Reed-Tsochas, F. (2007). Small-world networks and management science research: a review. *European Management Review*, 4(2), 77-91.

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***Anticipatory coordination around nanotechnology innovation systems and industries: successes, failures and muddling through.***

**Abstract:** Nanotechnology has been promising large socio-economic benefits for over 10 years now triggering a large number of national initiatives, regional policies and pan-European programmes (Bhushan 2010). A large focus on policies have been on stimulating nanodistricts (Robinson et al. 2007) and national programmes (Mangematin et al. 2005, Bozemann et al. 2007,). However, as the special session suggests, the process of transformation of potentially breakthrough technologies into technologies well embedded in society requires innovation systems and structures to be in place, as well as functioning markets.

If one looks at the level of nanotechnology domains, such as nanomedicine nanoelectronics, nanomaterials and nanofood, there are clear differences in the types of actors involved and the incumbent/comparable industry structures and value chains.

This presentation elaborates on a specific point, that nanotechnology as an umbrella term (Rip and Voss 2013) may work well for targeting research policy and research funding, however for innovation policy (which focuses on creating industries leading to beneficial socio-economic impacts) one must look underneath the umbrella term and focus on the specifics of nanotechnology domains (Rip et al. 2007). There have been moves in this direction, particularly in Europe in the form of anticipatory coordination and policies to stimulate collaborations. However, each of the four nanotechnology domains mentioned above have had different degrees of success, and in one case little visible success in terms of building dedicated innovation and market infrastructures.

To illustrate this, the presentation will describe the four nanotechnology domains as emerging techno-economic pathways (Robinson and Lagnau forthcoming, Robinson and Propp 2008, Schubert et al. 2013, Sydow et al. 2005, Garud and Karnoe 2013), and outline the difference characteristics of the four pathways in terms of innovation and market infrastructures.

The presentation will show how in some cases, a techno-economic path has failed to emerge and has lead to what is labelled as an innovation waiting game. 'Innovation waiting games' – that lead to innovation impasses where emergence is hindered – although recognised as a key challenge has received little attention in the innovation management and policy literature, while it is clearly important to understand the phenomenon, and to be able to do something about it. Such impasses are particularly striking for radical or architectural innovation processes, which are full of uncertainties and unknowns, and accompanied by high expectations. Waiting games, such as those involving the first mover problem, are strategic games in the real world (Scharpf 1997). To overcome them requires a change at the collective level, amidst high uncertainty, to create design and development regimes and infrastructures to break out of the impasse. In this presentation I will show some examples of how waiting games have been avoided to a greater or lesser extent.

References



- Bhushan, B. (2010). Springer handbook of nanotechnology. Springer. Chicago
- Bozeman, B., Larédo, P., & Mangematin, V. (2007). Understanding the emergence and deployment of “nano” S&T. *Research Policy*, 36(6), 807-812.
- Garud, R., & Karnoe, P. (Eds.). (2013). Path dependence and creation. Psychology Press.
- Mangematin, V., Rip, A., Delemarle, A., & Robinson, D. K. R. (2005). The role of regional institutional entrepreneurs in the emergence of clusters in nanotechnologies (No. 200515).
- Rip, A. and J.-P. Voß (2013) Umbrella terms as a conduit in the governance of emerging science and technology. *Sci. Technol. Innov. Stud.*, vol. 9, no. 2, pp. 39–59, Sep. 2013.
- Rip, A., Robinson, D. K. R., & te Kulve, H. (2007, September). Multi-level emergence and stabilisation of paths of nanotechnology in different industries/sectors. In *Workshop on Paths of Developing Complex Technologies* (pp. 16-17).
- Robinson, D. K. R., Rip, A., & Mangematin, V. (2007). Technological agglomeration and the emergence of clusters and networks in nanotechnology. *Research policy*, 36(6), 871-879.
- Robinson, D. K., & Propp, T. (2008). Multi-path mapping for alignment strategies in emerging science and technologies. *Technological forecasting and social change*, 75(4), 517-538.
- Robinson, D. K. R. & Morrison, M. (2011). Nanotechnologies for improving food quality, safety and security. Editors: Lynn Frewer, Willem Norde, Arnout Fischer and Frans Kampers *Nanotechnology in the agri-food sector. Implications for the future* (working title). John Wiley & sons, Inc., New Jersey.
- Robinson, D. K. R. (2011). Value chains as a linking-pin framework for exploring governance and innovation in nano-involved sectors: illustrated for nanotechnologies and the food packaging sector. *European Journal of Law and Technology*, 2(3).
- Robinson, D. K., Le Masson, P., & Weil, B. (2012). Waiting games: innovation impasses in situations of high uncertainty. *Technology Analysis & Strategic Management*, 24(6), 543-547.
- Robinson, D. K. R. & Lagnau, A. (Forthcoming) Additive Manufacturing in Transition: Characterising distinct techno-economic pathways in the move from rapid prototyping to mass customisation.
- Scharpf, F.W. 1997. *Games real actors play: actor – centered institutionalism in policy research*. Boulder, Colorado/ Oxford:Westview Press.
- Schubert, C., Sydow, J., & Windeler, A. (2013). The means of managing momentum: Bridging technological paths and organisational fields. *Research Policy*, 42(8), 1389-1405.
- Sydow, J., Windeler, A., Möllering, G., & Schubert, C. (2005, June). Path-creating networks: The role of consortia in processes of path extension and creation. In *21st EGOS Colloquium*, Berlin, Germany.



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***Do Funding Sources Complement or Substitute? The Case of the UK Cancer Research***

**Abstract:** This paper examines complementarity of research funding sources. Previous research has extensively investigated this phenomenon at the level of the scientist and research host organisation thus neglecting that multiple individuals and research host organisations with their own associated funding sources are often involved in the research process to produce a single scientific output. Funding sources may therefore complement or substitute at the level of the publication. With this paper, we attempt to expand our understanding of the complementarity among funding sources by focusing on the publication as unit of analysis. We distinguish funding sources between (i) national, (ii) international, and (iii) industry. National funding sources are further decomposed in major and minor sources according to proportion of the overall research output they supported. The empirical analysis is performed on a large dataset of publications (N= 7,510) related to the cancer domain and involving UK research host organisations. Findings reveal complementarity among national and international funding sources and between the latter and industrial support. The empirical analysis does not provide evidence of complementarity between national and industrial funding sources while a strong complementary among the (major and minor) national funding sources is supported.

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***Identifying bottlenecks in the Colombian innovation system: an analysis of the functions performed***

**Abstract:** Introduction

The innovation system approach has been embraced by many developing countries to guide policy-making and the institutional set-up regarding innovation. In analysing the origins and development of the concept, Arocena and Sutz (1999) found an important distinction between developed and developing countries

NSI is an ex-post concept for developed countries, built upon empirical studies which show similar organizational patterns around innovation. For Latin America, as they stated, NSI is an ex-ante concept, in the sense that governments have created technology related institutions and have tried to build networks to promote innovation at the firm level, on the basis of the NSI model. This is not insignificant, as they stated, because in Latin American “very few patterns of the socio-economic behaviour regarding innovation can be viewed as working in a system-like manner” (Arocena & Sutz, 1999, p. 5). Following these authors, one could argue that the NSI concept in developing countries has been used more frequently as a normative framework rather than as an analytical tool, therefore limiting the usefulness of the conceptual framework. Besides, more emphasis has been done in identifying the components of the systems and depicting the relations between them, than finding the systemic problems and failures, and the causes behind them, in order to propose policy guidelines.

**The Colombian system of innovation**

In the case of Colombia the model was applied when the system of innovation was formally launched in 1995, as part of the national system of science and technology (SNCyT by its acronym in Spanish), which is leaded by Colciencias (governmental agency in charge of science, technology and innovation promotion and funding). Then a number of supporting organizations were created, such as: technological development centres thought as intermediaries between the research system and the industry; technological parks and incubators to house start-ups and spin-offs; and venture capital funds. The Colombian government used the concept to guide the design of policies and instruments; to build and organize the system, in other words, to set up the infrastructure, with the final objective of facilitating the linkages between various actors (Salazar, 2010).

In Colombia, as in many developing countries, universities and R&D institutes continue to be the main actors and are the producers of knowledge par excellence, so the use of the term science, technology and innovation system (SNCTI by its acronym in Spanish) is more common, as it is known today.

In recent years several diagnostics have been done of the Colombian STI system showing the weakness of the organizations, the institutions and some of the policy instruments,

regarding the impact they have upon firms and innovative propensity. The background report of the STI system in Colombia (Fog, Salazar, Nupia, & Vesga, 2012), done for the OECD, point to several weaknesses, such as:

- Weak relations of the productive sector with other actors of the system, in the government sector as well as in education and research.
- Low demand of public resources for innovation.
- Few and weak links between firms and university or R&D centres.
- Low investment in R&D, both from public and private sectors.
- Few innovating companies.
- Little human resources engaged in STI activities.
- Low levels of coordination and articulation between actors of the system.

The OECD review of the Colombian innovation policy, reinforce some of the points stated above. It affirms that firms have a weak role and are not at the centre of the NIS. Besides, because of the “historical origin of Colciencias as a science funder may partly account for the predominance of this “science push” model and the proliferation of interface and commercialization support instruments in public organizations” (OECD, 2013, p. 10), despite having adopted the NIS concept.

This leads us to ask if the systemic problems or failures are what affect the country, “as the process for identifying the causes of lock-in and eliminating those bottlenecks to enable innovation and economic progress both at the firm and system level” (Klein Woolthuis, Lankhuizen, & Gilsing, 2005, p. 612). These authors raise four types of systemic failure, related to infrastructure, capabilities, institutions, and networks or links (Klein Woolthuis et al., 2005). However, to my best knowledge, no analysis of the systemic failures of the Colombian SNCTI has yet been done.

The final objective of the research is to identify the bottlenecks in the Colombian innovation system, going a step forward of the SWOT analysis. The method to be used is to look at the functions performed in the NSI using the framework proposed by Edquist (2005, 2011), providing evidence of every activity and actor involved, as the first step of a work in progress (see table below). This will lead to the identification of the systemic problems. Finally the bottleneck analysis will allow for a future definition future of an SI-based innovation policy,

This approach in any case, will not solve all the questions regarding policy-making, as Kuhlmann and colleagues stated, [despite] “the innovation system approach has been made more dynamic, inter alia by introducing the concept of „functions“ of „critical success factors“ of innovation systems. (...) Still, the question remains how actual policymaking refers to functions, and how functions translate into policymaking and policy effects” (Kuhlmann, Shapira, & Smits, 2010, p. 6).

TABLE GOES HERE

Source: own elaboration based on Edquist (20011, p. 1729).

As seen in the table above in the Colombian SNCTI most of desired functions are performed

by several organizations, certainly many not with the intensity and efficiency required. From an innovation system perspective the elements and the activities are present, but many interactions between the actors are lacking. Besides it is needed to increase the number of innovative firms that are the core and the basis of the system.

Based on the data from four national innovation surveys of the manufacturing industry<sup>2</sup> that cover the period 2003-2010, the percentage of non-innovators manufacturing firms, which are the majority, is increasing, they were 52 per cent in 2003 and rose to 61 per cent in 2010 (OCyT, 2012). Besides, looking at the results of the last three innovation surveys that cover the period 2007-2012, the percentage of private firms investing in innovation activities is very low, ranging from 16 to 33 per cent in the period, with a diminishing trend. In addition, the public funding of those activities is marginal, fluctuates between 0.46 to 1.08 per cent, and the total investment in innovation is diminishing (Lucio-Arias, Sánchez, Mora, & Villarreal, 2013, p. 207).

In terms of the market failures that occur normally in economies such as the Colombian, perhaps the most frequent and the one that has the greatest impact is the one related to the risks associated with the development of STI activities, and the uncertainty of the appropriation of the benefits. For instance, Colombian manufacturing firms report that the uncertainty related to the demand for goods or services innovations, is one of the main obstacles they face.

For Colombia, some systemic failures can be identified, such as: i) a physical infrastructure not suitable for innovation and competitiveness; ii) institutions, relating to the cultural, social and political values that do not favor innovation; and possibly iii) technological dependency (path dependency) and inability to adapt to new technological paradigms, resulting from the low STI national capabilities, particularly of the productive sector. The development of this preliminary analysis is the next step of this research in progress.

#### Footnotes

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2 The national statistical agency (DANE for its acronym in Spanish) is in charge of the innovation surveys in Colombia; results can be downloaded from:

<http://www.dane.gov.co/index.php/tecnologia-e-innovacion-alias/encuesta-de-desarrollo-e-innovacion-tecnologica-edit>

#### References

Arocena, R., & Sutz, J. (1999). Looking at national systems of innovation from the south. Paper presented at the DRUID Conference on National Innovation Systems, Industrial Dynamics and Innovation Policy, Rebuild, Denmark.

Edquist, C. (2005). Systems of innovation: Perspectives and challenges. In J. Fagerberg, D. Mowery & R. Nelson (Eds.), *The Oxford handbook of innovation* (pp. 181-208). Oxford, New York: Oxford University Press.

Edquist, C. (2011). Design of innovation policy through diagnostic analysis: identification of systemic problems (failures). *Industrial and Corporate Change*, 20(6), 1725-1753. doi: 10.1093/icc/dtr060

Fog, L., Salazar, M., Nupia, C., & Vesga, R. (2012). National system for science, technology and innovation in Colombia - Background Report, presented to the OECD. Bogotá.

- Klein Woolthuis, R., Lankhuizen, M., & Gilsing, V. (2005). A system failure framework for innovation policy design. *Technovation*, 25(6), 609-910.
- Kuhlmann, S., Shapira, P., & Smits, R. (2010). Introduction. A systemic perspective: the innovation policy dance. In R. Smits, S. Kuhlmann & P. Shapira (Eds.), *The theory and practice of innovation policy. An international research handbook*. Aldershot, UK and Brookfield, US: Edward Elgar.
- Lucio-Arias, D., Sánchez, E., Mora, H., & Villarreal, N. F. (2013). Estudio comparativo de los resultados de las Encuestas de Desarrollo e Innovación Tecnológica (EDIT) en la industria manufacturera en Colombia desde una perspectiva sectorial. In J. Lucio (Ed.), *Observando el Sistema Colombiano de Ciencia, Tecnología e Innovación: sus actores y sus productos*. Bogotá: OCyT.
- OCyT. (2012). *Indicadores de Ciencia y Tecnología - Colombia 2012*. Bogotá: Observatorio Colombiano de Ciencia y Tecnología.
- OECD. (2013). *OECD Reviews of Innovation Policy: Colombia- Overall assessment and recommendations*. Paris.
- Salazar, M. (2010). *Communication channels among the actors of the Colombian system of science, technology and innovation: a test of the Sabato's triangle model*. (PhD thesis), Simon Fraser University, Burnaby. Retrieved from <https://theses.lib.sfu.ca/>

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***Participatory loans and innovation in SMEs: rethinking the public funding of innovation capabilities***

**Abstract:** We analyze the impact of a specific experience of public funding (the participatory loan) for SMEs innovative projects, on the performance of firms. The selection criteria of the projects to be financed incorporate atypical attributes of the firm, related with the concept of intellectual capital management. Results suggest that firm's productivity can be partially explained by the development of the participatory loan projects, indicating a satisfactory selection of projects. The implications for policy making are straightforward, since these kinds of instruments might improve the incentives for more accurate selection of projects in public funding institutions (for example, by requesting the elaboration of intellectual capital reports), and ease the effects of uncertainty on private funding.

Specialized literature has highlighted the relationship between access to finance and production scale. For example, Martinelli (1997) observes that large firms face lower interest rates than small firms. Czarnitzki and Hottenrott (2011) suggest that small firms may have disadvantages because they cannot exploit scale economies, and have fewer overall physical assets that could serve as collateral compared to large capital intensive companies. However, previous literature is consistent with the idea that innovative capabilities might not be matter of scale, or at least not everywhere (Acs and Audretsch, 1987; Damanpour, 1992; Lee and Xia, 2006; Becheikh, Landry and Amara, 2006). These facts might be interpreted as a market failure in the financial system, due to its limitations for selecting successful innovative projects. Moreover, the existence of these barriers for small firms is consistent with the idea that production scale is part of the selection criteria in the evolution of knowledge of the economic system.

To overcome this problem, some authors have stressed that reporting intellectual capital might influence the decisions of financial analysts (Alwert, Bornemann and Will, 2009). According to the Report to the European Commission of the high level expert group on Reporting Intellectual Capital to Augment Research, Development and Innovation in SMEs (RICARDIS), an IC Statement [i.e., intellectual capital report], if properly used, can not only help SME's to explain why finance is needed and how it will be used, but also to provide a basis for assessing the degree of risk and uncertainty surrounding the finance proposal. This is the keystone for the evaluation of the suitability of the financial proposal to the different alternatives, debt, equity or a mixture of the two (EC, 2006:81).

The participatory loans are especially interesting because it allows us to discuss a selection mechanism that explicitly takes into account this soft part of the organization. The public institution that delivers these loans is the National Innovation Company (ENISA), from the Ministry of Industry, Energy and Tourism of Spain. Their selection criteria include issues such as the viability of the project, the degree of innovation in the business model, or the experience of the management team in its sector of activity. The type of firm receiving the loan depends to a large extent on the ENISA credit type through which the credit has been submitted. For example, the line of credit for technology-based firms (EBT line) is intended to support companies that carry out projects that result in a technological breakthrough in

the development of new products, processes or services: The ENISA line tries to capture newly created companies submitting projects with an innovative business model. And, finally, SME line aims to support projects aimed at improving competitiveness of the firm.

#### Data and methodology

The study was performed with panel data from 387 companies that have received participatory loans. The data includes information such as the date and amount of credit, type of credit and accounting data received from the balance sheet and the income statement. Accounting data are available for at least three years for each firm during the period 2004-2012. This yearly information might be prior to the lending. This characteristic of our data will be important in shaping our explanatory variable.

The basic framework for our analysis is the production function of the firm. The focus is on analyzing the explanatory power of the evolution of the project on the performance of the firm, regardless other factors such as production scale, type of credit and type of assets. The model also includes unreported controls for individual and time effects. The models were estimated by panel data techniques. Since we have firms reporting sales equal to zero in some periods (i.e. we have a censored endogenous variable), we use a random-effects tobit regression.

#### Results

The results of the econometric model, for alternative specifications, are consistent with the hypothesis that the maturation of the project, measured by number of years since the credit was granted, is associated with higher productivity. These results are reproduced, with marginal changes, taking groups of firms according to the credit line granted.

#### Discussion

One of the main issues raised in the literature on the participation of public funding on the R&D and innovation activities, is the complexity to select "successful" projects due to uncertainty of the outcome. To cover this gap implies rethinking the selection criteria; otherwise the same results in terms of underinvestment would be achieved. In this sense, evidence of a statistical relationship between the project financed by the public sector and productivity could also be prove of successful project selection schemes, coexisting with other selection schemes (like the market), and shaping the evolution of knowledge production.

Although, as we have said before, results are interesting, this is an ongoing research and it must advance in the correct specification of the production function of the firm. To this purpose, it will be necessary to improve the database, introducing alternative information sources to better understand the nature of each project. Moreover, although the presence of firms in various stages of project implementation (even before starting) allows us to study the effect of public financing, it would be advisable to extend the sample to other firms that are implementing innovative projects selected with other criteria (e.g., which are funded exclusively by private funds).

#### References

- Acs, Z.J. and Audretsch, D.B. (1987), "Innovation, market structure, and firm size", *The Review of Economics and Statistics*, Vol. LXIX, Num. 4.
- Alwert, K.; Bornemann, M.; and Will, M. (2009), "Does intellectual capital reporting matter to financial analysts?", *Journal of Intellectual Capital*, Vol. 10 No. 3, pp. 354-368.

Becheikh, N.; Landry, R. and Amara, N. (2006), "Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993–2003", *Technovation*, 26 (2006) 644–664.

Czarnitzki D. and Hottenrott H. (2011), "R&D investment and financing constraints of small and medium-sized firms", *Small Business Economics* (2011) 36:65–83.

Lee, G. and Xia, W. (2006), "Organizational size and IT innovation adoption: A meta-analysis", *Information & Management*, 43 (2006) 975–985.

Martinelli, C. (1997), "Small firms, borrowing constraints, and reputation", *Journal of Economic Behavior & Organization*, Vol. 33 (1997) 91-105.



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***Regional Human Capital and University Orientation: A case study on Spain***

**Abstract:**

The role of Higher Education Institutions (HEIs) in regional economic development continues to be at the forefront of the debate in various areas of scholarly research. From the perspective of economic geography, human capital (HC) is a prime source of innovation, economic growth and regional competitiveness (Glaeser et al., 1995; Glaeser, 2005; Uyarra, 2010; Goddard et al., 2012). While universities are portrayed in this literature as key hubs for the generation and circulation of high-skilled workers (Florida et al., 2008; Abel, 2012), no clear explanation is offered on the roots of persistent differences in the ability to accumulate and use knowledge across regions. On another front, studies on the economics of university articulate in great detail the historical determinants of higher education and the changing relation of the latter with the attendant societal context (Geuna, 1999; Wittrock, 1993; Youtie and Shapira, 2008). The contribution of HEIs is conceptualized here as flowing through three main channels coinciding with the apocryphal “missions”, namely (and concisely): the provision of teaching and training; scientific research; and the promotion of university-society synergies. This approach offers a rich characterization of the constellation of HEIs’ activities but, arguably, overlooks the dynamics that influence demand for skills at regional level. To be sure, the foretold traditions strive to emphasize different aspects of the same phenomenon rather than being in opposition with one another, and indeed they share common ground. First, both streams portray universities as strategic hubs entertaining a wide spectrum of formal and informal relations with various other actors within their regions. Secondly, both approaches concur in understanding HEIs as a knowledge-creating entity and in acknowledging the sheer diversity of forms of knowledge and of pathways through which this can be put to use.

Our claim is that the gaps identified above have a common root, namely the lack of operationalization of key concepts such as Human Capital and University Mission which are treated, at best, only in abstract terms. The present paper seeks to analyze the impact of HEIs’ mission orientations on the HC endowment of their regions. It will do so on the basis of a critical assessment of some consolidated notions. On the one hand we argue that since the opportunities and the challenges at play in different regional contexts have a strong effect on the path of development of individual HEIs, the prototypical “one-size-fits-all” approach to university mission falls short. Is it realistic, or even desirable, that all universities are expected to engage all missions at once (Sánchez-Barrioluengo, 2013)? We argue that regional factor bias may trigger selection effects on mission engagement, and that the extent of this relation has not been analysed in depth so far. Second, and relatedly, prolonged commitment towards a particular university mission can be either a catalyzer or a barrier for the developmental path of a region. As a result, local labor markets may or may not reflect the pattern of the regional HEIs due to cyclical or technological forces (Beaudry, et al, 2010; Autor and Dorn, 2013). On the whole, we argue, the literature on regional

economic development has disregarded the complementarity (or lack of thereof) between regional specialization, factor endowment and traditional indicators of employment dynamics such as skill intensity and wages.

This paper will tackle the foretold gaps by means of an empirical study of the relation between regional demand and supply of skills. In particular it will focus on three questions:

- How does the university mission orientation contribute to competitive advantage in a region?
- What is the role of university in forging the supply of regional human capital?
- Do local labor markets reflect the pattern of specialization of regional universities?

Our empirical study focuses on 17 regions in Spain and the 47 public universities that operate within them over the period 2002-2012. To address the foretold questions it will elaborate novel empirical constructs and operationalize them in two steps. First, using data on 22 indicators (i.e. total enrolled students, research and third stream funding, scientific production, knowledge-transfer activities) we compute an index of regional university orientation that will allow measuring individual university performance in each of the three “missions”. This novel index captures in a synthetic way the relative importance of university engagement by assigning key HEIs activities to a particular mission construct. Second, we compute an index of regional skill intensity that reflects both quantitative and qualitative features of local human capital as debated in recent literature on labour market dynamics (see e.g. Spitz-Oener, 2006; Goos and Manning, 2007; Autor and Dorn, 2013). The second index is built by merging employment data from the Spanish Labor Force Survey (2-digit occupations) with data on the skill content of occupations (source: O-NET). Additionally, and coherent with the conceptual framework laid out above, we control for a range of region-specific characteristics (Boschma, 2004), namely: number of firms, %R&D on GDP, Number of High-Technology manufacture firms and % of ICT use.

Preliminary results show that university orientation is a good predictor of regional skill endowment, while overall educational attainment is not. This is in line with literature showing that traditional measures of educational stock have less connection to economic performance (e.g. Rodríguez-Pose and Vilalta-Bufí, 2005). We also observe differential engagement of university missions across regions, and that these are significantly influenced by region-specific characteristics. On the whole this initial analysis corroborates the conjecture that university orientation plays a strong role in the process of regional economic development. From this we derive preliminary policy implications. First, our results point to the weakness of the ‘one-size-fits-all’ model that is usually employed in the debate on university missions. Acknowledging, rather than ignoring, these differences is a first step towards the full exploitation of university potential on the basis of the revealed pattern of specialization. Second, our analysis of the skill content of the workforce affords the opportunity of a concrete assessment of the types of know-how that are relevant to regional economic development. Skill intensity as a unit of analysis is not knowledge in abstract terms but, rather, an empirical measure of supply and demand forces filtered by the reality of the regional labour market. Last but not least, the present study offers a more nuanced view of the connection between demand and supply of knowledge as mediated by institutional processes such as education, employment and economic performance.

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***Exploring academic and policy discourses on social innovation and the 'Grand Challenge' rhetoric***

**Abstract: Purpose**

This paper aims to analyze the evolution in the conceptualization of Social Innovation (SI) and how these conceptual approaches are being considered in policy discourses on 'Grand Challenges'. With this purpose, the paper presents a systematic literature review, analyzing 229 definitions extracted from documents dated from 1922 to 2014.

**Introduction & research questions**

Over the past decades a growing literature on SI has emerged in a wide variety of sources ranging from policy reports and applied practice-oriented to academic contributions (Chambon et al., 1982; Gerometta et al., 2005; Howaldt & Schwarz, 2010; Moulaert & Nussbaumer, 2004; Mulgan, 2006a; Bureau of European Policy Adviser, 2009; Andrew & Klein, 2010; Nicholls & Murdock, 2012; Moulaert et al., 2013). SI is seen as providing new solutions and instruments to cope with the 'Grand Challenges', i.e., the economic crisis and other global dilemmas such as climate change, energy and resource scarcity, health and demographic imbalances, which are becoming more urgent and require rapid resolution (Reid et al., 2010). However, SI is considered a 'buzz word' (Pol & Ville, 2009), a catchword (Godin, 2012a) or a 'container concept' (Gurrutxaga, 2013) that remains underdefined and, in other cases, seems to be overdetermined in social sciences, i.e., it holds many different and divergent meanings. Although the SI body of literature is expanding, research is fragmented in terms of theoretical and methodological approaches, and several conceptual ambiguities persist despite the accumulation of empirical data (Edwards et al., 2012; Cajaiba-Santana, 2013). In this context, this paper aims the following questions:

- How the conceptualization of SI has evolved from 1922 to date? (the year 1922 identifies the first reference analyzed)
- At what extent are these concepts and theoretical approaches considered/recognized in the rhetoric of the 'Grand Challenges' as drivers for research and innovation policy?

**Theoretical approach**

Although SI is being frequently used as a 'descriptive metaphor' for social change and the transformation of society more broadly (Godin, 2012b; Howaldt et al., 2013), the role of SI is marginal in the mainstream of the innovation studies. For example, SI is not mentioned in the ample analysis of the knowledge basis of the innovation field realized by Fagerberg et al. (2012) neither by Susana Borrás in her book 'The Innovation Policy of the European Union: From Government to Governance' (2003). Literature about SI seems still widely on

anecdotal evidence and cases studies with a plethora of meanings and interpretations scattered among different fields like sociology (Chambon et al., 1982; Howaldt & Schwarz, 2010; Gurrutxaga, 2013); urban and regional development (Hillier et al., 2004; MacCallum et al., 2009); public policy (Chetkovich, 2011); management (Goldenberg, 2004; Goldenberg et al., 2009); creativity (Mumford, 2002); social psychology (Taylor, 1970) and social entrepreneurship (Leadbeater, 1997), among others. One common point of reference in economic thinking is the publication in 1912 of the Theory of Economic Development in which Schumpeter acknowledged the role of innovation in other spheres of society than the economic—that is, in the cultural, social, and political life—recognizing its role in the transformative process of ‘creative destruction’ (Abernathy & Clark, 1985). This approach is criticized by Godin (2012a,b), who adopted a historical perspective to examine how the concept of SI has been present in academic literature since the beginning of the twentieth century, and even before, related to macro-societal changes. On other hand, the comparison between SI and the general meaning of innovation in the field of innovation studies is problematic due there is a diversity of definitions and that the term SI is frequently used interchangeably and in confuse ways with other concepts like inclusive innovation (Cozzens & Sutz, 2012; Foster & Heeks, 2013), open innovation (Chesbrough, 2003), frugal innovation (Pralahad, 2005), grass-root (Smith et al., 2013), Jugaad innovation (Radjou et al., 2012) and responsible innovation (Von Schomberg, 2013), among others. For example, both frugal innovation and SI are associated to theories which lie at the intersection of social and institutional entrepreneurship (McMullen, 2011) and their role as instruments to achieve inclusiveness and social cohesion.

This paper explores all these approaches with analytical lenses considering innovation as a ‘result/output’ and, at the same time, draw attention to SI as process. In this sense, following to Garud et al., (2013) innovation processes are co-evolutionary (implicating multiple levels of analysis), relational (involving a diverse set of social actors and material elements), inter-temporal (experienced in multiple ways during their evolution) and cultural (unfolding within contextualized settings). The principal hypothesis in this paper is that the concept of SI has experienced an evolution in its meaning and interpretations guided by struggles between different rationalities and divergent epistemic communities.

## Methodology

A systematic literature review was used to generate a database including definitions from different literatures, including grey and also academic literature (economics, innovation, sociology, social psychology, etc.). A systematic literature review is based on a rigorous process to identify, select and make a comprehensive analysis and critical synthesis of relevant studies that address a defined question. Compared to traditional literature reviews, systematic reviews offer several advantages for researchers, managers and policy makers, in particular the identification and mobilization of key scientific knowledge on the subject meeting explicit criteria for inclusion and exclusion and transparent quality assessment of studies identified (Becheikh et al. 2006; Hemsley et al. 2003).

One thousand registers were retrieved from Google Scholar using the software Publish or Perish and compared with 364 academic papers from ISI Web of Knowledge and SCOPUS, using the key words ‘social innovation’ and other key terms combinations.

Each register was classified attending to the source of information (academic paper, book, chapter book, research report, policy report and working paper) being the selection

criterion the presence in the document of an explicit definition and explanation of SI. The final database contains 229 definitions organized around a set of attributes/dimensions determined by a recursive content analysis, using matrix techniques for the effective categorization of data (Miles & Huberman, 1994; Creswell, 2003).

### Expected findings & Contribution

This paper aims to provide a state-of-the-art in the conceptualization of SI and how SI relates to the Grand Challenges comparing academic and policy discourses.

### References

- Abernathy, W. J. & Clark, K. B. (1985). Innovation: Mapping the winds of creative destruction. *Research Policy*, 14(1), 3-22.
- Andrew, C., & Klein, J. L. (2010). SI: What is it and why is it important to understand it better. ET10003. Ontario Ministry of Research and Innovation. Toronto. Cahiers du Centre de recherche sur les innovations sociales (CRISES). Collection Études théoriques, no ET1003.
- Becheikh, N., Landry, R., & Amara, N. (2006). Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993-2003. *Technovation*, 26(5/6), 644-664.
- BEPA (Bureau of European Policy Advisers). (2009). SI as part of the Europe 2020 strategy. Brussels: European Commission.
- Borrás, S. (2003). The innovation policy of the European Union: from government to governance. Edward Elgar Publishing.
- Chambon, J. L., David, A., & Devevey, J. M. (1982). Les innovations sociales. Paris: Presses Universitaires de France.
- Chesbrough, H. W. (2003). Open Innovation. The New Imperative for Creating and Profiting from Technology. Boston (Mass), Harvard Business School Press.
- Cozzens, S. & Sutz, J. (2012) Innovation in Informal Settings: A Research Agenda. Ottawa: IDRC.
- Creswell, J. W. (2003). Research design: Qualitative, quantitative, and mixed methods approaches (2nd ed). Thousand Oaks, CA: Sage Publications.
- Dagnino, R. (Coord.). (2010). Tecnologia Social. Ferramenta para construir outra sociedade (2nd ed.). Sao Paulo, Brazil: KOMEDI.
- Edwards-Schachter, M. E., Matti, C. E., & Alcántara, E. (2012). Fostering Quality of Life through Social Innovation: A Living Lab Methodology Study Case. *Review of Policy Research*, 29(6), 672-692.
- Edwards-Schachter, M. & Tams, S. (2013). How Empowering is Social Innovation? Identifying Barriers to Participation in Community-driven Innovation. Conference 'Social frontiers: the next edge of social innovation research. November 14-15th, 2013. London, UK.
- European Commission (EC) (2010a). Europe 2020: A Strategy for Smart, sustainable and inclusive growth. Communication from the Commission. COM (2010a). 2020.
- European Commission (EC). (2010b). Europe 2020 Flagship Initiative Innovation Union. Communication from the Commission COM (2010) 546 final.
- Fagerberg, J., Fosaas, M., & Sappasert, K. (2012). Innovation: Exploring the knowledge base. *Research Policy* 41(7), 1132–1153.
- Foster, C. & Heeks, R. (2013). Conceptualising Inclusive Innovation: Modifying Systems of

- Innovation Frameworks to Understand Diffusion of New Technology to Low-Income Consumers. *European Journal of Development Research* advance online publication, 4 April 2013; doi:10.1057/ejdr.2013.7
- Garud, R., Tuertscher, P., & Van de Ven, A. H. (2013). Perspectives on Innovation Processes. *The Academy of Management Annals*, 7(1), 775-819.
- Gerometta, J.; Haussermann, H. & Longo, G. (2005). Social Innovation and Civil Society in Urban Governance: Strategies for an Inclusive City. *Urban Studies*, vol. 42:11, pp.2007-2021.
- Godin, B. (2012a). —Social innovation: utopias of innovation from c 1830 to the present . Working Paper No. 11, Project on the Intellectual history of Internationalisation,, Montreal, Canada, CSIIIC. Available online at: [http://www.csiic.ca/PDF/SocialInnovation\\_2012.pdf](http://www.csiic.ca/PDF/SocialInnovation_2012.pdf)
- Godin, B. (2012b). 'Innovation Studies': The Invention of a Specialty. *Minerva*, 50(4), 397-421.
- Gurrutxaga Abad, A. (2013). *Societies of social innovation. Voices and arguments*. UK:Sussex Academic Press.
- Hargrave, T. I., & Van de Ven, A. H. (2006). A collective action model of institutional innovation. *Academy of Management Review*, 31(4), 864-888.
- Hamalainen, T. J. & Heiskala, R. (Eds.), *Institutional change and economic performance*. Cheltenham, UK: Edward Elgar, 52-79.
- Heiskala, R. (2007). Social innovations: Structural and power perspectives. In T. J. Hamalainen & R. Heiskala (Eds.), *Institutional change and economic performance*. Cheltenham, UK: Edward Elgar, 52-79.
- Hemsley-Brown, J., & Sharp, C. (2003). The use of research to improve professional practice: A systematic review of the literature. *Oxford Review of Education*, 29(4), 449-470.
- Howaldt, J. & Schwarz, M.(2010). *SI: Concepts, research fields and international trends*. Report of ESF,EU, and Aachen University.Dortmund, May2010.
- Howaldt, J.; Kopp, R. & Schwarz, M. (2013). Social innovations as drivers of social change-Tarde's disregarded contribution to social innovation theory building. Conference Social Frontiers: The next edge of social innovation research. 14th-15th November 2013, London (UK).
- Leadbeater, C. (1997). *The rise of the social entrepreneur*. London: DEMOS.
- MacCallum, D., Moulaert, F., Hillier, J., & Vicari Haddock, S. (2009). *SI and territorial development*. Aldershot, UK: Ashgate.
- McMullen, J. S. 2011. Delineating the Domain of Development Entrepreneurship: A Market-Based Approach to Facilitating Inclusive Economic Growth. *Entrepreneurship:Theory & Practice*, 35(1): 185-193.
- Mair, J., Robinson, J., & Hockerts, K. (2006). *Social Entrepreneurship*. NY: Palgrave.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis*. Sage: Thousand Oaks, CA.
- Moulaert, F.; MacCallum, D.; Mehmood, A. & Hamdouch, A. (Eds.). (2013). *The International Handbook on Social Innovation*. Cheltenham, UK: Edward Elgar Publishing Ltd. Pp. 13-24.
- Mulgan, G. (2006a). *A manifesto for social innovation: What it is, why it matters and how it can be accelerated*. London:The Young Foundation.
- Mulgan, G. (2006b). The process of social innovation. *Innovations*, 1(2), 145–162.
- Mumford, M. D. (2002). Social innovation: Ten cases from Benjamin Franklin. *Creativity Research Journal*, 14(2),253–266.
- Murray, R., Caulier-Grice, J., & Mulgan, G. (2010). *The open book of social innovation*. London: NESTA.
- Nicholls, A. & Murdock, A. (2012). *Social Innovation: Blurring Boundaries to Reconfigure*



Markets, Palgrave Macmillan.

Pol, Eduardo; Ville, Simon (2009): Social innovation: Buzz word or enduring term? In *Journal of Socio-Economics* 38 (6), pp. 878–885.

Prahalad, C.K. (2005). *Fortune at the Bottom of Pyramid*. Wharton School Publishing.

Radjou, N., Prabhu, J., & Ahuja, S. (2012). *Jugaad innovation: think frugal, be flexible, generate breakthrough growth*. Wiley. com.

Reid, W. V., Chen, D., Goldfarb, L., Hackmann, H., Lee, Y. T., Mokhele, K., Ostrom, E.; Raivio, K.; Rockström, J.; Schellnhuber, H. J. & Whyte, A. (2010). Earth system science for global sustainability: grand challenges. *Science*(Washington), 330(6006), 916-917.

Smith, A., Fressoli, M., & Thomas, H. (2013). Grassroots innovation movements: challenges and contributions. *Journal of Cleaner Production*, 30, 1e11.

Taylor, J. B. (1970). Introducing social innovation. *Journal of Applied Behavioral Science*, 6(1), 69–77.

Von Schomberg, R. (2013). A vision of responsible innovation. In Owen, R.; Heintz, M. & Bessant, J. (Eds.). *Responsible Innovation*. London:JohnWiley,

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***How do innovative companies grow? Business strategies and policy induced resources in small and mid-size green goods enterprises in the UK***

**Abstract:** The green goods sector has received much attention for its potential to regenerate the economy in addition to its energy and environmental benefits. At the same time, the promise of “green jobs” for example, has not necessarily lived up to the hopes for economic renewal through the green economy. In this study we investigate two questions. First what differentiates the business strategies, technology pathways, and relationships of green innovative companies that stay in business and grow? Second what are the contributions of policy-induced resources in supporting green innovative companies that stay in business and grow? To understand what is behind the innovation dynamics of the green sector, this study looks at a panel of UK small and medium sized enterprises (SMEs) involved in manufacturing green goods in 2012. Along with analysing traditional data sources our study utilises text-mined data collected from firms web-sites. The paper uses an explicit definition of green goods that is keyword based, building on prior definitions while going beyond traditional government industry classifications and patent-oriented definitions. The work is guided by a set of hypotheses that growth in green goods companies is positively associated with regulation of the industry, also known as the Porter Hypothesis.

In Shapira, et al (2014) we have developed a keyword method for identifying 300 UK based green goods companies. This method involves employing a keyword based search of the trade description of companies rather than conventional SIC based firm identification which is appropriate to identify firms in green goods sector. The novelty of our approach comes from adding to our explanatory variables with information that is collected from firm’s web-sites. This “web-scraping” data collection approach allows us to build a unique dataset that can give us an invaluable insight into innovation dynamics of the green goods firms. As well as providing data to construct variables on the characteristics of the companies such as the importance of manufacturing, web-scraping can reveal global connections for the firm with other countries. We estimate a cross-section regression for firm data in the year 2012. We utilise the linear probability model (LPM) which has a binary dependent variable that is one when the firm experiences growth in real turnover between 2011 and 2012. Additional data sources for our analysis include financial data (FAME), patents (Derwent), publications (Scopus), credit data (Experian) and government research support data (TSB).

In the 2012 LPM cross-section estimation we find that firm growth is positively related to our web variables for regulation, manufacturing intensity and rest of world cities (a proxy for a firm’s global linkages). Also growth is positively related to earlier increases in employment and if the firm is small in size (with employment between 10 and 50). As our firms are distributed across the UK we use NUTS 1 regions as control dummies and find that all regions apart from North East region are negatively related to growth.

Efforts to foster “green” technologies and sectors have been launched in many countries and regions. For example, the European Commission has launched a program dedicated to



eco-innovation through the Executive Agency for Competitiveness and Innovation in 2008. Here the “objective is to boost Europe’s environmental and competitive standing by supporting innovative solutions that protect the environment while creating a larger market for “green” technologies, management methods, products and services.” As Kemp and Oltra (2011, p.250) highlight “policy is crucial for giving environmental benefits a value in the marketplace through the use of regulation, taxes and tradable emission rights.” Suppliers and customers of business also need to grasp the value of eco-innovation in order to stimulate both supply and demand for green technologies that have utility in reducing harmful environmental consequences and conserving scarce natural resources. Although eco-innovation can raise concerns about potential negative consequences on business and employment, proponents of eco-innovation maintain that such policies will generally result in positive economic growth outcomes as well as beneficial environmental effects. There is indeed an empirical literature that tests the hypothesis (Porter, 1991; Porter and van Linde, 1995) that environmental policies can foster competitiveness by inducing technological innovation. Böhringer, et al (2012) analyze a panel of German manufacturing sectors and find a positive impact of environmental investment on production growth. Costantini and Mazzanti (2012), in an analysis of sectors across 15 European Union (EU) countries, report that the high tech sector exports have responded positively to energy and environmental taxation, although they suggest further research on the effect of environmental policies in inducing firms in specific green technology sectors to increase their innovative efforts (which our study is considering). Using German innovation survey firm data, Rennings and Rammer (2011) find that innovations stimulated by environmental regulation increased sales but when looking at different sectors within the green industry they report mixed results on profitability. Firms in recycling and waste management benefit, in term of higher profit margins, from regulation but those in water management experience lower profitability, as costs for eco-innovation cannot be fully passed on through prices in this sector. Yet, while there has been a growth of research studies on eco-innovation and sustainability (Markard et al., 2012; Borghesi et al., 2013), there is also recognition that the linkages between eco-innovation, business development and jobs are still not fully explicated, including understanding the combined effects of mixes of policies related to eco-innovation, enterprise promotion, and sustainability (Berkhout, 2011).

The article is guided by the Porter Hypothesis which suggests that firm growth is aided by greater regulation in the green goods industry. Our web-scraped variable for regulation supports the Porter Hypothesis along with the manufacturing intensity and global linkages of UK green goods firms being important factors for growth. UK policy should continue to promote support and development services like those offered by UK Trade and Investment with their Green Technology Roadshow visiting Manchester in February 2013 (see: <http://www.manchestereveningnews.co.uk/business/smes/uk-trade--investment-host-1299276>). Also the Department of Business and Innovation Skills (BIS) has launched See Inside Manufacturing (SIM) which is a partnership between BIS and Industry created to transform students perception of manufacturing in strategic sectors (<http://discuss.bis.gov.uk/seeinsidemufacturing/>). There is also the Made in Britain Campaign (<http://www.madeingb.org/>) supporting British manufacturers.

## References

Berkhout, F. (2011). Eco-innovation: Reflections on an evolving research agenda.

- International Journal of Technology, Policy and Management, 11(3/4), 191-197.
- Böhringer, C., Moslener, U., Oberndorfer, U. and Ziegler, A., (2012). Clean and productive? Empirical evidence from the German manufacturing industry. *Research Policy*, 41, 442-451.
- Borghesi, S., Costantini, V., Crespi, F., and Mazzanti, M., (2013). Environmental innovation and socio-economic dynamics in institutional and policy contexts. *Journal of Evolutionary Economics*, 23(2), 241-245.
- Costantini, V. and Mazzanti, M., (2012). On the green and innovative side of trade competitiveness? The impact of environmental policies and innovation on EU exports. *Research Policy*, 41, 132-153.
- Gök, A., Waterworth and A. Shapira, P., (2014). Use of Web Mining in Studying Innovation, MIOIR Working Paper, Sustaining Innovation project.
- Kemp, R. and Oltra, V., (2011). Research Insights and Challenges on Eco-Innovation Dynamics, *Industry & Innovation*, 18, 249-253.
- Markard, J., Raven, R., and Truffer, B., (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy*, 41, 955-967.
- Porter, M., (1991). America's Green Strategy. *Scientific American* 264, 97-118.
- Porter, M., van der Linde, C., (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives* 9, 97-118.
- Rennings, K. and Rammer, C., (2011). The Impact of Regulation-Driven Environmental Innovation on Innovation Success and Firm Performance. *Industry and Innovation*, 18:3, 255-283.
- Shapira, P., Gök, A., Klochikhin, E. and Sensier, M. (2014). "Probing "green" industry enterprises in the UK: A new identification approach". *Technological Forecasting & Social Change*, vol. 85, pp. 93-104.

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***Changing Norms on Scientific Publication in the Doctrine of Publish or Perish: a Case Study of Japanese Life Sciences***

**Abstract:** Introduction

Recent policies have increasingly emphasized the role of academic science in technological innovation and economic growth and attempt to boost scientific productivity (Etzkowitz and Leydesdorff, 2000; Stephan, 2012). Since scientific productivity is commonly measured on the basis of scientific publication, academics and research organizations are under intense pressure to publish (Hagstrom, 1974), often described as the doctrine of “publish or perish” (e.g., Anderson et al., 2007; Fanelli, 2010). Despite the strong emphasis on productivity, it is debatable whether the current regime actually facilitates the progress of science. It is not difficult to find examples in which academics resort to rent-seeking behavior such as misconduct, abuse of authorship, and inadequate citation practices to inflate superficial productivity (e.g., Martin, 2013). Such misbehaviors set aside, there is a concern that recent policies may not contribute to the quality of science while probably increasing the quantity of publications. Recent years have seen a substantial increase in commercial journals, including countless online-access journals, not a few of which are criticized for dubious scientific legitimacy (Bohannon, 2013). In addition, a significant proportion of publications attract little scholarly attention at least in terms of citation. Laband and Tollison (2003) showed that the proportion of uncited papers in economics had been constant over two decades. Wallace et al. (2009) also report that uncited papers are common in many other disciplines. Though citation does not directly translate into quality (Macrobarts and Macrobarts, 1996), roughly speaking, the scientific contribution of rarely cited papers and unread journals should be limited (Cole and Cole, 1972). Importantly, low-quality publications can result from ill-designed policy interventions. An infamous example was reported on the Australian funding system, where the system was reformed so that research money is now awarded based on publication count, and academics started to produce more papers but of lower quality (Butler, 2003). Intriguingly, productive academics do not always publish excellent papers, nor do unproductive academics always publish mediocre papers. Many academics produce both high and low-quality papers. This appears paradoxical especially when the qualitative aspect is highly regarded in most evaluation systems, which led us to question rationales behind such a publication pattern. Though papers in scientific journals tend to be simply considered output of science, we argue that they are in fact a collection of differently motivated products, and that the motivation is affected differently by contexts. The goal of this study is to explore such multifaceted rationales behind scientific publication with micro-organizational contexts taken into consideration. In so doing, this study aims to offer implications for science policy in better designing and implementing incentive system in science.

**Methods & Data**

To this end, the current study offers a case study of the Japanese biology sector. We suppose that the sector offers an interesting case in that Japan is highly ranked in life

sciences (Adams et al., 2010) and yet commonly produces low-quality publications. Importantly, the Japanese science system is fairly free from extrinsic incentives (e.g., pay raise) for publication, which allows us to see some rationales for publication possibly hidden in other contexts.

We first conducted in-depth interviews of 30 principal investigators (PIs) of biology laboratories. We chose our interviewees from universities of a diverse range of organizational ranks to highlight institutional differences. We investigated interviewees' publication record based on bibliometric data and asked a series of questions about their specific publications. We further inquired into their publication strategies, the impact of recent policies, the evaluation criteria in their departments, and so forth. To further explore the findings from the interviews, we conducted a questionnaire survey of PIs in 2010. We mailed the survey to randomly sampled 900 PIs in 56 universities and collected 400 responses (response rate = 44%). For the 400 respondents, we collected publication data of approximately 12,000 articles that the respondents authored from 2006 to 2010 from Web of Science (WoS). We also obtained the Impact Factor (IF) data from Journal Citation Report (JCR).

Our analytical approach draws on the quality-based portfolio of scientific publication at the individual level; that is, we collected the data of scientific papers published by an individual academic in a certain period and analyzed the distribution of quality among the collection of papers. A typical measure of publication quality is citation count (e.g., Garfield, 1972), but for the following reasons, we draw on the distribution of Impact Factors (IFs) of the journals where our respondents published their papers. Though IF is a controversial index (e.g., Denrell and Liu, 2012), it has attained a high consensus particularly among life scientists (McAllister et al., 1980) and is incorporated in science systems. In fact, our interviewees suggested that their perceived quality of journals reasonably agree with IFs, and that IFs are, explicitly or implicitly, in common use in formal evaluations, though they express some concern in excessive use of IFs. As a result, the decision of academics and research organizations is strongly influenced by IFs in some fields where academics' perceptions of journal quality and IFs coincide well (Frank, 1994; Gordon, 1984). Thus, we believe that academics' choice of journals in terms of IFs well reflects their motives and is probably more directly affected by policy and organizational contexts than citation count is. With this measure, we attempt to disentangle the determinants of high and low-quality publication to better understand the subtle nature of scientific production.

## Results

This study offers three implications for science policy. First, it indicates that scientific papers are produced for many different reasons, and that they may be different sorts of products from authors' viewpoints even if they appear the same to policymakers and administrators. In particular, our results imply that some papers are published as a by-product of student training and industry collaboration. Thus, evaluating publication purely on its scientific merit might be misleading, especially when the role of academic organizations has become diverse in modern science (Dasgupta and David, 1994; Hackett, 1990).

Second, this study suggests that publication quality is governed by the norms on quality, which can substantially differ with academics' career process such as inbreeding and mobility. Particularly, in the Japanese context, we found that returnees from foreign experience (mostly from the US) tend to demonstrate peculiar norms; they despise low-quality research and are unwilling to publish in low-IF journals. In fact, returnees publish

fewer papers than their domestic counterparts. Our interview implies that returnees tend to scrap papers that are rejected or likely to be rejected by high-impact journals. Such norms may deter disclosure of scientific discoveries.

Third, this study offers empirical evidence of a detrimental effect of Japanese science policies. The policies have emphasized competition and concentration of budget and human resources on productive academics with the intention of fostering high-quality research. However, our results indicate that excessive resource input can actually compromise quality. Possibly, academics with abundant resources might resort to mediocre ideas, or they might employ mass-production strategies without a thorough design, hoping for accidental success. Furthermore, overconcentration can compromise the diversity of research. Emphasis on competition and merit-based resource allocation is a global trend (Geuna and Martin, 2003; Hicks, 2012). With Matthew effect (Merton, 1973), such policies could unjustifiably bias resource allocation. These results call for rethinking the evaluation systems in modern science.

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***How mismatching institutional logics frustrate sustainability transitions***

Abstract: Introduction

This paper aims to explore the (problematic) interaction between organizations with competing institutional logics as well as the activities of intermediaries that aim to close this logics gap. This study is conducted in the empirical context of the Dutch energy sector. Old actors (network operators) are forced to accept a new role as a consequence of the transition to a more sustainable energy system. As such, this research adheres to the theme: 'Old actors, new roles?'

The Multi Level Perspective (MLP) conceptualizes socio-technical transition processes as interplay between novel technologies (the niche) and stable socio-technical arrangements (the regime). However, the exact form of this interaction between niche and regime has received insufficient attention (Smith, 2007; Diaz et al., 2013). As Diaz et al. (2013) state: 'initiating a transition is not a matter of simply 'scaling-up' a technology that has been developed in a niche, but is a complex and often messy process' (p. 63). This knowledge gap at the heart of transition theory needs to be urgently addressed.

A specific knowledge gap remains with regard to physical infrastructure: a core element of regimes. Certain niches depend on existing infrastructure, such as electricity and gas networks, for their operation. As niches grow, access to infrastructure becomes increasingly important. However, the material and long-term nature of regime infrastructure make accommodations extremely difficult (cf. Markard, 2011).

Niches and regimes can be characterized as different types of rule-sets (Fuenfschilling & Truffer, in press), which can also be conceptualized as institutions. Institutional Theory teaches us that people do not just have different interests; they actually think and operate on the basis of different values, goals, and assumptions (Scott, 1987). We use the concept of 'institutional logics' (e.g. Thornton & Ocasio, 2008) to study this package of guiding principles (Fuenfschilling & Truffer, in press). Institutional logics are defined as 'the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality' (Thornton & Ocasio, 1999:804). In relation to transition processes, the logics concept enables us to observe more closely how niche and regime behavior differs as well as what the underlying motivations for this behavior are.

The aim of this paper is to explore how the difference in institutional logics in niches and regimes help explain transition dynamics. Empirically, we apply the institutional logics lens to a case study of the Dutch gas sector: how the niche of biomethane interacts with the natural gas regime. Since 2008, large government subsidies encourage the food and agricultural sector to produce biogas, upgrade it to biomethane and inject it into the natural

gas infrastructure. Thus, biomethane producers are pushed into a relationship with network operators. This leads to the following research question: How do interacting institutional logics influence the development of biomethane injection into the Dutch natural gas grid?

## Theory

While the logics of each organization or sector provide a (semi-)coherent package of practices and belief systems, two different sets of logics are not necessarily aligned. A specific form of institutional misalignment is 'structural overlap', in which 'individual roles and organizational structures and functions that were previously distinct are forced into association' (Thornton & Ocasio, 2008:116). When niches need existing infrastructure, niche and regime actors are forced into association and structural overlap occurs.

Institutional literature mentions that certain actors actively engage in 'boundary bridging': a function performed by organizations that (can) operate between different types of settings and that can bridge between these settings (Greenwood & Suddaby, 2006). Thus, 'actors moving between fields "transpose ideas"'. These boundary bridgers '[lessen] institutional embeddedness by exposing actors to interinstitutional incompatibilities, increasing their awareness of alternatives' (Greenwood & Suddaby, 2006:38, emphasis in original).

## Methods

For this extreme case study we created a database of over 250 news articles related to biomethane injection in the Netherlands during the period 2003-2012 that served to identify the most important actors and activities that occurred in this period. In addition, relevant policy documents, annual reports, and research reports were analyzed. One researcher visited the 2011 and 2012 editions of an industry and science congress that largely focuses on gas issues in Groningen.

Furthermore, 14 semi-structured interviews were conducted with biomethane producers and intermediaries (5), the major network operators (both national and regional) (7), and government representatives (2). Interviews were fully transcribed and analyzed in NVivo.

## Findings

A first clash of logics happens between the functioning of network operators according to codes and norms on the one hand, and the quick and pragmatic operating style of the producers on the other. This leads to frustration for both sides: network operators find producers ignorant of the rules of the gas sector and producers find network operators slow and ineffective in decision-making.

Secondly, network operators are used to dealing with large scale infrastructure and large quantities of gas, whereas biomethane projects produce relatively small amounts of gas. The focus on large scale operations precludes fitting in biomethane projects easily and efficiently.

Thirdly, the safety and reliability of the grid is one of the most important goals for network operators. Biomethane is perceived as a threat to these principles. This leads to a relatively high burden of proof for biomethane producers, increasing their costs.



The result of the competing logics is difficult communication and distrust between the two parties. However, various organizations related to the biomethane and gas sector try to bridge the logics gap. One type of organization brings actors together and engages in the sharing of knowledge. However, this does not bridge the gap. Another organization actively translates communication and brings people together, so they get to understand each other better. A third organization visits the parties separately and adapts its behavior according to the setting, so as to obtain results.

Finally, change managers within the network operators also engage in boundary bridging by gaining an in-depth understanding of why people do their work a certain way and by slowly convincing them to consider alternative ways. For this interpersonal trust and technical knowledge is required.

### Contribution

The mismatch of logics is relevant for the study of transition processes. Firstly, differences in culture and decision-making style alone can severely undermine the willingness to cooperate. This research shows that we cannot ignore this social dimension of change processes. Furthermore, incompatibility of logics poses a serious obstacle to exploiting the (technical) potential of an innovation, due to the embeddedness and stability of logics in both thinking, acting, and physical infrastructure.

Secondly, boundary bridgers take up the essential task of connecting or translating between people from different logics, both between and within organizations. Boundary bridgers help to overcome people's intuitive resistance and encourage them to consider alternative options, thus 'matching logics'. Boundary bridging will become more important as the scaling up of innovations often brings them into contact with previously unrelated actors.

### References

- Diaz, M., Darnhofer, I., Darrot, C., & Beuret, J.-E. (2013). Green tides in Brittany: What can we learn about niche-regime interactions? *Environmental Innovation and Societal Transitions*, 8, 62–75.
- Fuenfschilling, L., & B. Truffer (in press). The structuration of socio-technical regimes. Conceptual foundations from institutional theory. *Research Policy*.
- Greenwood, R., & Suddaby, R. (2006). Institutional entrepreneurship in mature fields: The big five accounting firms. *Academy of Management Journal*, 49(1), 27–48.
- Markard, J. (2011). Transformation of infrastructures: Sector characteristics and implications for fundamental change. *Journal of Infrastructure Systems*, 17(3), 107–117.
- Rip, A., Kemp, R., 1998. Technological change. In: Rayner, S., Malone, E.L. (Eds), *Human Choice and Climate Change*, Vol. 2. Battelle Press, Columbus, OH, pp. 327–399.
- Scott, W.R. (1987). The adolescence of institutional theory. *Administrative Science Quarterly* 32 (4), 493–511.
- Smith, A. (2007). Translating sustainabilities between green niches and socio-technical regimes. *Technology Analysis and Strategic Management*, 19(4), 427–450.
- Thornton, P. H., & Ocasio, W. (1999). Institutional logics and the historical contingency of power in organizations: Executive succession in the higher education publishing industry, 1958–1990. *American Journal of Sociology*, 105(3), 801–843.



Thornton, P. H., & Ocasio, W. (2008). Institutional logics. In R. Greenwood, C. Oliver, K. Sahlin, & R. Suddaby (Eds.), *The Sage handbook of organizational institutionalism* (pp. 99–129).

Thornton, P. H., Ocasio, W., & Lounsbury, M. (2012). *The institutional logics perspective. A new approach to culture, structure, and process*. Oxford University Press, UK.

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***Towards a Network State: Mapping Institutional Structure of National Innovation Policies in China (1980-2011)***

**1 Introduction**

How and why does institutional structure of innovation policy change? It is an actual question for innovation system and policy fields but lacking unified answers by scholars. Within the traditional analysis of innovation policy and system, this question has been answered on indirectly or partially. For example, most of scholars have analyzed the economic and technological effects of innovation policies at the different levels. These literature regard innovation policies as government actions or treat innovation policy-making process as a 'black-box'. Distinguishing innovation policies and governments is central to understanding the role of state and innovation policies in innovation system. Recent studies have paid closer attention to this line in three aspects. At first, the governments and politics are important background factors in the innovation policy making and implementation process. Second, the innovation policies are the outcome of governments and politics. Third, how the government shapes the innovation policy? It is obviously that we can find very limited theoretical insights to answer our question among the existing literature. If the formulation of innovation policies is a political process, why not use the theoretical concept and analytical tool of political science to explain this issue. This study attempts to place policy network, in particular institutional network, in a system framework of policy analysis to develop a explaining framework of institutional structure based on the existing foundations of innovation systems and political science studies, then use the analytical tool of social network analysis (SNA) in China's innovation policies sector. We intend to understand the evolutionary process of institutional network from the perspective of both policy system and actors.

**2 Analytical framework, methodology and data**

Based on a system framework of policy analysis, the process of policy-making is a cyclic system regarding to policymaker, policy agenda, policy adopter and policy content. The government agencies-policymakers and their relationships formed institutional network, meanwhile the change of institutional network also is reflected in the relationships and actors. Within the tradition of policy network analysis, how and why do institutional structure change is often answered by 'placing networks in their larger context' or the relative bargaining power of the actor changes. In fact, the advantages of network may enable us to overcome this artificial division between the focus unit and its environment, the simple-minded dichotomy between structure and performance. Obviously, the behaviors of individual government agency as the actor cannot be understood separately for its collaborators and their environment. First, the policymakers create the policy contents referring to instruments, categories and topics in documents. Second, the policy agenda and adopter will determine the network how to create what kinds of policies.

Further, the effective coordination of government agencies in the policy process is a significant factor in improving the efficiency of the policy network and policy outcomes. Policymakers create the policy content in documents, and meanwhile policy documents include their information regarding to who issue the policy. Collaboration data of government agencies can be exploited to map the complex web of social ties, and measure its structural properties. The following hypothetical example illustrates the main idea (see Figure 1). Suppose there are four agencies (1-4). Policy A was collaborated by three agencies (1-3), Policy B was collaborated by two agencies (3 and 4), while the agency 3 formulate policy C. Therefore, the inter-institutional collaborative relationship is 1-2, 1-3, 2-3, 3-4. One agency formulates a policy independently, leading to one loop. The width of the lines could reflect the strength of the collaborative relation between each pair of nodes, representing the number of links between each pair of agencies. Repeating the same exercise for each policy document, we end up with a map representing the institutional network of innovation policies in China. Base on the map of network, the evolutionary trend of network characteristics is measured by UCINET software package. First, we analyse characteristics of whole network by network size, network density and small-world structure. Second, we attempt to know the types of ties-external ties or internal ties based on the small group of agencies in the network. Third, we focus on the actor's position or the role of institutions-contributor or coordinator-in the network by centrality.

Policy documents are the foundational data for analysis. Our scope of policy collection is innovation policies issued by Chinese national government in 1980-2011. A set of 463 innovation policies is constructed by collecting policy documents from official documents set of innovation policies, policies and regulations sections in internet website of agencies. At first, this study has attributed a policy to a current ministry if the function of previous agency combined to the current one, and uses the name of the ministry at the time if the previous agency died out. Second, besides ministries under the State Council, the policymakers also include other types of actors. Third, for the purpose of the paper, however, these thirty plus years have been divided into five periods instead, with the years of 1985, 1995, 2006, 2008 used as the key demarcation points when three important pieces of new policy originated and an important international event happened.

### 3 Conclusions

This study intends to uncover institutional structures by introducing policy network concept and SNA tool based on a system framework of policy analysis. Taking 463 Chinese innovation policies as a sample, we mapped the institutional structure of national innovation policies in 1980-2011.

At the whole network level, more agencies created more connections by collaborations and the network was shifting to denser and cohesive form 1980 to 2011. The policymaker and other parts of system framework was co-evolution together, the economic development was required to technology upgrading, and the state hopes innovative actors to conduct S&T and innovation activities, thus the top leader created national innovation strategy in terms of the status quo of economic and S&T development at that time, then the government would formulate innovation policies to implement the national strategy by institutional network, both actors and connections, however, the policy effort was not always effective to policy adopters. Then, the policy system will enter into the next

circulation due to the operation problem of innovation system.

At the group level of network, S&T and economic group contributed most of connections, institutions from each group created more external ties than internal ties gradually, and there are several closely inter-group unions between MOST, NDRC and MOF and other agencies. At the actor level of network, MOST is the only agencies shifted to the high-high quadrant and an important actor regarded as both contributor and coordinator, the MOST does broaden its potential role of horizontal coordination along with its political status and prestige declining.

In sum, it seems to that China was shifting to a network state from a pyramid structure in S&T and innovation sector, which due to economic development, S&T system reform and the political leader's mind partly and the relative bargaining power of the institutions change partly, such as the S&T/economic group and mission-oriented/supporting group, and MOST's position. Of course, a shift in the institutions' relative bargaining power also caused by external context. Thus, the evolution of institutional network was a whole, structure and performance, content and context.

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***What does the “responsible research” and “responsible innovation” label stand for? A scientometric analysis***

**Abstract:** This paper is part of a wider research on the genealogy and the possible futures of Responsible Research and Innovation (RRI). The “RRI” label was coined by the DG Research of the European Commission in the ‘2000s and it is part of on-going reflection on changing relations between Research, Innovation, and the wider Society. In so-called “knowledge societies”, innovation is considered as the solution to important societal challenges; at the same time legitimization of innovation is at issue since, in so-called “risk societies”, there is a strong attention to its negative effects (be there direct/undirect, intentional or not). Hence, the study of RRI is important to get a good appraisal of the evolution of science/society interactions. In this perspective, one of the key questions is related to the possible (medium to long term) effects of RRI. Can we see the potential for qualitative changes or is it mainly a matter of “responsible washing”?

This question may be framed as an issue of institutionalization and we may want to consider how RRI as an emergent field comes along with new actors, discourses, competences, practices, rules, standards, etc. As a first stage in this research, we have performed a scientometric analysis of the academic literature in order to identify the origins of RRI and the main characteristics of its evolution, so far. Of course, such a scope is limited since RRI emerges in various spaces and not only in the academic field. However, this first analysis allows us to formulate a first set of hypothesis on the possible futures of RRI.

## Methods

Our methodology relies on a scientometric corpus of methods, lexical mapping and co-citation analysis, which have been developed for several years and are implemented in an online tool developed at IFRIS: CorTexT manager. This main tool is complemented with the HistCite software, developed by Eugene Garfield and freely available online at the Thomson Reuters website, along with several dedicated R scripts written on purpose. Bibliographical information was retrieved from Scopus bibliographical database.

One of the key issues for the study of emerging fields lies in the delineation of the corpus, as the boundaries of such fields are not stabilized and battles about definition is part of the process of emergence. In this paper, we chose to work with two different approaches of RRI: a RRI stricto sensu approach and a RRI close semantic surroundings approach. RRI stricto sensu was identified with the following query executed on fields AB, TI, AUTHKEY: "responsible research" OR "responsible innovation" OR ("RRI" AND responsib\*). It leads to identify 206 documents. The stricto sensu query was broadened with chosen terms extracted from TI, AB and AUTHKEY fields of the stricto sensu corpus: "responsible research" OR "responsible innovation" OR ("RRI" AND responsib\*) OR "responsible development" OR

"ethics in research" OR ("ELSA" OR "ELSI") and "ethic\*") OR "responsible conduct of research" OR (RCR AND responsib\*) OR "research integrity" OR "scientific integrity" OR "scientific misconduct" OR "research misconduct" OR "broad\* impact\*" OR "technolog\* risk". Our aim was not to provide an extension of corpus #1 in the sense that it would gather RRI documents that would not be labelled as such. Instead it was to provide close corpus #1 semantic surroundings, and see if RRI documents relate to them. We extracted each author's keyword and 1000 most frequent words from corpus #1 titles and abstracts. We then checked their relevance to the idea of responsibility in research and innovation. We then had a look at the frequencies of those chosen terms, both in corpus #1 and in Scopus. They can roughly be gathered in five groups: (1) terms close to 'RRI' in meaning (e.g. responsible development), (2) terms related to ethics (e.g. ethics, bioethics), (3) terms related to research integrity (e.g. responsible conduct of research), (4) terms related to (innovation and technology) impact (e.g. technology assessment), (5) terms related to (innovation and technology) risks (e.g. broader impacts). Some of them are highly present in Scopus (e.g. ethics with almost 88,000 references) while others are not (e.g. responsible science with 43 references). For methodological reasons linked to our tools, we choose to avoid such scale differences and kept terms with a Scopus frequency between 100 and 2000 in each category.

#### Results 1/ RRI stricto sensu

##### A new emerging topic

According to our corpus, the first document goes back to 1978: Duke (1978), "Toward responsible innovation", published in Educational Forum. Several documents are published from year to year, but the RR, RI and RRI themes really start growing in 2005, with an acceleration in 2008 and 2010. Those themes are really new in the academic literature, with Doug Robinson being the first academic author to use the expression "responsible research and innovation" in his 2009 article.

##### Two distinct topics: scientific integrity and science governance

We gathered internet data for the 21 key authors and key cited authors in order to understand those authors's shared institutions, research projects, firms and conferences. A synthetic result is presented in a network pattern. Those 21 prominent authors belong to either a highly connected cluster of authors, or to several small disconnected dyads. At first sight, RRI topic therefore seems to gather two distinct thematic communities, trying to address different questions: questions on science governance related to public sensitive topics, on the one hand (main cluster), and questions related to scientific behaviour in research, on the other hand (smaller clusters).

The two top journals are Science and Engineering Ethics and NanoEthics. The first one "encompasses professional education, standards and ethics in research and practice, extending to the effects of innovation on society at large", while the second one is a "forum for informed discussion of ethical and social concerns related to nanotechnology". We therefore see that scientific misconduct and new technology impact on society, especially nanotechnology, are important topics of this corpus.

However, these results on main authors, main cited authors and main sources draw an incomplete view of the corpus, as they only reflect the “top of the iceberg”. A more accurate picture of the most prominent themes studied under the “RI” or “RR” or “RRI” label is drawn through lexical mapping.

The technique used to build this accurate picture consists in the building of the corpus' terms cooccurrence network (lexical mapping). Terms describing each document are extracted from TI (Title) and AB (Abstract) fields, their cooccurrence calculated and a network displayed. The corpus can roughly be divided into two main thematic groups: responsible conduct of research, research integrity and bioethics on the one hand, and responsible innovation on the other hand. Since they are connected through ethics words, we can consider that RRI gathers two probably distinct strands of research on ethics, addressing responsibility questions in different perspectives, almost equal in terms of documents number.

We tested whether the two strand of research previously found are indeed distinct. We built the co-citation network of the top 72 references of the corpus (cited at least three times), and displayed it. The figure displays a main cluster of co-citations alongside a smaller cluster. The main cluster gathers almost all those main citations. It draws back to Poliany's and Collingridge works, i.e. research related to social consequences of innovations. Four little clusters can be distinguished inside this main cluster, connected with three bridging works: Collingridge (1980), Fisher (2006) and Shuurbiens (2011). They respectively mainly deal with technology assessment (yellow cluster), STS scholars engagement (blue clusters) and public engagement (dark green). The second, small cluster (#2) draws back to Beecher 1966, a study dealing with informed consent and ethical research in medicine.

## Results 2/ RRI close semantic surroundings

However, even if RRI, RR or RI strictly speaking are new increasing topics in the academic literature, the idea that research and innovation should be responsible for their impacts and actions on the environment and societies is not new. We addressed the link between those old strains of research and RRI through our RRI close semantic surroundings corpus. Co-citation and lexical mappings show that the RRI research branch is clearly distinct from those close semantic surroundings: responsible conduct of research or research integrity, and bioethics. Its closest surrounding is technology risk management. The nature of their ancestors references vary, too: normative versus sociological works.

## Conclusion

Altogether, our different results on this narrow corpus show that there are two different, disconnected strands of research under the “RRI” label: responsible conduct of research, on the one hand, and responsible outputs of research, on the other hand. Moreover, we show that the “responsible research and innovation” label is mainly connected to the second one, i.e. responsible innovation. We also show that several questions regard the central role of STS in this landscape. Our results thus open the following questions: will RRI broaden its scope and objects of inquiry? Has RRI the potential to make connections with those older and well-developed questions?

This first look at the emergence of RRI based on academic journals will be completed by an extension of the corpus of texts to other sources such as legal texts, guidelines, newspaper articles, blogs, etc. This will be instrumental for analysing the issue of institutionalisation of RRI as a process of stabilisation of (formal and informal) rules or routines in heterogeneous social worlds.



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***Integration of clinical and scientific competencies in life science innovation***

**Abstract:** How do good ideas with innovative potential emerge in the life sciences? Which type of competencies are they most likely to be based on? Recent research on development of medical innovations has highlighted the importance of the interface between clinical and scientific knowledge for development of new medical practices and product innovation, but also for dissemination and post-introductory improvements of new practices or products in medicine (Lander 2014, Ali & Gittelman 2014).

Through empirical studies of particular innovation trajectories in disease areas or areas of medical practice, the characteristics and dynamism between the complex set of actors involved in medical innovation have been analyzed. Several researchers have focused on understanding innovation and technological developments in medicine through what is termed “micro-innovation systems”: “These consist of small innovation networks organized around a specific and relatively narrow set of technical problems” (Mina 2009). Specific medical problems (often related to diseases) represent the empirical core of these studies, and more precisely the processes of defining, solving and spreading new technical and medical solutions to medical problems. By viewing innovation trajectories as long-term problem solving processes, collaboration between diverse sets of participants becomes a key activity, also in early phases of research and opportunity framing (Vohora et al. 2004).

Metcalf et al (2005) highlight that innovation processes are distributed, meaning that interaction across fields of science, organizations and sectors is a key feature of the problem-oriented learning processes that over time lead to development and use of new medical technologies, services or drugs (c.f. Blume 1992, Rosenberg et al. 1995, Ramlogan et al. 2007, Gittelman 2012). A particularly important aspect of medical innovations is the “pervasive role of science-industry interfaces” and collaboration between research organizations and small high tech firms in the commercialization of knowledge, as impetus to medical innovations often comes from different part of the science system – but not necessarily from the life sciences. But as Metcalfe et al. (2005), Morlacchi and Nelson (2011), Rosenberg 2009, Nelson et al. (2011) all highlight, health care providers and clinical knowledge and clinical practices are fundamental components of the health innovation system, but less well understood.

Morlacchi and Nelson (2011) claim that medical innovations or improved medical practices are the result of developments in three “co-evolving pathways” – advances in biomedical scientific understanding, improvement of the ability to develop new medical technologies, and learning in (clinical) practice. These pathways partly correspond to sets of institutions that “harbor” them – universities, firms and hospitals, but since they are also interrelated and recursive, fluid networks and communities (of practices) that transgress each pathway are equally important. Since medical innovations draws on several sources of knowledge, “rich ecologies” of organizations including universities, firms, hospitals and research

institutes are involved in developing and dissemination of medical innovations (Ramlogan et al. 2007).

Innovation processes within medicine are recursive with considerable interaction between invention, development, dissemination, and use of new knowledge and technology. New medical innovations develop in an incremental manner and require substantial adaptation in many stages, considerable feedback from users and considerable post implementation development. It is hard to separate the creation of new knowledge and new technologies and the dissemination and use of these technologies in medical practices (Merito and Bonaccorsi 2007, Mina, Ramlogan et al. 2007). According to Ramlogan et al (2007) the very high degree of interdependence between development of new knowledge/ technology and use of knowledge in practice is a distinguishing characteristic of health innovations.

With these perspectives in mind, the paper focuses in particular on the early stages of research-based medical innovation, utilizing a detailed dataset of individuals involved in generating inventive ideas. The dataset is based on disclosures of inventions (DOFIs) to the technology transfer office of the University of Oslo and Oslo University Hospital, the largest university and hospital in Norway within the product segment life science. The dataset therefore contains data on individuals that have been involved in submitting one or more inventive idea and are located with hospitals and universities in the Oslo region (N=296). Apart from information about the ideas for new inventions themselves, we have collected a range of information about the individuals such as demographics, characteristics of scientific activities, as well as data on the organizations in which the individuals are employed to describe the environments in which inventive ideas in life science emerge. Data were collected through the DOFI register, employee registers, and two public databases on scientific activities and output in Norway (for hospitals and universities). The DOFI database contains information about disclosed ideas that might represent an invention – or at least that the submitter assumes that the idea is novel and potentially patentable. Not all of the ideas will turn into patentable ideas, or patents or licenses. The dataset does however include information about the decision made by the TTO to develop the idea further, patents generated and licenses attached to each idea. The data on the performance of the disclosed ideas are not included in the analysis presented in the paper.

The main question investigated in this paper is where new ideas for life science innovations emerge from, and to what extent collaboration across the scientific and clinical interface is important in the idea generation phase, as indicated by previous research on medical innovation. We do however assume that the value of integration of clinical and scientific competence might be different in different kinds of medical innovations (Alkærsig & Valentin 2014) and that it might be particularly important for so-called tangible medical innovations (medical technologies) and less so for bio-medical and pharmacological innovations that are more likely to emerge from basic research units.

To investigate this question empirically, we first look at the relative share of inventive ideas that emerge from hospital staff and university staff in different product segments, and then look at the extent of interaction between clinical and scientific environments in different product segments. This analysis uses a similar methodology as Gittelman & Ali (2014) that assumes that cross-domain teams (consisting of staff employed in both clinical and scientific

units) represent a mechanism for integration of basic scientific and clinical competencies. However, this will only tell us at a surface level whether integration of clinical and scientific competencies potentially occurs, it does not tell us how different competencies are utilized during early stage innovation processes and how they are integrated. To further develop an understanding of the process of knowledge integration and its role in medical innovation, we have also collected interview data with a number of the most productive lead inventors in the sample. All lead inventors that had contributed to at least three submitted DOFIs were contacted and at this point eight lead inventors have been interviewed. The interviews emphasized questions like what kinds of competencies were utilized in the course of invention, and whether and how competencies from scientific and clinical environments were integrated in the inventive process and the role different sets of competencies played.

Results of the analyses of the DOFI dataset shows that about 50 percent of the inventions come from clinical environments in hospitals and 50 percent from scientific environments in universities. The relative share of hospitals vs scientific inventions differ between different product segments, but the differences are less than expected. Hospitals staff had a larger share of inventive ideas in medical devices, and university staff had a larger share of inventions within the area of therapeutics and new therapeutic components, as expected. Hospital staff and university staff have a relatively equal share of inventions within diagnostics and research tools. 40 per cent of the DOFIs have been submitted by individuals or groups from just one organization (only hospital or university) and 60 percent have been submitted by groups representing multiple institutions. Multi-institutional collaboration is most common in diagnostics, research tools and therapeutics innovations, and less common in medical devices. Multi-institutional collaborations is equally common in inventions that emerge from clinical units in hospitals as scientific/university units, but it is more common for hospital based inventions to emerge from individuals that have dual affiliation positions (mainly individuals employed in adjunct positions in universities in addition to holding a hospital job).

The interviews with lead inventors indicate that integration of clinical and scientific competencies is important, particularly for individuals and teams involved in diagnostic and research tools inventions. Also collaboration is seen in particular as valuable for the scientists working outside hospitals. For these scientists collaborating with clinical staff and clinical units represents access to relevant problems requiring new solutions and to experiment with new solutions in the clinical environments where the potential products will be implemented and used in the future. Staff working in hospitals that have been involved in medical device innovation describe a similar need driving collaboration; they need input from technical or natural science environments in the universities or in small specialized technology or design firms. But hospital inventions within life science seem to be less dependent on interaction scientific environments, than the opposite.

The results indicate that collaboration across scientific and clinical domains is common and important for life science innovations, at least in the early stage of product development (idea generation). As seen more than half off the disclosed ideas emerge from research groups representing multiple institutions that span scientific and clinical units or individuals with multiple institutional affiliations (representing boundary spanners). Interaction between scientific and clinical units is more common in certain types of inventions

(particularly diagnostics and research tools), where also interviewed lead inventors claim that access to relevant clinical competencies is necessary to take ideas from the laboratory to an experimental clinical phase. But in correspondence with prior research (Ali & Gittelman 2014) we do find that clinical units are more important as motors for medical innovation than expected; also in the idea generation phase. Clinical units in the sample generate about half of the new ideas as well as being heavily involved in the process of generating and developing the ideas that emerge from scientific units.

The policy implications of this study as well as a recent string of studies into medical innovation is first and foremost the need for a better understanding of clinical sites and hospitals in innovation and research. A policy review of Norwegian research and innovation policy (Gulbrandsen & Thune 2014) indicates that research and innovation policy has a complete blind spot concerning hospitals role in innovation, and that innovation is not an issue in health policy. An important implication of many recent studies is that there is a need for a better integration across policy domains.

#### REFERENCES

- Alkersig, L. & Valentin, F. (2014). Effects on medical innovation of combining academic and clinical expertise. Forthcoming. Presented at Workshop Desember 12th 2013 in Oslo.
- Blume, S. S. (1992). *Insight and industry: on the dynamics of technological change in medicine*. Cambridge, Mass., MIT Press.
- Consoli, D. and A. Mina (2009). "An evolutionary perspective on health innovation systems." *Journal of Evolutionary Economics* 19(2): 297-319.
- Gittelman, M. (2012). The revolution that never arrived: Clinical and genetic paradigms in bio-medical research and the R&D productivity paradox. Paper presented at the 2012 DRUID conference, June 19-21, Copenhagen Denmark
- Gittelman, M. & Ali, A. (2014). Doctors without borders: The integration of clinical and basic research for innovation and academic medical centers. (Unpublished manuscript)
- Gulbrandsen, M. & Thune, T. (2014). Innovation perspectives and innovation policy: the case of the public health sector in Norway. Paper presented at the Lundvall Symposium, Ålborg March 2014
- Merito, M. and A. Bonaccorsi (2007). "Co-evolution of physical and social technologies in clinical practice: The case of HIV treatments." *Research Policy* 36(7): 1070-1087.
- Metcalfe, J. S., et al. (2005). "Emergent innovation systems and the delivery of clinical services: The case of intra-ocular lenses." *Research Policy* 34(9): 1283-1304.
- Morlacchi, P. and R. R. Nelson (2011). "How medical practice evolves: Learning to treat failing hearts with an implantable device." *Research Policy* 40(4): 511-525.
- Nelson, R. R., et al. (2011). "How medical know-how progresses." *Research Policy* 40(10): 1339-1344.

Ramlogan, R., et al. (2007). "Networks of knowledge: The distributed nature of medical innovation." *Scientometrics* 70(2): 459-489.

Rosenberg, N., et al. (1995). *Sources of medical technology: universities and industry*. Washington, D.C., National Academy Press.

Vohora, A. et al. (2004). Critical junctures in the development of university high-tech spinout companies. *Research Policy*, 33:144-175.

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***Universities in external knowledge networks: Particular roles for particular universities?***

**Abstract:** Research questions

The paper addresses the key issue within the special track “One size does not fit all”: are there distinct ways that different kinds of universities interact with their environments at local, regional and national levels? In this paper, we begin from the critique in the call for papers to this track of what is termed a simplistic model of the universities’ regional enhancement role. The session seeks to explore how universities (or different tertiary level/higher education institutions) relate with other organizations in their environment in particular ways, depending on the characteristics of both the regions and the universities. In this paper, we seek to contribute to these debates by addressing the research question of whether there are distinct profiles of different kinds of higher education institutions that can be observed in terms of how academic employees in universities interact with external organizations in their environments and who they interact with.

In general, organizational factors – or characteristics of higher education institutions – have been less explored when it comes to interaction between universities and external organizations (Perkmann et al. 2013), partly because individual level and scientific field level variables account for a substantial element of variance in external engagement. Several empirical studies have found that academics in different fields of science differ with respect to the level of external engagement and the kinds of external engagements academics participate in (Schartinger et al 2002; Perkmann et al 2013, Ramos-Vielba & Fernandez-Esquinas 2012, Abreu & Grinevich 2013; Olmos Penuela et al., 2013a; b). Hughes & Kitson (2013) find however that the level of interaction (measured on the proportion of staff within each scientific field that was involved in external engagement activities) was relatively equal, what differed was how the activities were carried out and who academics’ collaborate with.

However, organizational level factors, such as the profile of the higher education institution (applied/professionally oriented institution vs general academic institution, research university versus polytechnic/regional college), location, scientific quality of universities, and institutional commercialization policy and strategies have also been found to influence academics’ external engagement activities in some studies (Audretsch & Lehmann 2005, Perkmann et al. 2013, Bishop et al. 2011, Wright et al. 2008, Abreu & Grinevich 2013) in addition to scientific fields. Some recent studies indicate that the effect of organizational level characteristics (such as the scientific quality of the institution) on academics external engagements differ systematically by fields of science (Perkmann et al. 2011, Bishop et al. 2011). As a consequence, it is critical to also account for the relative importance of

organizational variables (size, location, kind of institutions, quality of institution, leadership, IPR policy, etc.) when controlling for differences between scientific fields and profile of academic staff. A methodological problem is, however, that samples of higher education institutions in many countries are small and that one would need a range of variables to distinguish institutions at academic field and institutional level characteristics in the same analysis.

## Methods and data

To address the question of whether there are distinct institutional profiles, we look at whether institutional characteristics (institutional type and location) matter for academics' external engagement activities in the complete higher education system of Norway, when we also control for a range of scientific field and individual level variables.

We address this question by utilising data from a survey administered to 8500 tenured/permanently employed academic employees in all public higher education institutions in Norway (the survey received 4440 useable responses, giving a response rate of 52,5 percent). The respondent analysis showed no significant differences between the sample and the whole population of academic staff in Norway, entailing that the data is in general representative for the whole population of academic employees in Norwegian higher education institutions. The survey included a range of questions about external engagement (frequency, kinds of external contacts/modes of interaction, kinds of external organizations that academics mainly interacted with, academics' motivation for external engagement, drivers for external engagement and level of external funding of research activities among academic staff). The survey also includes data on academics' teaching and research activities. Data on the institutional and disciplinary affiliation, as well as a range of individual level characteristics, was collected through the Norwegian database on academic personnel (Forsker-personaldatabasen).

To investigate patterns of external engagement activities, respondents were asked to indicate what kinds of external engagement activities they had been involved in over the last three years. 22 different activities could be selected, and 93 percent of the sample indicated that they had been involved in at least one external engagement activity. The survey also asked whether the respondents had collaborated with external partners the last three years, where respondents could select ten different partners (public, private and third sector at local, national and international level). In both questions multiple responses were possible. We use factor analysis to discern between main clusters of external engagement activities, and use these clusters as dependent variables in the regression analyses to explore the characteristics that influence how interaction is carried out and who the partners are.

Scientific fields are measured by standard Norwegian classification of scientific fields employed for statistical purposes (six categories: humanities, social sciences, technical sciences, mathematics/natural sciences, medical/health sciences and agriculture/veterinary sciences). We discerned higher education institutions by legal status, age and location (five categories: pre 2005-universities, post-2005 universities, scientific colleges, urban state college and regional state college)



## Results

The factor analysis of interaction modes identified five main patterns in how academics interact with external organizations: dissemination/communication, education/competence oriented, research collaboration, mobility/consultancy and research commercialization.

There are not large differences between institutional types with respect to participation in different kinds of external engagement activities, other than in the area of commercialization of research. However, the state colleges as a group participate to a lesser extent than employees in all other institutions also within collaborative research and consultancy forms of interaction, but above average in competence/education related activities with external users.

In the regression analysis we did however discerned between urban and regional state colleges as well, and tested whether the observed differences are significant, when also controlling for other factors. The analysis indicates that the observed differences between institutions with respect to commercialization are not statistically significant, entailing that the pre-2005 universities are not significantly more active than other institutions. We do however find significant differences between institutions with respect to research collaboration, where the post-2005 universities and the regional state colleges are significantly more active than other institutions. We therefore see that the regional institutions are more prone to active engagement in the form of research collaboration, than other institutions. State colleges both in the urban centers and in the regions are significantly more active than other institutions in dissemination activities, and urban state colleges are also more active than other institutions in competence enhancement activities. Regional state colleges are also more active in consultancy activities.

There are also interesting differences between institutions the main collaborating partners (public sector, industry or third sector). A factor analysis indicates three clusters of partners that academics' collaborate with: Private industry, regional, public/community organisations and national and international public organisations. The regression analysis indicates that post- 2005 universities and specialized university-institutions collaborate significantly more with private industry than all other institutions. The old universities and state colleges (both regional and urban) collaborate significantly less, and there are no significant differences between these institutions. There are less differences between institutions in collaborating with public national institutions, and the post 2005 universities and state colleges collaborate significantly more than all other institutions with regional public institutions.

## Conclusions

The paper has addressed whether we can observe distinct ways that different kinds of universities interact with their environments at local, regional and national levels? To do this, we have looked at the behavior of academic employees in terms of how they are participate in external engagement activities of diverse forms and who they collaborate mainly, looking at a large dataset from the Norwegian higher education system. The dataset contains many different variables at institutions, scientific field and individual level, but in



this paper differences between institutions of different legal status (and thereby profile) and location matter for how academics interact with their environment.

There are of course observable disciplinary differences that match the patterns found in previous studies, but we are looking at institutional differences when also controlling for other variables. The descriptive results indicated relatively small differences between institutions of different type, but large differences between fields of science. The regression analysis did however find that there are significant differences between institutions in all main modes of external knowledge engagement, and where the regional state colleges and post-2005 universities (also regional) have a significantly higher level of engagement in most forms of interaction compared to the pre-2005 universities. In fact, the older and larger pre-2005 universities do not have any higher propensity to engage in any form of external knowledge engagement activity compared to other Norwegian higher education institutions, which is perhaps surprising. The main conclusion to the research question on whether there are particular roles for particular universities in this case is not straightforward. In general, we see that certain intuitions are active in all modes of interaction and collaborates with both public and private organisations. In this context, the regional institutions at both university and college level are more active participants than other institutions. Compared to the older established universities, it is more the case of regional institutions taking an active role; while the universities do not appear to take any particular role.

The results contribute to the ongoing discussion about the nature of university profiles for societal engagement – particularly at the regional scale – as well as contributing to a more nuanced understanding of the sources of heterogeneity in the role of higher education institutions in regional development.

## References

- Abreu, M. & Grinevich, V. (2013): The nature of academic entrepreneurship in the UK: Widening the focus on entrepreneurial activities. *Research Policy*, 42 (2013)
- Audretsch, D. & Lehmann, E. (2005): Do university policies make a difference? *Research policy*, 34 (2005)
- Bishop, K. , D'Este, P. & Neely, A. (2011): Gaining from interaction with universities: Multiple methods for nurturing absorptive capacity. *Research Policy*, 40 (2011)
- Olmos-Peñuela, Julia, Jordi Molas-Gallart, and Elena Castro-Martínez. (2013a): "Informal collaborations between social sciences and humanities researchers and non-academic partners." *Science and Public Policy* sct075.
- Olmos-Peñuela, J., Benneworth, P., & Castro-Martínez, E. (2013b). Are 'STEM from Mars and SSH from Venus'? Challenging disciplinary stereotypes of research's social value. *Science and Public Policy*, sct071.
- Perkmann, M. , King, Z. & Pavelin, S. (2011): Engaging excellence? Effects of faculty quality on university engagement with industry. *Research Policy*, 40 (2011)
- Perkmann, M. et al (2013): Academic engagement and commercialization: A review of the literature on university-industry relations. *Research Policy*,
- Ramos-Vielba, I. & Fernandez-Esquinas, M. (2012): Beneath the tip of the iceberg: exploring multiple forms of university-industry linkages. *Higher Education*, 64 (2012)

Wright, M. (2008): Mid-range universities' linkage with industry: Knowledge types and the role of intermediaries. *Research Policy*, 37(2008)

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***Towards the Societal System of Innovation: the Case of Metropolitan Areas in Europe***

**Abstract:**

Innovation serves many purposes. In this paper we study new varieties of innovation and innovation policy which address societal challenges in the largest cities in Europe. These metropolitan areas consistently show resounding characteristics in terms of multiplicities of innovation, governance and societal challenges. They serve as 'living labs' and 'lead-markets' for solutions to societal challenges. The identified and analysed cases of social innovation initiatives in these metropolitan areas organise for new resourceful interactions between the demand for social innovations and the capacities to generate multi-domain solutions. It is the context dependencies of these cases of social innovation that open up diverse interest-based possibilities. In this daily, life-world context a multiplicity of actors select local-interactive processes. The broad range of actors includes: government research labs, public sector, creative and other service industries, social entrepreneurs, intrapreneurs, student platforms, and profession-linked open communities. Such interactions represent emerging transformative capabilities for addressing societal challenges, turning local-societal (political/administrative; economic/ financial; technological/social) solutions into multi-level (regional, national, global) opportunities, and a wider range of benefits. In metropolitan areas, these multi-domain and multi-level potentials are activated by organizing societal synergies between "social participative creativity" and "economic innovative efficiency" for any level. Existing concepts of innovation systems do not capture and explain these unique societal synergies, because they only focus on one specific type of innovation and one specific type of sectoral, technological, socio-technical, social or spatio-organisational (national, regional) system of innovation. It requires acknowledging that innovation and innovation systems are not only instrumental for economic benefits in a system-technocratic sense, but also for addressing societal challenges in a grassroots-communicative sense. Therefore we construct an overarching yet deepened concept: "the societal system of innovation", a theoretical-analytical framework based on empirical background. We do not add yet-another type of innovation system, but acknowledge the over-laps and linkages between the existing types of innovation systems. The existing types are the special cases of the societal system of innovation with respect to the presence/absence of organisations, of organisational rules and interactional play between them. Over-embedded or lacking interactions among these special-case innovation systems cannot capture evolving contextuality (life-world) for innovation. This shortcoming provides a complementary policy rationale for being critical in the organisation of widened interactions (S2S, system-to-system; G2G, grassroots-to-grassroots) and deepened contextuality (S2G, systems-to-grassroots; and G2S, grassroots-to-systems) under the concept, instruments, measurement/assessment of the societal system of innovation.

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***Why do researchers collaborate internationally? The interplay of epistemic, institutional and social motives***

**Abstract:** Summary

Collaboration is the main way to organize research in many fields, as it allows bringing together diverse competencies needed to tackle complex problems. Bringing together highly specialized competencies and addressing global problems can require collaboration across national borders. A crucial element in explaining success of collaborative research is motives of involved researchers. Whether collaboration works largely depends on their motivation to contribute their ideas, competencies and effort to joint endeavour. This paper analyses motives of researchers to collaborate internationally as well as interaction of scientific, institutional and social motives. It draws on extensive study of international research collaboration among nanoscientists and technologists in Germany, France, Netherlands, Belgium and UK, using multiple methods and data sources such as publication, organizational, project and CV data, site visits and semi-structured interviews.

**Keywords:** collaboration motives, international research collaboration, research policy

*“In studies of research collaboration [...] it is easy to lose sight of the fact that the objects are flesh and blood human beings pursuing multiples, complex and often conflicting motives. It would certainly be convenient if collaborations could be understood fully as efforts to maximize economic pay-off from research, but qualitative studies show us that even in those cases where economic gain is paramount, there is nonetheless much more going on than that.” (Bozeman et al. 2013, p.38)*

In science and innovation policy environment today research collaboration (including the one across national borders) is often assumed to be ‘a good thing’ that should be encouraged (Katz & Martin, 1997, p. 1) and positively valued ‘for its own sake’ (Duque, et al., 2005; Shrum, et al., 2007, p. 202). Facilitation of international research collaboration is a core aim of transnational initiatives and funding programmes such as the European research Area and the EU Horizon 2020 programme (Chou and Gornitzka 2014). Moreover, recent focus of research policy on tackling so-called Grand Challenges – global socio-economic problems in areas like health, energy and environment - increases the need to collaborate across national borders (Cagnin et al 2012).

Previous research has identified benefits of international collaboration (e.g. access to additional skills, information and infrastructure) as well as costs of time and effort needed to reconcile diverse management styles, organizational cultures and interests of collaborators (Bozeman et al 2013; Georghiou 1998; Katz & Martin 1997). A crucial element accounting for the way research collaboration develops is motivations of involved researchers.

The main aim of this paper is to deepen the understanding of motivations to collaborate internationally. In particular, it analyses how these motivations work in specific disciplinary and institutional contexts and how different motivations interact. While a number of earlier studies have identified and listed important motivations to collaborate internationally (Beaver 2001, Beaver & Rosen 1978), an in-depth understanding based on systematic empirical research is still missing and recent reviews of collaboration literature have highlighted the need to enhance knowledge about motivations to collaborate (Bozeman et al. 2013). It has even been argued that due to the recent changes in the researchers' environment (e.g. declining grant money, fewer academic positions, increased competition) "there is now greater need to understand the complexity of collaboration calculus" than it was in earlier times when abundant resources were the norm (Bozeman et al. 2013, p.38). The paper focusses on individual motives of collaborating researchers taking into account that they can be influenced by specific institutional, disciplinary and national contexts. Better understanding of researchers' motives that drive research collaborations is needed for both– for developing comprehensive theory of research collaboration (Shrum et al. 2007) as well as for designing relevant policies to facilitate collaboration.

Motivations do not always fall neatly in the three above-mentioned groups; sometimes they overlap. Nevertheless, here these three broad categories are seen as a useful device for organizing analysis. The findings suggest that there is a certain hierarchy of collaboration motives. The scientific reasons dominate for international collaborations characterized by longer distances and less funding opportunities. Researchers collaborate internationally because of common research interests, access to high quality highly specialized expertise and interest in doing creative and risky frontier research. On the intersection of scientific and social motives, researchers value international collaborations because they associate joining diverse mind-sets, backgrounds and perspectives with creativity. Institutional reasons to collaborate increase with further internationalization of research funding and careers. Social reasons such as friendships can emerge during the collaboration and facilitate it but are not sufficient factor to continue collaboration when scientific interests or understanding of quality diverge. While some tensions between intrinsic collaboration motives and external requirements of specific collaborative schemes (modes of interaction, administrative burdens, etc.) have been observed, in productive international collaborations researchers' motives to collaborate internationally are largely in line with and go beyond the policy aims to support collaborative research, being an important resource that can be utilized in designing better research and innovation policies.

#### Bibliography:

- Beaver, D. D. (2001). Reflections on scientific collaboration, (and its study): past, present, and future. *Scientometrics*, 52(3), 365-377.
- Beaver, D. D., & Rosen, R. (1978). Studies in Scientific Collaboration. Part I. The Professional Origins of Scientific Co-authorship. *Scientometrics*, 1, 65-84.
- Bozeman, B., Fay, D., & Slade, C. P. (2013). Research collaboration in universities and academic entrepreneurship: the-state-of-the-art. *Journal of Technology Transfer*, 38(1), 1-67.

- Cagnin, C., Amanatidou, E., & Keenan, M. (2012) Orienting EU innovation systems towards grand challenges and the roles that FTA can play. *Science and Public Policy* 39(2), 140-152.
- Chou, M.H., & Gornitzka, A. (Eds) (2014) "Building the Knowledge Economy in Europe. New Constellations in European Research and Higher Education Governance", Cheltenham: Edward Elgar.
- Cummings, J. N., & Kiesler, S. (2007). Coordination costs and project outcomes in multi-university collaborations. *Research Policy*, 36(10), 1620-1634.
- Duque, R. B., Ynalvez, M., Sooryamoorthy, R., Mbatia, P., Dzorgbo, D. B. S., & Shrum, W. (2005). Collaboration paradox: Scientific productivity, the Internet, and problems of research in developing areas. *Social Studies of Science*, 35(5), 755-785.
- Georghiou, L. (1998). Global cooperation in research. *Research Policy*, 27(6), 611-626.
- Katz, J. S., & Martin, B. R. (1997). What is research collaboration? *Research Policy*, 26(1), 1-18.
- Lauto, G., & Valentin, F. (2013) How Large-Scale Research Facilities Connect to Global Research. *Review of Policy Research* 30(4), 381-408.
- Melin, G. (2000). Pragmatism and self-organization - Research collaboration on the individual level. *Research Policy*, 29(1), 31-40.
- Melkers, J., & Kiopa, A. (2010). The Social Capital of Global Ties in Science: The Added Value of International Collaboration. *Review of Policy Research*, 27(4), 389-414.
- Shrum, W., Genuth, J., & Chompalov, I. (2007). *Structures of Scientific Collaboration*. Cambridge/London: The MIT Press.
- Ulnicane-Ozolins, I. (2013) "Influence of Institute Governance on International Research Collaboration: Towards a Typological Theory", University of Twente.
- Wagner, C. S. (2005). Six case studies of international collaboration in science. *Scientometrics*, 62(1), 3-26.

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***Impact of research evaluation modes of public research funding on the development of research fields and groups in Estonia***

**Abstract:**

Extended abstract

Evaluation of Science Technology and Innovation (ST&I) policy is becoming inevitably important to generate the evidence-based input for developing policy-making towards more sustainable growth. However, demonstrating the relevance to growth of funding and thus, legitimizing the funding has become almost as important in the current funding evaluation modes as growth itself. In this, scientific merit, pushing the borders of science and understanding, compete with the goals of proved – or at least declared – goals of socio-economic impact. While a hot topic in evaluation literature, little attention has been given to the relationship between scientific merit versus socio-economic impact of science when evaluating research activities and actual funding decisions (see Hellström and Jacob, 2012; Leitch et al., 2013). In addition, despite the growing acknowledgment of the importance of socio-economic effects of science (see e.g. Salter and Martin, 2001; Martin and Tang, 2007, Wolfe and Salter, 1997), excellence-based science evaluation schemes seem to prevail in performance based public funding systems.

Therefore the aim of this article is to fill a part of this gap in the literature by analysing the impact of evaluation modes used for allocating public funding for research. More specifically we are looking how these evaluation modes effect dynamics of public research in different research fields and groups. The main theoretical contribution of this article is to identify relevant dimensions of the main evaluation modes and develop a model that shows how certain dimensions of research evaluation determine others – what is the interplay between these dimensions (e.g. the evaluating agency, (official) aim, (informal) motives, level, time, criteria, indicators and method used for evaluation) and what are the potential effects of evaluation modes (and their dimensions) on research dynamics.

To focus the empirical study we are looking at the effects of the prevalent evaluation mode of research – the excellence-based model. To challenge the applicability of the prevalent mode the case of a small country like Estonia is chosen, which is also an extreme example of an ‘excellence-based’ and also ‘project-based’ science funding system (see e.g. Masso and Ukrainski, 2009) and a good case also because of the absence of other selection mechanism. Our focus is on the impact of the evaluation mode of the main state funding program for science (Ministry of Education and Research target financing). ‘Smallness’ of a country poses usually additional challenges (or increases the ones already in place) related to the limited critical mass in different fields of research and scarce financial, human capital and other resources. In that sense it enables us to even better highlight the problems with the prevailing evaluation mode of the main public funding program for research.

The posed research puzzle is analysed based on Estonian targeted financing data from 1998-2012 provided by Estonian Ministry of Education and Research (EMER), science groups that were doing research in the fields of information and communication technology (ICT), biotechnology, energy and environmental technology that had at least once received the most important public science funding in Estonia – public targeted financing, were identified. Next, official documents like applications and reports of their targeted financing projects were analysed regarding: the amount of funding received and a wide selection of performance indicators (articles, patents, PhDs, project composition and output etc.). For triangulation and to validate the data collected 47 structured interviews with science group leaders (35) and representatives of financial (6) and science and development (6) departments from the main universities and public research institutions in Estonia were conducted between April 2013 to October 2013 (list of interviewees will be provided in Annex 1).

Preliminary results of the analysis show that allocating public funding to all research fields under same evaluation criteria produces adverse effects. Main problems are related to reputation, signalling and resource concentration effects that pose a general threat to the sustainability and continuity of a heterogeneous science landscape and contribute to a self-enforcing research system.

## References

- Hellström, T., Jacob, M., 2012. Revisiting 'Weinberg's Choice': Classic Tensions in the Concept of Scientific Merit. *Minerva*, 50(3), 381-396.
- Leitch, S., Motion, J., Merlot, E., & Davenport, S., 2013. The fall of research and rise of innovation: Changes in New Zealand science policy discourse. *Science and Public Policy*, 1-12.
- Martin, Ben R. and Tang, P., 2007. The benefits of publicly funded research. SPRU Electronic Working Papers, Paper No. 161.
- Masso, J., & Ukrainski, K. (2009). Competition for public project funding in a small research system: the case of Estonia. *Science and Public Policy*, 36(9), 683-695.
- Salter, Ammon J. and Martin, Ben R., 2001. The economic benefits of publicly funded basic research: a critical review. *Research Policy* 30, 509–532.
- Wolfe, David A. and Salter, A., 1997. The Socio-Economic Importance of Scientific Research To Canada. A Discussion Paper Prepared for The Partnership Group for Science and Engineering, October 1997.



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***Flanders Ahead, Wallonia Behind (But Catching Up): Regional Policymaking in a Knowledge-based Economy***

**Abstract:**

Drawing on a documentary analysis of two socio-economic policy programs, one Flemish (“Vlaanderen In Actie”; VIA), the other Walloon (“Marshall Plans”; MPs), and a discourse analysis of how these programs are received in one Flemish and one Francophone quality newspaper, this paper illustrates how Flanders and Wallonia both seek to become top-performing knowledge-based economies (KBEs). The paper discerns a number of discursive repertoires, such as “Catching up,” which Flemish and Walloon policy actors draw on to legitimize or question the transformation of Flanders and Wallonia into KBEs. The “Catching up” repertoire places Flanders resolutely ahead of Wallonia in the global race towards knowledge, excellence, and science-driven innovation, but suggests that Wallonia may, in due course overtake Flanders as a top-competitive region. Given the expectations and/or fears that “Catching up” evokes among Flemish and Walloon policy actors, the repertoire serves these actors as a flexible discursive resource to make sense of, and shape, their collective futures, and thus their identities. By rendering explicit how Flanders and Wallonia each acquire a distinct identity through the global KBE, the paper underlines the simultaneity of, and the interplay between, globalizing forces and particularizing tendencies and illuminates the political, nation-building and identity-building functions of science, technology, and innovation.

The paper starts from the following preliminary observations. While both the VIA plan and the MPs emphasize the need of transforming Flanders and Wallonia into KBEs in order meet the demands of globalization (OECD 1996), the plans adopt a different tone and stance. The Flemish plan repeatedly states the need of transforming Flanders into “a top region, not only in Europe, but in the world, particularly in the social and economic field” (VIA, 2006: 4). It also states that Flanders is already prosperous and already has many strengths, but that the welfare and prosperity of Flanders are “under threat” in a “challenging global economic environment” (2). The message is thus that Flanders is doing relatively well in the global economy, but that it must do even better if it is to maintain its competitive edge and its welfare. By contrast, the MP is framed from the perspective of Walloon recovery and “redressement.” Although the term “Marshall Plan” evidently brings to mind the European Recovery Program for rebuilding Western Europe after World War II, recovery also refers to the period of prosperity before the World Wars, when Wallonia was one of the most economically advanced industrial regions in Europe. The MP suggests that Wallonia’s glorious past (“le passé glorieux”) can be rewon, if the Walloons deploy every tool they can muster and work together to “relaunch” the Walloon economy (3). To incite joint action, the MP urges the Walloons to become the architects of their own fate. This aspiration is clearly expressed in the opening sentence of the first MP plan: “The federalization [of Belgium; by which is meant the regionalization of policy and competences] bestows the Walloons with political autonomy, which renders them responsible for their own destiny.” At the same

time, this statement reads as a call to independence, as the Walloons are bestowed with political autonomy (by the Flemings, who have repeatedly pushed for the dismantling of Belgium as a unitary state).

As the above excerpts from the Flemish and Walloon policy plans indicate, VIA and the MPs characterize a state of political and economic affairs, take position in relation to these affairs, and, most importantly, envision a prosperous future for the Flemish and Walloon region, respectively. The plans are thus driven by expectations, visions and values, as well as fears. They mobilize arguments, explanations, evaluations, descriptions and prescriptions, sometimes by drawing on tropes or stereotypes, anecdotes, and illustrations. As the plans also indicate, transforming Flanders and Wallonia into top KBE regions does not happen by itself. For instance, while the VIA plan describes Flemings as entrepreneurs, it also states that “we must dare to be entrepreneurial” (3). Similarly, the MP urges Walloon citizens to change their “état d’esprit” or mindset, if economic growth is to ensue (3). Thus, identity construction and transformation are in order both in Flanders and in Wallonia.

The above observations serve as starting points for our media analysis. As we want to know whether, and how, these particular conceptions of the nation/region are picked up in press reporting on STI policies, we ask the following interrelated questions: How are the Flemish (VIA) and Walloon STI policies (MPs) received in the Flemish and Francophone press? Do we discern in the press the same notions of identity as in the policy programs? Are these notions reproduced, problematized or transformed? If so, in what ways? What does this mean for Flemish and Walloon identity construction, and for the construction of “Belgium” at large?

Recognizing the role of “institutions of power” (e.g. language, media, technologies) in articulating nationalism (Anderson 1991: 163; Billig 1995: 11), our analysis conceives of journalists and the press as potential policy agenda setters and opinion makers, as the press potentially reproduces and redefines political identities. As this paper will illustrate, the Flemish and Francophone press speak out on issues of collective identity and also offer various policymakers a platform to express their views on regional economic development, STI, and the state. Thus, from our perspective, policymaking is not only the prerogative of mandated policymakers, but of journalists and other opinion leaders (e.g. captains of industry) as well (Lenschow & Sprungk 2010).

To enable analysis, we draw on a range of literatures, including science and technology studies, discourse analysis, and media analyses. Our approach is interpretive and interactionist, as it assumes that realities (e.g. identities, nations, as well as practices and materialities) are socially constructed rather than exist as objective phenomenon that can be discovered through empirical testing (Fischer 2003: 118). Hence, we ask how identity is created, structured, maintained, or conversely deconstructed, resisted, and challenged. Our aim is thus not to uncover an objective reality behind identity, but to understand how identities are collectively made and remade on a continuous basis. To this end, we draw on the notion of “coproduction” (Jasanoff 2006: 2) to empirically demonstrate how STI and nationalism are “coproduced” through technoscientific practices (Felt 2013).

In what follows, we first present, discuss, and situate Flemish and Walloon STI policies in

time and place, as a means of contextualizing the “nationalisms” inscribed in the VIA plan and MPs. Next, we present our methodological framework for discourse and media analysis, our data, and key findings. Upon drawing together these findings, we single out the storyline of “Catching up” as an important discursive backdrop against which processes of collective identity construction play out through STI policymaking and press reporting. We conclude by tying our findings into a broader discussion about the place of Belgium in Europe and the world, as nation states are constantly (re)defined in terms of their constituent segments and overarching structures, including the KBE.

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***Science and Technology Parks and Cooperation for Innovation: Empirical evidence from Spain***

**Abstract:** Science and Technology Parks (STPs) are one of the most important regional innovation policy initiatives. Previous studies show that location in a Park promotes cooperation for innovation but have not investigated if they help to achieve better results from cooperation. We extend previous literature by analyzing how STPs influence the results of cooperation of Park firms and how this influence is channelled. We rely on a much larger sample of firms and STPs than previous studies and account for selection bias and endogeneity when these problems arise. Results show that location in a STP increases the likelihood of cooperation for innovation and the intangible results from cooperation with the main innovation partner, mainly due to the higher diversity of the relationship.

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***Learning from the de facto governance of Responsible Research and Innovation (RRI)***

**Abstract:** Recently, the European Union has adopted the notion of Responsible Research and Innovation (RRI) as an integrative concept in virtue of the three-pillar ambition for the Horizon 2020 program: excellent science, competitive industry and addressing societal challenges (EP&C 2013). While it is clear that any governance strategy aiming for RRI has to account for tensions in the simultaneous pursuit of these policy goals, a pressing, still under-researched question is under which conditions such governance strategies can be mutually aligned and effective. In fact, many, if not all normative goals listed under the banner of RRI (or similar terms like responsible innovation or responsible development), are not new and already institutionalized in a vast and heterogeneous collection of governance arrangements. Think of evaluations of societal relevance for research, corporate responsibility schemes, health and environmental safety regulation, ethical reviews, stakeholder and public dialogue, education, open access instruments, sustainability policies, gender policies, etc. If the notion of RRI has to become really integrative, it has to be thought through from a governance perspective, which can take into account the various ways in which RRI is conditioned by these manifold modes and styles of governance.

In this paper we discuss important conceptual and methodological issues in tracing and analyzing typical factors conditioning the governance of RRI. We will do so by presenting a research heuristic for learning from the 'de facto governance' of RRI in both new and existing practices of RRI governance. This approach has been developed in the context of the FP7-project Res-AGorA, which aims to develop a (meta-)governance framework for RRI. The notion of de facto governance enables us to analyse the dynamics of governance processes as emerging from the dynamic interplay between (mostly organized) actors within and between organisations, their resources, interests and power, fora for debate and arenas for negotiation of the instruments applied in working towards legitimate objectives and outcomes (cf. Kuhlmann 2001, Benz 2006, Braun 2006). These dynamics can add up to certain patterns or de facto governance arrangements (cf. Rip 2010). The conceptual and methodological challenge is to come to a useful search strategy for capturing the relevant conditioning factors in the governance of RRI.

In the Res-AGorA project we have taken up this challenge in an iterative approach for conceptual development and empirical research. In the paper we discuss the three main conceptual steps of our approach and demonstrate its use by an analysis of governance practices of responsible innovation initiatives in the Netherlands, in particular in the field of nanotechnology.

As a first step we guide our search for lessons for the governance of RRI by characterize the main governance challenges identified in the current (policy) discourse on RRI. Typically, there is a search for prospective and collective accounts of responsibility, accompanied with

the need for deliberative and inclusive settings (cf. Von Schomberg 20xx and Owen et al. 2013). We argue that from a governance perspective, the particular challenges in this quest for responsible innovation can be clustered under the notions of 'responsibilisation' and 'managing contestation'. By 'responsibilisation' we understand all factors that can exert influence on actors to take their responsibilities seriously (Dorbeck-Jung & Shelley-Egan 2013). Inextricably, 'managing contestation' seems to be a crucial challenge as the concept of RRI is contested and the pursuit of RRI is loaded with tensions about responsibilities and good practices. Whatever claims of responsibility come up, e.g. related to individual responsibilities or to the collective outcome or process of research and innovation, the way in which these are constructed, deliberated and negotiated, always involves polyvalent judgement, whether this is due to the future orientated character of RRI claims or to the sheer (social) complexity of many research and innovation processes.

In the second step we conceptualise a practice perspective for the governance of RRI. This step enables us to research those aspects that condition the realization of governance challenges identified in the first step, in real-world situations of de facto governance of RRI. To this end we position the notion of 'de facto governance' in relation to literature on research governance and theories of innovation in which important conditions for governance are conceived. In the third step we operationalize this governance practice perspective in a research model that is developed to investigate de facto RRI governance practices, taking into account the particular governance challenges of RRI. For this model a limited set of 'descriptors' is developed, specifying the conditioning factors we are looking for, while still able to account for the heterogeneity in RRI governance arrangements, processes and practices as situated in various settings of scientific and technological domains, political cultures, etc... Finally, we discuss criteria to assess the observed governance successes or failures.

In the paper we will demonstrate the use of our research model with findings from case studies conducted in the Netherlands, in particular in the field of nanotechnology, which has been figuring as a salient domain of RRI discourse and activities. In one case we will discuss how the deployment of a public policy model for risk governance is related to both governance successes and failures. In another case we analyse how the objective to integrate risk analysis and technology assessment into a large national research and innovation program is being pursued and shaped in its specific context. The reflection on these case studies lead to (very) preliminary lessons on conditions for good RRI governance and methodological and other issues for the further development of the research model.

Relevance to special session theme and Eu-SPRI conference

We would like to submit our contribution to the special session "Understanding and addressing the governance challenges of Responsible Research and Innovation" as we – partly represented in the organization of this session – think it well addresses the first goal of the session (improving the analytical understanding of the complex governance challenges posed by RRI in the field of STI) as well as in being framed as part of an overall approach to the second goal of the session (discussing promising approaches and methods with which the identified governance challenges can be addressed). Moreover, we think that our discussion of conceptual foundations for learning from de facto governance is of broader relevance to understanding the dynamics in STI policy and practice.

## References

- Benz, A. (2006) Governance in connected arenas – political science analysis of coordination and control in complex control systems. In: Jansen, D. (ed.): *New Forms of Governance in Research Organizations. From Disciplinary Theories towards Interfaces and Integration*, Heidelberg/New York: Springer, pp. 3-22.
- Braun, D. (2006) Delegation in the distributive policy arena: the case of research policy. In: Braun, D. & Gilardi, F. (eds.): *Delegation in Contemporary Democracies*, London: Routledge, pp. 146-170.
- Dorbeck-Jung, B. & Shelly-Egan, C. (2013) Meta-Regulation and Nanotechnologies: The Challenge of Responsibilisation Within the European Commission's Code of Conduct for Responsible Nanosciences and Nanotechnologies Research. *Nanoethics*, 7 (1). 55 - 68. ISSN 1871-4757
- European Parliament & Council [EP&C] (2013) Regulation (EU) No 1291/2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC. Brussels: Official Journal of the European Union L 347: 104-173. ISSN 1977-0677
- Kuhlmann, S. (2001) Governance of Innovation Policy in Europe – Three Scenarios. In: *Research Policy, Special Issue Innovation Policy in Europe and the US: New Policies in New Institutions*, edited by Hans K. Klein, Stefan Kuhlmann, and Philip Shapira, vol. 30, issue 6/2001, 953-976.
- Owen, R., Stilgoe, J., Macnaghten, P., Fisher, e. & Guston, D. A Framework for Responsible Innovation. In: Owen ,R.; Bessant, J.; Heintz, M. (Eds) *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*. London: Wiley
- Rip, A. (2010) De facto governance of nanotechnologies. In: Goodwin, M. Koops, B. & Leenes, R. (eds.) *Dimensions of Technology Regulation*. Nijmegen: Wolf Legal Publishers, 2010, 285-308.
- Von Schomberg, R. ( 2013) A vision of responsible innovation. In: Owen ,R.; Bessant, J.; Heintz, M. (Eds) *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*. London: Wiley

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***Avian influenza narratives and research landscapes: towards new science policy approaches in biomedicine***

**Abstract:** The problem of characterizing the research landscape of a given topic is critical not only in terms of understanding the structure and dynamics of research, but also of providing useful information for decision-makers involved in the governance of research. Specifically, the governance of research in response to emerging threats and the development of new technologies can be informed by considering different avenues of research and linkages among them from a public science perspective (McMillan et al, 2000, Dresser, 1999). Moreover, our work implies a shift towards holistic, “problem-based” approaches to science policy in the context of large-scale public health challenges.

There has been much research done on characterizing dominant health policies and narratives regarding avian flu and other similar pandemics (Scoones, 2010; Abeysinghe and White, 2011). There are different narratives about what constitutes a problem for an issue such as avian flu, and each of these narratives is associated with somewhat different problem-solving activities. Research is seen as a key contributor to potential solutions by most narratives, but the specific configuration of research avenues that are seen as crucial to address the problem depend on each narrative. The focus of this paper is about linking narratives and the associated normativities for prioritizing certain solutions to avian flu, with specific research avenues such as clinical research, vaccine, immunology, virology or epidemiology.

First, this paper empirically investigates the avian influenza research avenues and, second, the appraisal of those avenues in terms of relative priority by stakeholders. We combine quantitative science mapping techniques with interviews in order to and characterize avian influenza research over the past decade, and connect the main policy narratives with existing research avenues. This focus on avian influenza as a multidisciplinary “public research” issue – provides insight into how research avenues are viewed and prioritized by stakeholders. The research landscape and its characterization in a broader public policy context can thus become central to how basic and clinical research is supported by funding organizations, particularly in the public sector.

**An evolving research landscape for avian influenza**

First, we situate avian influenza research in the broader context of Influenza A, which comprises a variety of strains usually associated with causing the disease in birds. More specifically, this can refer not only to “seasonal flu” strains, but also to strains such as H5N1 which are commonly known as “highly pathogenic avian influenza”, alongside those such as H1N1, more commonly known as “swine flu” (since swine are the main vector of transmission). Figure 1 (attached) shows how different strains can come to dominate influenza research overall, namely following the several (relatively) small H5N1 outbreaks



occurring as of 2003 and a large H1N1 outbreak in 2009. In terms of understanding overall research capacity and trends worldwide, the lens of “Influenza A” thus seems appropriate for understanding the broader research landscape and future avenues for avian influenza research.

We can map the overall evolution of research on Influenza A (Figure 2, attached) based on an analysis of the co-occurrence of terms within abstracts. This type of mapping analysis reveals cognitive distances between words representing different types of research (van Eck and Waltman, 2010; Rafols, Porter and Leydesdorff, 2010). We have found that the emergence of new clusters, the disappearance of others and the changes within dominant clusters reflect concerns over new strains, the development of new methods in molecular biology and epidemiology, and, most importantly, the influence of public policy priorities relating to the control of influenza overall. While there are many other methods for generating maps and clusters from bibliometric data, for mapping research landscape of grand challenge, co-word analysis appears to show the connection with most common narratives surrounding influenza. For example, after 2009, there is less work related to understanding the spread of disease and monitoring it from a public health standpoint, but increased and more readily identifiable work on vaccine development, as shown by the yellow clusters in Figure 2. The red clusters, which are primarily related to clinical medicine and public health in all periods of Figure 2, become more focused on clinical trials and diagnosis after 2009, the work distancing itself from epidemiological research and molecular biology.

We are performing an in-depth analysis of the 2010-2012 period clusters, through a comparison of co-word mapping with other methods of bibliometric analysis, through the examination of other quantitative publication data and through consultations with experts and stakeholder. We can thus perform a preliminary characterization the dominant Influenza A research avenues in 2010-12 (Figure 2) as: clinical medicine (red -right side), immunology (green -top left), virology (blue -bottom left) and vaccine development (yellow -top right). While this type of map-based classification appears to be an accurate representation of the types of research being performed, it is not capable of differentiating several key areas such as epidemiology and surveillance.

#### From policy narratives to research prioritization

We are also conducting an analysis of the narratives and normativities associated with research avenues. We have performed an analysis of editorials of leading scientific journals and are now consulting experts and stakeholders on different types of research options and how they relate to the various facets of the disease, particularly in the context of the risk of a global pandemic. Editorials in high-impact scientific journals play a key role at the interface of science and public policy (Waaaijer et al., 2011). More importantly, the views of stakeholders at this interface provide a diversity of “problem-based” perspectives on a heterogeneous set of research. We thus hope to understand how different types of values and objectives – societal, economic, etc. – underpin research avenues and how stakeholders associate these avenues with a range of risks and benefits, from the dangers of bioterrorism to economic prosperity to improving public health in developing countries.

We contend that linking research-based and policy-based narratives can then inform the governance of avian influenza research, namely in terms of how different scientific approaches are prioritized by a given organization. As a first step, we have developed a map-overlay technique for co-occurrence of terms, combined with data on research funding, to characterize entire research portfolios of funding organizations as a subset of the research landscape (Figure 3, attached). This provides insight into the priorities of the organizations and the existing connections between various elements of the landscape, in response to a perceived public health risk. More specifically, this reveals how organizational objectives translate – implicitly or explicitly – into a mix of research topics being funded. Moreover, these maps of portfolios are a powerful means for eliciting perspectives from some of the main stakeholders associated with avian influenza. We believe there may be practical value for science policymakers in being able to gain insight into the prioritization of research on avian influenza, particularly when linked to existing narratives surrounding the development of vaccines, improved surveillance capabilities and strategies for managing human-animal transmission, for example.

We believe that this approach can help support deliberation on prioritisation and coordination in the case of grand challenges, not only for tackling avian influenza, but also a range of large-scale, multidisciplinary biomedical and agricultural research topics.

## References

- Abeyasinghe, S., & White, K. (2011). The avian influenza pandemic: Discourses of risk, contagion and preparation in Australia. *Health, Risk & Society*, 13(4), 311–326.
- Dresser, R. (1999). Public advocacy and allocation of federal funds for biomedical research. *The Milbank Quarterly*, 77(2), 257–74, 175.
- McMillan, G. S., Narin, F., & Deeds, D. L. (2000). An analysis of the critical role of public science in innovation: the case of biotechnology. *Research Policy*, 29(1), 1–8.
- Rafols, I., Porter, A. L. and Leydesdorff, L. (2010). Science Overlay Maps : A New Tool for Research Policy and Library Management, *Journal of the American Society for Information Management and Technology*, 61(9), 1871–1887.
- Scoones, I. (2010), Unpacking the International Response to Avian Influenza: Actors, Networks and Narratives, in I. Scoones (ed.), *Avian Influenza: Science, Policy and Politics*, London: Routledge, p. 19-64.
- van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523–538.
- Waaaijer, C. J. F., van Bochove, C. a, & van Eck, N. J. (2011). On the map: Nature and Science editorials. *Scientometrics*, 86(1), 99–112.

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***Research portfolios for societal challenges: a conceptual framework***

**Abstract:**

In the context of calls for increased transparency in the administration of public research, there is a need to better account for how resources are allocated as a means to achieve societal goals. Calls to address large-scale multi-stakeholder challenges (e.g., poverty reduction, malaria eradication, climate change mitigation and adaptation) focus on policy outcomes, multidisciplinary and international coordination, and require a systems approach to allocating and administering research funds. These problems are often framed as “grand challenges” (e.g., Daar et al., 2007; Reid et al., 2010). Research portfolios are tools that might help decision-makers consider a broad scope of research avenues and make strategic choices in priority-setting in terms of research agendas, complementarities and synergies rather than relying solely on evidence on the perceived quality of individual projects. A portfolio approach is particularly timely as scholars and policymakers seek new means of taking stock of “public values” and “social impact” of research (Bozeman and Sarewitz, 2011; Cozzens and Snoek, 2010).

**From corporate R&D, to public value portfolios**

The notion of a “research portfolio” has become more and more common among large science performers and funders over the past 20 years (Merrill and McGeary, 1999; National Science Foundation, 2001, p. 3). A portfolio sometimes just refers to a unit of analysis for reporting on expenditures, but also in other cases it is also a means of analysing how funds are spent at various scales (from laboratory to centre to agency). In the academic literature, increasing references to the term and other synonymous expressions have often been used either rhetorically, or, in the case of corporate R&D portfolios, focusing narrowly on monetary expenditure and returns. Analogies derived from this latter take, i.e. a financial view of portfolios, remain dominant. However, we posit that the conventional methods applied to private-sector R&D, though relatively well-developed (Chien, 2002), are ill-suited for public decision making. We argue that there is a need to take a critical look at these financial interpretations and to revisit the “research portfolio” approach from a public science perspective. Our examination of the uses of the term reveals a strong disconnect between science policy practices and potentially relevant scholarly literature – e.g., studies on the socio-economic impact of research, on biases in research evaluation, and science dynamics. This paper aims to bridge this gap, and explore how relevant scholarly literature can inform science policy practices in portfolio appraisals and management (Rogers and Dietz, 2012; Srivastava et al., 2007).

**Focusing on portfolios for societal challenges**

We propose that the notion of portfolio may be particularly useful when applied to tackling

a given societal problem in which science's contribution is viewed as important, such as in pandemic influenza, climate change or aging. We revisit the notions of risk, benefit and diversity, broadening the interpretation beyond monetary terms to include a range of societal considerations and, most importantly, to allow for a plurality of diverging opinions and values. In particular, we propose to develop a comprehensive understanding of the existing research landscape, in terms of social, cognitive and institutional parameters. Furthermore, a portfolio approach tries to make possible to connect the options for future research with identifiable social outcomes and stakeholder considerations. We further propose that the research landscape lens may be helpful for thinking on the interactions and potential synergies between portfolio elements.

#### Multiple value perspectives and incomplete knowledge in portfolio appraisal

Applying portfolios to so-called “grand challenges” – complex, multidisciplinary research to address major societal issues – implies taking into account a wide variety of perspectives relating to what specific outcomes are to be prioritized or what approaches will be effective and socially acceptable in bringing solutions. These complex problems also require a diversity of research avenues, including many which involve interdisciplinary approaches. Also, many such challenges (e.g., food security, climate change adaptation, pandemic preparedness) operate within a context of highly incomplete knowledge, and are thus better addressed by a variety of different approaches (Stirling, 1994). For example, for a given institution or country, one must not only consider better research outcomes, but also expected benefits in terms of human capital (Bozeman and Rogers, 2001), whereby high levels of diversity can come at a cost of decreased specialization. For this reason, diversity has to be considered not only at the level of a given portfolio, but also as a set of portfolios, namely because, unlike private-sector R&D, “public good” research results are often shared among producers.

#### Exploring interactions, complementarity and synergies between portfolio elements

A key component of portfolio analysis involves identifying interactions between research avenues. Here, the visualisation of the existing research landscape – based on cognitive proximity – can provide insights into how different types of research avenues can be related (Rafols, Porter and Leydesdorff, 2010). Complementary social, institutional and organizational parameters can also be visualized or analysed within such a landscape. We illustrate our discussion using bibliometric data on avian influenza, where a variety of disciplines are mobilized to tackle a common problem, but where there are diverging perspectives on research priorities. We can identify and characterize research avenues, as well as describe the levels of diversity in some of the existing portfolios of major funders. Overall, we view quantitative data sources and tools related to bibliometrics just as a component of a broader effort to expand the evidence base for decisions on funding for research portfolios. Thus, a portfolio “lens” can be a practical means of considering the balance of research options to address a specific issue. Irrespective of whether the driver is a targeted policy initiative or a public debate, moving beyond simple financial analogies to discuss public research portfolios can lead to identifying alternative sets of projects, potentially leading to alternative solutions, which are distinct not only in terms of cost-effectiveness, but possibly also in terms of greater inclusiveness (e.g., Chalmers et al., 2014).

These are complementary or alternative to existing approaches which tend to focus primarily on research quality.

## Conclusions

In summary, we propose that new conceptualizations and methodologies associated with research portfolios could foster strategic thinking in funding for societal challenges. This could support new approaches to developing policy for science in a public sector context, most notably in evaluation, where the current focus for project selection is perhaps too focused on “research quality”. In terms of wider science policy processes, this could have direct implications for the role of peer review and basic indicators of “quality”. More broadly, portfolios can facilitate increased transparency and stakeholder engagement in debate and decisions regarding public research. In addition, our approach provides a means to consider grand challenges beyond a simplistic dichotomy of basic vs. applied research, moving towards a holistic, more systemic approach that is better suited to such endeavours. We discuss the potential value of this approach at a variety of different scales and for several typologies of such “grand challenges”, including current public research initiatives in the U.S. and Europe.

## References

- B. Bozeman and J.D. Rogers (2001), “Strategic management of government-sponsored R&D portfolios”, *Environment and Planning C: Government and Policy*, 19, 413-442.
- B. Bozeman and D. Sarewitz (2011), “Public Value Mapping and Science Policy Evaluation”, *Minerva* 49, 1-23.
- I. Chalmers (2014), “How to increase value and reduce waste when research priorities are set”, *The Lancet*, 383, 156-165.
- C.F. Chien (2002), “A portfolio-evaluation framework for selecting R&D projects”, *R&D Management* 32, 359-368.
- S. Cozzens and M. Snoek (2010), “Knowledge to policy. Contributing to the measurement of social, health and environmental benefits”, Paper prepared for the Workshop on the Science of Science Measurement”, Washington, December 2-3, 2010.
- A.S. Daar et al. (2007), “Grand challenges in chronic, non-communicable diseases”, *Nature* 450, 494-496; W.V. Reid et al. (2010), “Earth system science for global sustainability: grand challenges”, *Science* 330, 916-917.
- J.S. Dietz and J.D. Rogers (2012), “Meanings and policy implications of ‘Transformative Research’: Frontiers, Hot Science Evolution and Investment Risk”, *Minerva* 50, 21-44.
- S.A. Merrill and M. McGearry (1999), “Who’s balancing the research portfolio and how?”, *Science* 285, 1679-1680.
- National Science Foundation (2001), *The Scientific Allocation of Scientific Resources*, NSB 01-39 Discussion Paper, [http://www.nsf.gov/nsb/documents/2001/nsb0139/nsb0139\\_2.htm](http://www.nsf.gov/nsb/documents/2001/nsb0139/nsb0139_2.htm).
- I. Rafols, A.L. Porter, and L. Leydesdorff. 2010. “Science Overlay Maps: A New Tool for Research Policy and Library Management.” *Journal of the American Society for Information Science and Technology* 61 (9): 1871–87.
- C.V. Srivastava, N.D. Towery and B. Zuckerman (2007), “Challenges and opportunities for research portfolio analysis, management and evaluation”, *Research Evaluation*, 16, 152-156.

A. Stirling (1994), "Diversity and ignorance in electricity supply investment: Addressing the solution rather than the problem", *Energy Policy*, 22, 195-216.

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***Innovation of technology, policy and industry: the case of disruptive innovation in Brazilian petroleum***

**Keywords**

Disruptive innovation, discontinuous innovation, emerging technologies, breakthrough technologies, local content, emerging economies

**Abstract: Extended Summary**

Petroleum is crucial to many industries around the world as a source of fuel, and beyond in some countries, to the stability of the national economy. The demand for petroleum is ever-increasing but there are serious concerns with regards to supply. Conventional oil reserves, which for decades have been easily-obtained and cheap to produce, are running low. In light of this, the industry is increasingly looking to less-conventional oil and gas reserves, but these pose significant technological challenges.

This technological uncertainty has disrupted an industry where the competitive dynamics have remained essentially the same for over forty years. The industry has long been dominated by a few 'major players', often in ownership of a vertically-integrated value chain. However, technological uncertainties with regards to the extraction of less-conventional reserves have created an opportunity for new entrants to the market: small, innovation-focussed firms who demonstrate a very different business model to the one that has proven so effective for the incumbent firms for such a long time. The balance of power may be shifting from those who own the access to the reserves, to those who develop the technology to extract those reserves. With this comes the potential for value chain fragmentation.

Examples of this fragmentation can be seen in many countries' petroleum industries, which is very much in keeping with the disruptive innovation literature (Christensen, 1997; Dosi, 1982; Johnson et al., 2008). With its foundation in Schumpeter's creative destruction concept, this literature states that during this period of disruption, the dominance of incumbent firms will be eroded away, leading to their decline. This is often the result of an inability of these firms to capture potential emerging technologies – the exploratory business – due to a single-minded focus on the exploitative business: maintaining production, hitting profit margins, etc. In this industry, these emerging technologies have tremendous potential to generate disruptive innovation, thereby significantly altering the long-standing competitive dynamics therein.

A unique and fascinating example of incumbent-led disruptive innovation exists in Brazil, in the case of Petrobras. In recent years, Petrobras has become a world-leader in ultradeep water petroleum exploration and production technologies. This dramatic increase in technological development was born out of necessity, following the discovery of the *pré-sal* oil fields in 2007, where reserves reside at depths of over 6000m. Given the nature of these reserves and the challenges that must be overcome in extracting them, incremental improvements to existing technologies (i.e. sustaining innovation) would not suffice. Petrobras have since been developing a wealth of emerging technologies specifically designed to support the exploration and production of the *pré-sal* reserves, many of which involve nanotechnology, which is the focus of this study. These include: nanorobots, which independently and intelligently analyse reserves, relaying information back to the surface in real-time; nano-coatings that are corrosion-resistant, can withstand extremes of temperature,



and can even be used to separate oil from gas, metal and water on a molecular level at the source; nano-fluids to aid the drilling process, such as fracking compounds; and nanomembranes for filtration of impurities and separation of mud/sand during the drilling process. As the largest company in the southern hemisphere and one of the world's most significant oil producer, Petrobras is clearly an important case and this a timely point to study it.

The study examines how an incumbent firm such as Petrobras is able to successfully innovate in the pursuit of disruptive technologies, whilst also maintaining and even enhancing their already dominant position in the market. As such, it is not the technologies that are the unit of analysis but rather the business model that supports their development. It is here that the true innovation of Petrobras is explored: the development of a business model that drives success in both exploitative and exploratory business, contrary to almost all cases of incumbent firms studied by disruptive innovation researchers.

The successful pursuit of innovation by Petrobras is actually a story of collaboration, involving many diverse players. This was initiated by the Brazilian government, who instated a local content policy that sees 1% of revenues from Brazil's high-yield oil fields placed in a fund for university programmes, research centres and SMEs involved in the development of breakthrough technologies for application in the petroleum industry.

This amounts to around US\$1bn a year, around one-fifth of which is from Petrobras alone. The objective is clear: to develop emerging technologies and an expertise base that can be sold around the world, establishing Brazil, rather than just Petrobras, as world-leaders in this industry.

The success of this local content policy in developing disruptive technologies is somewhat in contrast to the literature (Johnson et al., 2008; Christensen, 2005), which often describes a landscape of increased competition and market disruption, with the incumbent firm ultimately being left behind as new entrants prosper. Here, success is a result of collaboration, between Petrobras, universities, research centres and new entrants.

The analysis is derived from thirty in-depth interviews held with government bodies, universities, research centres, Petrobras and new entrants across three states of Brazil. The government bodies include those responsible for distributing the considerable funds from local content and the interviews examine the role they play in supporting the countless collaborations that have already emerged from this policy. Ten interviews were conducted with various universities and research centres to attain their perspective on these collaborations, local content and the changing face of the industry. Several interviews were carried out with Petrobras' management team at their world-leading research centre, CENPES in Rio de Janeiro. Many small, extremely-innovative new entrants are also emerging in this sector and a particular focus is given to the business models that these firms utilise, examined through a further 15 interviews with Brazilian petroleum SMEs: exploring which business models are successful and why, and how these are different from Petrobras' own business model.

## References

- Christensen, C.M. (1997) *The Innovator's Dilemma: When new technologies cause great firms to fail*. Boston, MA: Harvard Business School Press.
- Christensen, C.M. (2005) *Riding the waves of disruptive change* [online]. Available at: <http://www.eetimes.com/General/PrintView/4056989> (Accessed 15 February 2014).
- Dosi, G. (1982) Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change. *Research Policy*, 11(3), pp.147-162.
- Johnson, M.W., Christensen, C.M. and Kagermann, H. (2008) Reinventing your business model. *Harvard Business Review*, 86(12), pp.51-59.



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***Towards mission-oriented governance systems: the case of security***

**Abstract:** Currently, STI policy debates gravitate around the issue of mission-oriented RTI programmes. However, such programmes are embedded in broader governance systems that integrate sectoral policy fields such as health, energy or transport (where the over-arching ‘missions’ are defined, as well as broader policies) with the field of RTI policy (where more specific RTI priorities and instruments are defined).

Traditionally, STI policy and sectoral policies have been rather separate spheres, each with their respective goals, processes and policy instruments. While it is true that in some countries dedicated research institutes are embedded in sectoral ministries to support policy development and implementation, for instance in fields like health or agriculture, the majority of “new” mission-oriented RTI activities are part of RTI policy under the responsibility of dedicated research and innovation ministries.

With the growing importance of mission orientation in RTI policy and beyond, a need for a more explicit connection between RTI policy and sectoral policies has become apparent, and the key argument of this paper is that this connection needs to go well beyond a re-design of thematic R&I programmes. There are at least three further aspects of these governance systems that need to be addressed in order to develop a new generation of mission-oriented policies:

- In terms of the substantive rationales to justify and legitimize mission goals and RTI priorities, which need to build on a combination of sectoral and RTI policies;
- In terms of process rationales to justify and legitimize mission goals and RTI priorities, as part of a multi-domain, multi-actor, multi-level decision space. This process needs to cover the entire policy (learning) cycle from problem and goal definition via foresight to evaluation, and it needs to integrate sectoral and RTI policies as well.
- In terms of the types of structures and institutions needed to realize the RTI and sectoral policy options that are regarded necessary from a mission-oriented perspective.

Currently, a lot of policy experimentation takes place in order to develop these mission-oriented governance systems at the intersection of RTI and sectoral policies, but the experiments tend to address very specific facets of the governance system only. Joint Programming Initiatives are an example of a new type of multi-country RTI programmes in areas of Grand Challenges, for which Strategic Research Agendas are developed on the basis of a systematic process that covers the full spectrum from foresight and impact assessment to – at a later stage - evaluation. At national level, the definition of thematic RTI programmes is more closely tied to longer term policy strategies in the corresponding sectoral policies (e.g. between transport policy and mobility research programmes). And efforts are made to better coordinate the national and European level initiatives around new missions (e.g. SCAR, SET Plan). In order to achieve coherence, shared substantive rationales need to be developed, well-orchestrated processes of policy development involving a broad range of stakeholders to be set up, and organisational structures and various types of institutions to be established that allow exploiting synergies between policies and RTI activities around the new missions.

In this paper, we look at the area of security research as an example of a mission-oriented governance system in the making, and we analyze it from two angles. First of all, current developments in this system are sketched. Secondly, an effort will be made to develop a consistent framework for the mission-oriented R&I governance in security. While acknowledging the specificity of the security field, the example serves as a basis for formulating some guiding principles for mission-oriented governance systems in general, in terms of substantive rationales for defining R&I priorities, process rationales, and organisational and institutional requirements necessary to realize these priorities.

As regards the substantive rationales defining missions and associated RTI agendas, it will be crucial to integrate lines of reasoning from security policy (as the demand side of RTI) with rationales that are common in RTI policy (as the supply perspective). For the former, principles of deterrence, protection and prevention have been traditionally used to define and legitimize policy agendas, but need to be revisited in the light of what the actual 'missions' of security policy are supposed to be in the light of a more societal interpretation of what security actually means. In RTI policy, arguments associated to market and system failure are usually applied to legitimize government intervention. For mission-oriented governance systems, these lines of reasoning need to be combined.

Procedural rationality needs to complement arguments of substantive rationality, in particular in areas where controversial values and assessments are likely to exist, and where substantive arguments do not lead to widely acceptable results. The balanced involvement of stakeholders in this process is crucial to enhance legitimacy, as is the establishment of a full cycle of policy learning, covering foresight, impact assessment, implementation and evaluation elements. Given the often longer-term character of the missions in question (and this applies to several sub-domains of security), foresight elements are crucial in the definition of what actually constitutes the mission.

In terms of system structures and institutions needed to realize the kind of mission-orientation, it is clear that conventional funding programmes are important, but probably insufficient to tackle the long-term and uncertain nature of new missions. For long-term and fairly well-defined future challenges (e.g. related to climate change), longer-term funding programmes, based on visions and roadmaps, may be a suitable means for tackling the mission. However, in highly uncertainty areas (think of cyber security issues), where the anticipation of future security challenges is almost impossible due to the fast pace of change, a programme-based approach is likely to always lag behind a fast-changing reality. In such cases, a mission-oriented governance system is needed that promotes a broad range of competencies as the basis for exploration and experimentation. In other words, the R&I system needs to be adjusted in organizational, structural and institutional terms in order to give justice to a more flexible and open approach to R&I.

The example of security as a specific case of a mission-oriented governance system shows that mission-orientation not only requires new programmes to address the challenges ahead. Instead, a much broader re-engineering of the governance system is needed that affects the substantive rationales used, the processes for policy development and learning, and the structures and institutions of the R&I system needed for realizing the mission-oriented agendas.

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***Where would I be without my right-hand (wo)man?: Professional knowledge and technical skills in R&D***

**Abstract:** Background

The emerging debate on the dynamics of skills and employment tends to focus on the institutional supply of suitably trained individuals, on the one hand, and the mechanisms and processes guiding the allocation of these human resources to industries and sectors, on the other hand. Both these approaches are important for understanding how institutions and firms address the demands for new skills linked to such factors as technical change or coordinated strategies to address societal challenges. In relation to the Vocational Education and Training (VET) sector, systematic syntheses of institutional and market processes have uncovered different underlying modes of organizing skills training and quality frameworks that are fundamental to distinguishing the particular strengths and weakness of different national innovation systems (Busemeyer 2009; Thelen 2004).

However, the debate as it stands tends to focus on the supply of skills for specific occupations and how these occupations can best be organized to perform required tasks and build capabilities in the form of organizational routines that are, in turn, open to improvement and the incorporation of innovations. What tends to be missing from these discussions is attention to the relations between different forms of knowledge and skills that are institutionalized in the workplace in the form of patterns of occupations and their interrelations. An analysis of the dynamics of skills and employment is not complete without an understanding of how changes in occupations impact on other interacting occupations. The division of labour is, in this sense, more than the distribution of the knowledge and skills required for the performance of certain activities across a group of occupations. The fact that certain of these occupations are interdependent, and irreducibly reliant on each other, frames an understanding of the division of labour as a social and organizational achievement that is constituted in the practices and contexts of collective work.

In this context an important dimension of the dynamics of skills and employment is the relationship between professional occupations and other supporting occupations. Many professional occupations rely on skilled occupations requiring educational qualifications and practical experience that differ from their own (Barley 1996). Of particular interest in this paper are the relationships between science and engineering occupations and supporting technical jobs. The paper explores the contributions highly skilled craft and technical workers make, alongside their professional scientist and engineer colleagues, in the contexts of collective research and development (R&D) work.

**The Study**

The study was undertaken in Australia with the aim of better understanding the roles and contributions of skilled trades and technical workers in the diverse contexts of R&D. The

empirical investigation was built around a stratified purposive sampling method, as potential interviewees and interview sites were required to meet a number of conditions to be included (Kemper et al. 2003). Interview sites were selected that matched the major characteristics of entities undertaking R&D in Australia by share of public and private R&D activity, employment size, degree of foreign ownership and diversity in the technologies employed. Access to some significant sectors for R&D was not secured, including automobiles and mining. This limited the study somewhat in terms of the diversity of technical activities and contexts for innovation covered. However, sixteen separate organisations conducting R&D at a total of 23 different worksites participated in the study. This included four PSROs, two universities, nine private firms, and two hybrid organisations. These last were Cooperative Research Centres (CRCs), which are dependent on a mix of public and private funding. A total of 103 in-depth interviews were conducted, with participants including trades and technical workers (n=71), research leaders/managers (n=27) and human resource managers (n=5).

### Results

Trades and technical workers are involved in a wide range of activities directly related to fulfilling the objectives of their professional co-workers. These activities included five key roles: installing, calibrating and customizing instruments; design; linking R&D to production; health and safety regulation; and training. The contribution of trades and technical workers to R&D exceeded simple execution of plans or designs provided by scientists or engineers. Key forms of craft knowledge were important to the conduct of research programs and projects. These included knowledge of the properties of materials, the importance of design for maintenance and the carriage of non-codified knowledge – particularly of as-built artefacts and of ongoing adaptation to technical change – from one project context to another.

Professional respondents were clear in their articulation of the importance of highly skilled technical workers to have the necessary capabilities to be their 'hands and eyes', whether in the laboratory or in the field. The hands-on involvement of technical workers means they are always 'close to the action', from the conceptualization stage of professionals' plans and designs and continuously into the development, testing and modification stages. Throughout, technical workers interact directly with professionals in a variety of formal and informal contexts. For example, collective engagement with a material artefact such as a prototype was an arena in which the different knowledge bases of scientists, engineers and skilled technicians could be translated and negotiated to settle on a shared understanding of progress and potential future strategies.

The central finding of the study is that trades and technical workers should be understood as providing far more than 'support' in R&D contexts. Rather, the appropriate integration and timely involvement of trade and technical occupations in project teams adds dimensions of skill, risk management and collective learning to R&D work processes that can have significant benefits not only for the conduct of knowledge intensive work, but also for the efficient subsequent translation of knowledge between R&D, quality control and production processes.

Discussion and relevance to the special stream

The emergence and decline of innovation cycles, whether they be based in technological advance or societal challenges such as the transformation to 'cleaner' forms of energy, produces intense challenges for the institutional supply of knowledge and skills. The modification of the scientific knowledge base means changes to the education of scientists and engineers. Similarly the rise in demand for 'green' or other skills requires a response from the VET sector. Yet changes in the professional curricula, methods of training and capabilities embodied by engineers do not happen in isolation from interacting occupations such as highly skilled technicians. Over time the frontiers between professionals and technical occupations may even be modified. In design activities, for example, increased reliance on the virtual forms of knowing (Amin & Roberts 2008) that underpin both computer-based modelling techniques and computer controlled workshop machinery can be seen to lead to a convergence of professional and technical skills around the manipulation of digital code (McCullough 1996). The evidence of this paper suggest that, at least in knowledge intensive contexts such as R&D, preserving or enhancing the capacity for complementarities to emerge between professionals and their skilled 'hands and ears' may be a worthy policy goal. The achievement of such a goal in contexts of new skills paradigms and dynamics may be better addressed through an holistic skills ecology, one that is inclusive of multiple forms of knowledge and diverse occupational groups. The emergence of hybrid institutions and/or increased policy emphasis on developing innovative forms of articulation between universities, polytechnics and vocational training institutions may be one important approach to confronting the types of future challenges already clearly on the horizon.

#### References

- Amin, A., Roberts, J., 2008. Knowing in Action: Beyond Communities of Practice, *Research Policy* 37, 353-369.
- Barley, Stephen R. 1996. Technicians in the workplace: Ethnographic evidence for bringing work into organization studies. *Administrative Science Quarterly*, Vol. 41, 404-441.
- Busmeyer, M., 2009. Asset specificity, institutional complementarities and the variety of skill regimes in coordinated market economies. *Socio-Economic Review* 7, 375-406.
- Kemper, E., Stringfield, S., Teddlie, C., 2003. Mixed Methods Sampling Strategies in Social Science Research. Ch. 10 in A. Tashakkori and C. Teddlie (eds), *Handbook of Mixed Methods in Social & Behavioural Research*. Sage Publications, London, pp. 273-296.
- McCullough, M., 1996. *Abstracting Craft: The Practiced Digital Hand*. MIT Press, Cambridge MA.
- Thelen, K., 2004. *How Institutions Evolve. The Political Economy of Skills in Germany, Britain, the United States and Japan*. Cambridge University Press, UK.

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***The characterisation of scientific advice in mission-oriented settings – the case of Scientific Advisory Councils***

**Abstract:** It is widely acknowledged that scientific evidence and advice generated through research has an important role to play in the policy-making process. As a result of the increasing pervasiveness of science and technology issues there has been a corresponding increase in the use of expert scientific advice to inform decision-making, at all levels of policy-making. This influence has been particularly notable with regards to sensitive (and sometimes high profile) issues relating to people's health and safety, plant and animal protection, and the environment. In this paper, we explore the role of high level Science Advisory Councils (SACs) in mission-oriented science and technology systems (MOSTS). Whilst there is a literature on scientific advisors, and expert advisory committees, to our knowledge the role of high level, general advisory bodies whose role is to "advise about advice", rather than to provide expert advice per se, has yet to be explored sufficiently – and certainly not in the context of their role in broader government mission-oriented science and technology systems. As such, our contribution will be to look at such bodies in practice, their working practices and management. Specifically, we will compare the two most prominent such bodies in the UK system, i.e. the SACs of the Ministry of Defence and Defra.

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***Credibility and Use of Scientific and Technical Information in Policy Making: An Analysis of the Information Bases of the National Research Council's Committee Reports***

**Abstract:** Often researchers are disappointed by the limited extent to which peer reviewed STEM research seems to contribute directly to high level public policy decision-making. However, does the perception of the limited use of formal scientific and technical information (STI) accord with empirical reality? What types of information “compete” with STI for inclusion in science policy-making, the realm in which one might intuitively expect greatest receptivity? How does the choice of various types of information relate to the use and impacts of science policy reports and recommendations? While there is a prodigious literature on the use of formal information in decision-making, our focus is on the use of STI in science, technology and innovation (S&T) policy, a domain in which there is virtually no empirical literature.

Our study will examine the use and impacts of STI. Our focus is on a single, but arguably quite important, S&T policy domain: National Research Council (NRC) reports. This is an especially important target institution for analysis because NRC committees have extensive information access and resources, as well as decision-makers who are well equipped to deal with a variety of information types, including STI. To understand the information ingredients of high-level S&T policymaking and advice in the context of the NRC, we provide an analysis of the characteristics of 600 NRC reports published from 2005-2012. We exclude workshops and narrow or very particular studies (such of those for the Transportation Bureau or in the Health and Safety area). For each of these studies, we collect, information about the study (e.g., size of the report, report area), about the committee chair and members (e.g., affiliation with academia, business, government), about these individuals' publication history (e.g., disciplines they publish in), about the outcomes of the report (e.g., in the media, in legislative documents), and about the references (e.g., STI journal articles, other types of articles). We expect that STI will be associated with reports that have less of a legislative impact, suggesting that more attention to broader impacts be paid in STI research.



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***The Involvement of Scholars and Scientists in the Organisation and Policy of Flemish Scientific Research (2000-2013)***

**Abstract:** 1. Introduction/outline and context of the paper.

A longstanding and continuously growing body of specialist literature accounts for the highly diversified ways in which regional and national science policy is organized into a plethora of ecosystems that is inhabited by a varied range of actors and subjected to abidingly changing influences, interactions and instruments. Depending on the perspective that prevails in these studies, scholarly attention is devoted to the altering (social) roles performed by scientists and scientific instances and the dynamic interplay in which these actors and instances are involved in different circumstantial settings (e.g. Merton, Knorr, Latour, Strauss, Baszanger...). Changing patterns marked by a high degree of heterogeneity of knowledge production (e.g. Gibbons, Nowotny, Pestre, Shinn, ...), norms and conventions (e.g. Harris), and so on have equally been subjected to scholarly analysis.

From the analyses directed towards the forms and dimensions of the interaction between the various knowledge producing actors on the one side and studies focused on the administration or regulating bodies on the other hand, two dominant viewpoints can be derived. A first approach is marked by an exclusive and singular treatment of one of the stakeholders concerned (knowledge producing actors or regulatory instance) (cf. remarks by Jasanoff, 2005). A second analytical category noticeable in the body of literature takes approaches used in system theory (e.g. triple, quadruple or N-tuple helix approaches, cf. Leyersdorf) as a focal point (e.g. Nowotny, Callon, ...). As a result, the role in the process played by individuals – scholars and researches – has largely remained unnoticed. The different positions and movements between the two institutional worlds of academia and administration these actors develop, the interactions they engage in, the influence they undergo and the possible imprint they might leave behind during these interactions have not been charted so far. On the contrary, as most of the studies indicate the choice for an analytical unit is often determined by a purely institutional perspective and remains fully dichotomous either focusing on the university or the regulative side (e.g. many papers at the conference 'The Special Role of Science in Liberal Democracy' in Copenhagen, Denmark, November 21-22, 2013, were typical of this approach).

This dichotomy does not concern the classical division that is rooted in an outdated traditionally upheld vision on science (and research) and policy. This traditional view considers science as a neutral, objective, independent and value free occupation while viewing the act of policymaking as an essentially value-related and ideological phenomenon. This viewpoint has been promulgated in modernity theory. Nowadays, the idea that organisational and institutional structures of science/research have gone through profound changes, is generally accepted. The same goes for the rapidly modifying public expectations uttered towards science and research. Similarly, over the last decades the nature of policymaking has undergone thorough transformations. Politicians - and the structures they



belong to - struggle with the immediacy of decision making (partly caused by the new (social) media). At the same time, they are faced with a growing demand for an evidence- (science-)based policy making. Consequently, science (and research) and policy making here and now, whether or not compelled by circumstances, fulfil fundamentally new roles when compared to previous decades.

The institutional loci in which the processes of science policy making take place constitute an interesting and revealing topic of study allowing for the observation of change and transformation. In this paper, the various forms in which science is 'present' and 'represented' in these aforementioned settings take centre stage. Equally, the various and multiple roles attributed to science, to research and to knowledge producing actors/instances and the changes afflicted upon them/these by policymakers or during the policymaking process are at the heart of the contribution that is proposed. Concretely, the representative, intermediary and participative functions scholars and scientists perform in the process of scientific and institutional norm creation and diffusion in the realm of science policy is what will be explored in the paper.

## 2. Research design: case selection, analytical framework, methodology.

For a micro level reconstruction of individual scholars' and scientists' contributions in the policy making process and the identification of the varied and multiple roles these persons assumed during the course of events, three specific moments in recent Flemish science policy have been selected as case studies. A description of the specific context frames reveals the relevance of the cases for our research purpose.

Context 1: During the 1980s, science policy, innovation and (higher) education in Belgium became regionalised policy competences (like other domains) which due to a constitutional reform were handed over by the federal authorities to the regional policy instances. As a result, the Flemish and the Walloon Governments, recognised as full regions with the Brussels Region in an exceptional status enjoying lesser executive authority in comparison to Flanders and Wallonia, were suddenly endowed with extensive powers in the aforementioned domains (as in others) while only residual domains were left to the federal authority. Especially in Flanders an extensive and extremely complicated system of subsidy instruments and funding mechanisms (with the accompanying (bibliometric) calculations and evaluation processes) was set in place in the past 25 years. The transition occurred under the supervision of two different executive ministers holding respective responsibilities into the domains of education on the one hand and science policy, innovation and economy on the other. The Flemish scientific landscape counts numerous HEIs, research organisations, survey centres, and the like in its ranks. All of these instances were shaped in the past decennia (cf. Soete, Fallon).

Context 2: In principle, federal and regional policy design is a competence of the legislative power instances (parliaments) in Belgium and much less a competence matter of the executive power holders (king, ministers). In reality, since the 1990s, a power shift has taken place: the policy design, management and execution resides in the midst of the regional executive circles and not in the ranks of their legislative counterpart. The governments consist of ministers who all have, when compared with e.g. the Netherlands, extensive

cabinets with many collaborators and advisors; the actual processes of policy- and decisionmaking take place in these cabinets - not in the parliaments, nor in the administrations, which mainly have an executive function (D. Vancoppenolle, 2009). As a result, cabinets (often considered as black boxes, as it is difficult to get access to the internal evidence) are extremely interesting settings where one can identify - within and between the cabinets - the presence of various forms of capital, of layered processes of power, of conflicting individual and institutional interests and ideas, of ideological positions and pragmatic decisions.

Context 3: In Belgium, science policy and the organisation of scientific research is confided to the regional ministers of Science policy (whose title has been modified several times over the course of the years due to political-strategic reasons) and the minister of Education. The responsible ministers are assisted and advised in their tasks by their administration, by intermediary semi-administrative domain-related organizations and institutions. All these instances taken in their entirety form a configuration of networks in which every parcel contributes to the conceptualization, the realisation and the regulation of these policy domains.

It is impossible in the framework of this paper to treat all the aforementioned aspects (parts of a broader research design). Based on policy documents produced in the three contexts sketched above, a genealogy of the state of affairs of science policy making with a focus on the different parts and roles played by scholars and scientists on various policy levels in this process as well as in different intermediary structures will be dressed. In the reconstruction, the fruition of concepts and ideas in the circles of the various stakeholders, the importance of terminology ('consensual terms') and deliberative structures in the making and the creation of a generally sustained policy discourse are given special attention. Two important decrees (and all related policy documents: working papers, reports from intermediary organisations and public institutions, reports by expert committees, ...) constituting the backbone of the actual science policy and scientific research (financing) structures and regulation (in Flanders) form the basis of this micro-analytical genealogical reconstruction, namely the Decree for the organisation of science policy in Flanders (2008-2012) and the Decree for the financing of higher education (research included) (2003-2012). The following elements are taken into account in the paper:

- ° the involvement and the interests of the different actors operating in the public or the private domains (both individual and collective stakeholders, institutions, firms, politicians, interest groups, intermediary organisations);
- ° the different loci and tempi of policy decisions on these terrains (with special attention to the aforementioned cabinets);
- ° the (structural) presence of levels of human capital and its various functions and roles;
- ° the complex mechanisms between apparent oppositional interests and viewpoints and the ways through which these are merged into a collectively supported consensus and implementation.

### 3. Structure of the paper.

- ° Concise sketch of the actual organisation of the Flemish Science and Research Policy;
- ° Concise context sketch of the aforementioned three 'contexts';

- ° Case analysis;
- ° Presentation of conclusions and general exploration with regard to the research relevance of 1) insights gained into the development and organisation of Science Policy in Flanders and the implications they bear, 2) the use and transformation of concepts, ideas and empirical data within the different levels of the decision making process, and 3) the acquisition of more general knowledge of the policy design and organisation of these domains.