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Title: Science's disparate responsibilities: patterns across European countries

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Abstract

It is a distinctive feature of European science policy that science is expected to meet economic and broader societal objectives simultaneously. Science should be governed democratically and take significant responsibilities towards the economy, the political system, and civil society, but the coherency of these multiple claims is underexplored. Using metrics that emerge from both quantitative and qualitative studies, we examine the interrelatedness of different responsibilities at the level of countries. 33 EU member states and associated countries are included in the analysis. We find no trade-off between economic and broader societal contributions. Europe is, however, characterised by major divisions in terms of the location of science in society. There is a significant East-West divide, and Europe appears to be far from accomplishing an integrated European Research Area.

Key words

Science in Society; RRI; Cluster analysis; Social contract; Metrics

Introduction

About 20 years ago, requests for a 'new social contract' between science and society emerged and spread rapidly (Guston and Keniston 1994; Gibbons *et al* 1994; Lubchenco 1998). Against a backdrop of growing investments in research, public unease about controversial technologies, and mounting expectations concerning societal benefits of scientific and technological advancement, the need for re-thinking science and its role and responsibilities in society became widely recognized. The exchange of reliable knowledge for public funding was no longer considered an adequate stipulation of the science-society relationship. The contributions of science and technology to society needed to be demonstrated and assessed in new ways, and academic organisations needed to cultivate new kinds of interaction with their societal constituencies (Molas-Gallart *et al* 2002), including policy-makers, industrialists, civil society organisations, and citizens.

Since then, science policies at the national and international level have tried in different ways to nurture the production of 'socially robust' knowledge (Gibbons 1999; Nowotny *et al* 2001) and to flesh out appropriate narratives about the location and functions of science in relation to society. In

Europe, the policies and research funding frameworks of the European Commission have significantly contributed to creating new visions about the place and purposes of science. Figure 1 is a recent attempt by illustrator Heyko Stöber to capture the progressive development of visions of constantly closer interaction; from ‘Science *and* Society’ in the 6th framework programme, over ‘Science *in* Society’ in the 7th, to ‘Science *with and for* Society’ in the current H2020 programme.

FIGURE 1 ‘Changing visions of science and society in European framework programmes’
INSERTED HERE.

The images helpfully show how science can be thought of as being located either in the centre, in the periphery, or outside of society. Even if the illustration is not an entirely accurate or exhaustive representation of the ideas embedded in the successive programmes, it does demonstrate the movement towards an understanding of science as intimately connected with societal stakeholders and of knowledge as being the result of co-creating practices. Within the most recent paradigm, the propelling of science, technology, and society to new heights depends on cross-fertilisation of values, norms, experiences, and expertise among all actors engaged with science; academic and non-academic.

It can be useful to think of science’s evolving responsibilities in terms of the societal domains that they concern. Considering the European policy trajectory over the last decades, four areas seem to be important.

First, science is increasingly expected to contribute to the economy by playing a central role in innovation systems. Previous separation of research policy and innovation policy has weakened, linkages between science and industry have been incentivized, and academic institutions are considered spearheads in national efforts to gain competitiveness in the global knowledge economy (Etzkowitz and Leydesdorff 1997). The prominent role of science towards innovation performance has been evident in Europe’s ambitious growth strategies (European Commission 2000; 2005; 2010a) and is captured in the vision of Europe as an ‘Innovation Union’ (European Commission 2010b).

Second, science should inform policy. Complex societal challenges require evidence-based policy-making, and science has faced a growing demand for feeding knowledge into policy processes (Jasanoff 1990). EU has given priority to bridging the gap between scientists and policy makers (European Commission 2008) and has developed guidelines that facilitate their interaction (European Commission 2010c).

Third, science is assigned an important role in cultivating the public sphere by communicating extensively its results and reservations. The benefits of science communication lie not only in empowering citizens who must deal with the uncertainties and complexities of modern, technology-driven societies in their daily lives, but also in stimulating a culture of reason and reflexivity in

public debate (Bauer *et al* 2007). Educational and democratic aims are thus intertwined and embedded in the growing body of science communication activities at national and European level. At the EU level, the framework programs for research funding have been instrumental in supporting this development (European Commission 2002).

And fourth, science is increasingly subjected to inclusive governance arrangements, in which citizens and societal stakeholders actively participate in prioritization and assessment. Inclusive governance is considered a crucial mechanism for aligning science and societal demands, and also for improving the political legitimacy of science (Stilgoe *et al* 2014). Public deliberation has become a target component of European science policy, and Europe has witnessed abundant experimentation around public and stakeholder participation in science decision-making (Felt and Wynne 2007).

There have been other manifestations of the new understanding of the science-society relationship in European policy, including e.g. the recent emphasis on challenge-orientation in research or the longstanding commitment to improving gender equality in science. However, the democratic governance of science, and the significant responsibilities that science should take towards the economy, the political system, and civil society, are central components.

Importantly, these four components of the relationship between science and society are believed to be internally coherent and non-conflictual, which is particularly visible in the emerging commitment to ‘Responsible Research and Innovation’ (RRI) in European policies (Owen *et al* 2012). An influential interpretation (von Schomberg 2013) defines RRI as ‘...a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)’. The notion thus embraces the innovation agenda but insists that science has substantial obligations beyond those relating to economic issues. While the above definition is by no means uncontested and while more operational concepts, such as the RRI ‘keys’ (European Commission 2012), are also important, an overall belief in the ability of research and innovation to meet economic and broader societal demands simultaneously seems to be a prevalent feature of the RRI discourse.

According to Horst and Irwin (2010), this combined commitment to innovation and deliberative, interactive governance, may be what ultimately makes European science policy distinctive. It is a crucial normative commitment and implicit claim of coherence, which we try to explore empirically in this paper. Can we empirically corroborate the new European philosophy of the science-society relationship, according to which science can serve the economy, policy-making, civil society, and democratic deliberation simultaneously? One can easily imagine that economic and broader social goals might indeed hamper one another, and critical observers have noted how narratives around commercialisation and industrial relevance can supplant discourses of concern about environmental, health-, social, and ethical repercussions of scientific and technological development (Hård and Jamison 2005). Others have argued that the hubris of innovation needs to be tamed by ‘technologies

of humility' (Jasasnoff, 2003), i.e. *social* technologies facilitating inclusive, democratic deliberations around science and technology. While the idea that economic and broader social goals can and should be maintained concurrently may be a distinctive feature of European science policy, it is interesting to explore the empirical soundness of this idea.

We address the question based on indicators of innovation performance, use of science in policy-making, science communication, and public participation in science governance at the country-level covering 33 European countries in the analyses. Clearly, other levels of analyses (e.g. organisations or individuals) also deserve attention, as do other sets of indicators (e.g. of 'challenge-orientation' or gender equality), but we limit this study to exploring country characteristics around innovation performance, use of science in policy-making, science communication, and public participation in science governance. As we shall point to in the next section, there are significant shortcomings in traditional quantitative data sources on research and innovation performance, and very limited cross-country measures of the kind of soft issues around democratization, communication, and policy advice that we wish to explore. By drawing on a combination of quantitative and qualitative data, however, we are able to address two issues: First, we explore the interrelatedness of innovation performance, use of science in policy-making, science communication, and public participation in science governance at the level of EU member states and associated countries. Second, we detect differences among countries with regard to the role that science plays. Europe aspires to become an integrated research area, in which national policies are closely interwoven and in which science consistently plays a central role in society and policy landscapes. We use cluster analysis to examine the location of science in the 33 countries and illustrate the pattern across Europe.

Data and analyses

The new agenda for science's role in society has been accompanied by increased demand for measures of science's societal contribution and impact (Wilsdon *et al* 2015). Attempts to provide comparable metrics on knowledge producing institutions' societal engagement and impact, including collaboration with industry, commercialization, and technology transfer but also public outreach and research-based policy advice are emerging strongly. Probably, transfer of academic knowledge to industry is the most developed area (Bozeman 2000), but complementary sets of indicators around other public benefits of science are being developed too (Vargiu 2014; Neresini and Bucchi 2011).

Science policy makers are in need of international comparative studies for policy learning and development, but even the most prominent existing quantitative data on research performance at the level of countries are fragile. Core time series, such as the OECD Main Science and Technology Indicators are not sufficiently uniform across countries and consistent over time (Godin 2005; Crespi and Geuna 2008), and beyond the issue of capacity (heads and budgets) limitations are even more profound. There are no continuous, robust sources of cross-country comparative quantitative

data on the parameters raised in this paper, such as public participation in science governance, use of science in policy-making, and science communicationⁱ.

The national-level indicators for innovation performance, use of science in policy-making, science communication, and public participation in science governance for this study are, therefore, harvested from two different sources. For innovation performance, the composite Innovation Union Scoreboard 2013 measure (European Commission 2014) is used, while the remaining three indicators emerge from an extensive qualitative study, the ‘Monitoring Policy and Research Activities on Science in Society in Europe’ (MASIS) project, which was aimed at monitoring policies on science in society in Europe (Mejlgaard and Bloch 2012). While the quantitative data on which the Innovation Union Scoreboard builds has been collected on a yearly basis and calibrated into a single indicator since 2006, the data collected in the MASIS project taps into areas, which have traditionally been studied using single-case or small-N comparative approaches.

Part of the approach of the MASIS project was to translate qualitative data into metrics. Data collection was performed by a network of national expertsⁱⁱ (or project ‘correspondents’) across 38 countries, working from a detailed common template and common guidelines to produce comprehensive reports on the roles and responsibilities of science in society in their respective countries. Each report provided a stand-alone national profile, but the homogenous composition of reports also allowed for horizontal cross-reading and thus comparative analysesⁱⁱⁱ.

A three-step procedure was introduced to mitigate risk of biases in the expert testimonies (cf. Mejlgaard and Bloch 2012). First, correspondents made use of their national networks, consulted other key persons in their country, explored a variety of data sources, and conducted interviews, focus groups, or workshops to enhance the quality of the information provided. As the appropriate procedure for data collection differed somewhat depending on national characteristics and the position and expertise of the individual correspondent, each national report included an appendix outlining the methods and procedural steps in data collection. These appendixes were used in the internal validation procedure as a means to optimize transparency and allow for mutual learning among correspondents. Second, each national report was checked for coherence, structure and format by the coordinator, and reviewed and discussed internally in smaller groups within the consortium in order to increase quality and consistency across reports. Third, each national report was submitted to a national ‘validator’ appointed by the European Commission, who offered comments and suggested improvements ahead of final revisions by the correspondent and approval by the coordinator. The reports are thus the products of an extensive process with several mechanisms for achieving consistency, transparency and high quality of contents.

In order to translate the qualitative descriptions into metrics, each report was coded using NVivo, a software for computer-assisted qualitative analysis. The typologies presented in tables 1-3 below were developed inductively, based on a preliminary coding chapter-wise by the same researcher horizontally across the full set of reports, deliberations and critical assessment by five researchers involved in the analyses resulting in final versions of the typologies, and subsequent country categorizations performed collectively by the group of five researchers (Mejlgaard *et al* 2012a).

Use of science for policy-making is categorised along two dimensions: first, the degree of formalisation, e.g. in terms of legislation requiring involvement of scientific expertise in decision-making or, more commonly, an infrastructure of advisory bodies and scientific institutions with a formal role in policy-making processes; and second, the degree to which scientific information has an impact on actual political decisions, either through formalised or non-formalised processes. Public participation in science governance is categorised using a similar combination of degrees of formalisation (are there procedures or permanent mechanisms in place to ensure citizen participation in decision-making processes?) on the one hand and degrees of influence (do citizens exercise actual influence on the decisions made?) on the other hand. Finally, science communication is categorised based on six parameters: infrastructure (diversity and intensity of science communication in media), political attention and support for science communication, diversity and volume of actors involved in science communication, academic tradition for communicating to broader audiences, public attentiveness to science, and the science journalism situation (e.g. professional organisations and training programmes) in the respective countries^{iv}.

Table 4 captures innovation performance, measured using the Innovation Union Scoreboard. The innovation index is a composite measure building on 25 different indicators^v.

TABLE 1 ‘The use of science in policy making’ INSERTED HERE.

TABLE 2 ‘Science communication’ INSERTED HERE.

TABLE 3 ‘Public participation in science governance’ INSERTED HERE.

TABLE 4 ‘Innovation index; 2013 country score’ INSERTED HERE.

We use cluster analysis to identify groups of countries based on their innovation performance, use of science in policy-making, science communication, and public participation in science governance. In total, 33 countries represented in both MASIS and the Innovation Union Scoreboard are included in the analysis for this study. We cover 27 out of 28 EU member states, since Malta did not deliver an acceptable report for the MASIS project, and hence is not included here. In addition to 27 member states, six countries (Iceland, Macedonia, Norway, Serbia, Switzerland, and Turkey) associated with the European framework programs for research and innovation are included in the analysis.

There are multiple approaches to cluster analyses, and criteria for choosing an appropriate clustering method include at least the size of the data matrix (number of observations and variables in the set) and the properties of the variables, specifically measurement level. Noting that the analysis applied here includes a limited number of observations (N=33), and that the included variables stretch across interval, ordinal, and nominal levels of measurement, we have chosen an average linkage, hierarchical cluster analysis with standardization (0-1) of the measures to make it less sensitive to outliers and measurement scales.

FIGURE 2 ‘Dendrogram, cluster solutions’ INSERTED HERE.

The dendrogram in Figure 2 visually summarizes the agglomerative constitution of clusters. Moving from left to right on the horizontal axis, we see how each country from the outset constitutes its own clusters, and how countries progressively cluster together based on the average linkage algorithm, resulting in continuously fewer clusters. There are different ways of deciding on the right ‘cutting point’ that will yield a useful cluster solution with an acceptable degree of loss of intra-cluster homogeneity (fewer clusters reduces overall complexity but also increases within-group dissimilarity). We decided on an interpretable three-cluster solution for the analysis presented in this paper.

Results

We identify three main clusters of countries. Each cluster is distinctively characterized by the four components which feed into the clustering algorithm. The cluster characteristics are captured in table 5.

TABLE 5: ‘Cluster distributions / mean score across the four components’ INSERTED HERE.

We can call the first cluster of countries ‘*Science central*’. In these countries, science communication is a consolidated activity with extensive participation by societal actors and a well-developed infrastructure. There are formalized procedures and supportive organizations for including broader publics in the governance of science, and such arrangements tend to be successful in engaging citizens. There are mechanisms in place for feeding research-based knowledge into policy-making, and scientific evidence has a genuine impact on political decisions. Countries within this cluster are characterised by high innovation performance and they provide platforms for the integration of science and business. In sum, science has a central location in society in terms of its roles and responsibilities towards civil society, the policy sphere, and the economy. It is fair to say

that within this cluster of countries, the four core components of the European vision for the science-society relationship seem to be accomplished.

The second cluster of countries could be called '*Science peripheral*'. Here, science communication is a developing activity with an emerging infrastructure and emerging societal attention. Countries within the cluster have no specific governance arrangements that require public participation in science and technology decision making, and generally there is a low degree of citizen engagement within this policy domain. There is some intra-cluster heterogeneity regarding the use of science for policy making, but as a group, the 'science' peripheral' countries have some degree of evidence-based policy-making. The innovation capacity and interlinkages between science and industry are well-established in these countries. In sum, science clearly plays a role in relation to society, but it does not take centre stage, and its responsibilities are more confined.

The third cluster of countries might tentatively be called '*Science disregarded*'. Within this cluster of countries, science communication is scattered and suffers from a low interest among citizens as well as scientists. In some cases, the collapse of communist regimes involved a corrosion of traditional science communication systems, and new ones have not been established. While some countries within the cluster have developed science governance mechanisms that would potentially allow public involvement in science decision making, nascent civil societies and non-inclusive political culture tend to form major barriers to democratic governance of science. There are very few formalised channels by which scientific knowledge can penetrate policy processes and in general scientific evidence plays a marginal role in policy-making. Innovation performance is significantly lower within this group, and overall the resources, activities, and outputs of the innovation systems are modest. In sum, science is below the societal radar and could be described as disregarded.

The result of the cluster analysis shows that the four important components of the science-society relationship examined in this paper appear to be positively related. In fact, the 'European model' that seeks to bring together high performance in terms of innovation, science for policy, science communication, and public participation in science governance, is clearly represented in countries within the cluster that we call 'Science central'. Similarly, low innovation performance co-exists with moderate achievements on all other components within the 'Science disregarded' cluster. We can make no claim about causality. It is not obvious, e.g., whether 'Science central' countries perform very well in terms of innovation because they nurture a general culture of extensive interaction between scientists, policy-makers, and members of the public, or whether it is success in terms of innovation performance which liberates some space and resources for also maintaining other kinds of responsibilities. Likewise, low innovation performance may reduce the willingness or ability to promote 'luxury' activities around inclusion and communication, but it might also be lack of stakeholder engagement and societal communication about science and technology that reduce innovation performance. We can simply note that there is no empirical evidence suggesting that the distinct European idea about science as a vehicle of economic progress as well as a democratic arena for interaction and co-production of knowledge and decisions among multiple societal actors

is flawed. Indeed, the empirical data examined here point to a positive relationship among the four components in question.

Figure 3 reports the distribution of countries across the three clusters. It reveals clear divisions across Europe. 13 countries, forming an axis from Finland and Scandinavia in the North through Western Europe to Italy in the South, populate the ‘Science central’ cluster. Four countries neighbouring the axis (Austria, Ireland, Luxembourg, and Spain) constitute the ‘Science peripheral’ cluster. Finally, 16 countries, counting all Eastern European countries covered, Greece and Cyprus in the South, and Iceland, Latvia, and Lithuania in the North, form the ‘Science disregarded’ cluster.

FIGURE 3 ‘Cluster membership’ INSERTED HERE.

It appears as if the demarcation lines that characterize Europe regarding the location of science in relation to society reflect the political and geographic divisions imprinted in European history. We find a significant East-West divide, where the Western European, old member states are significantly more prone to perform well on all of the four components included in our analysis, while the Eastern European, young members of the EU tend to be far from practising at the desired level on any of the parameters.

Discussion

For policy makers at the European as well as the national level, two tentative messages surface. First, the commitment to science as a vehicle for economic prosperity through its function in innovation does not seem to impede commitment to democratising science and insistence that science should also inform the political system and the broader society. Science can take multiple responsibilities in parallel, and there is no evidence of a trade-off between economic objectives on the one hand and broader social and democratic objectives on the other hand. Tsipouri (2012) found early evidence of congruence between innovation performance and science’s broader societal obligations, and the present study confirms the positive relationship. The ambitious understanding or vision of responsibility in research and innovation, which is currently developing in Europe, seems to be also practically achievable.

Second, while the analysis presented here suggests that economic and broader social goals do not hamper one another, it also shows that many European countries are far from realising the EU promoted vision of science’s role in society. Europe aspires to become an integrated research area in which science is located at the heart of society, but the analysis suggests that the location of science differs significantly across clusters of countries, and that the historical divisions of Europe remain salient. There is a clear, and probably expected, partition between East and West, but it is actually surprising how widespread the ‘Science central’ model is. The efforts related to developing

responsible governance of research and innovation in countries such as the UK (Macnaghten and Owen 2011), the Netherlands (v. d. Hoven 2014), and Denmark (Rowe and Frewer 2000) are quite well-documented, but the metrics-based results presented here indicate a much more broadly dispersed commitment to core components of the new vision about science and society in Europe, even stretching into countries such as Portugal, Italy and Estonia. There is no universal explanation for the relative success of the European model across ‘Science central’ countries, but it is likely that presence of particular national actors, such as the *Ciência Viva* in Portugal, and socialisation through the (funding) programmes at European level can be conducive to particular developments.

On the other hand, European integration is clearly challenged by the ‘disregard’ of science in many member states and associated countries. 2014 was set as the year in which the European Research Area, one which is firmly rooted in society and responsive to its needs, and in which all member states’ national research systems are open, interconnected, and interoperable, were to be completed. Our analysis reveals differences across countries of such magnitude that this target must be considered unachieved.

The study has several limitations. We use a limited number of indicators, and while they cover important functions of science in society, they clearly do not exhaust the array of responsibilities that science is expected to take. It is likely that the current efforts within the MoRRI project will offer new opportunities for testing a broader range of indicators of responsibility, and for arriving at a more subtle understanding of their interrelatedness. There are competing understandings of the emerging commitment to RRI, which we are also not able to capture based on the measures currently available for this study. Yet another, and crucial, limitation is the inability to make causal inferences based on the analysis. The analysis is rough in the sense that it does not reveal how and why science is capable of entertaining multiple purposes simultaneously in some countries but not in others, and it does not disclose the structure of the interdependencies among the different responsibilities. We will refrain from speculation, but only note that there is a need for in-depth case studies of country trajectories, in order to explain the co-emergence of science’s contributions towards the economy, the political system, democracy, and civil society. Moreover, arriving at a more fine-grained picture of the dynamics, distribution, and interrelatedness of science’s responsibilities towards society clearly requires studies at disaggregated levels. Looking at specific debates, controversies, and properties of interaction in particular areas of the knowledge ecosystem is certainly necessary for substantiating our general findings.

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Figure 1: *Changing visions of science and society in European framework programmes*

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Source: MoRRI Visioning Workshop (see Kukk *et al* 2015)

Table 1: The use of science in policy-making

Highly formalized / high impact	Less formalized / considerable impact	Formalized/ low impact	No formalization / low impact
Denmark	Austria	Romania	Croatia
Estonia	Belgium	Spain	Cyprus
Finland	Bulgaria		Czech Republic
France	Luxembourg		Greece
Germany	Switzerland		Hungary
Ireland			Iceland
Italy			Latvia
Norway			Lithuania
Portugal			Macedonia
Sweden			Poland
The Netherlands			Serbia
United Kingdom			Slovakia
			Slovenia
			Turkey

Source: Adapted from Mejlgaard *et al* 2012a

Table 2: Science communication

Consolidated	Developing	Fragile
Belgium	Austria	Bulgaria
Denmark	Cyprus	Croatia
Finland	Estonia	Czech Republic
France	Greece	Lithuania
Germany	Hungary	Macedonia
Italy	Iceland	
Norway	Ireland	
Portugal	Latvia	
Spain	Luxembourg	
Sweden	Poland	
The Netherlands	Romania	
United Kingdom	Serbia	
	Slovakia	
	Slovenia	
	Switzerland	
	Turkey	

Source: Adapted from Mejlgaard *et al* 2012a

Table 3: Public participation in science governance

Formalized / high involvement	Formalized / low involvement	Not formalized / high involvement	Not formalized / low involvement
Belgium	Croatia	Austria	Bulgaria
Denmark	Estonia	Iceland	Cyprus
Finland	Greece		Czech Republic
France	Latvia		Hungary
Germany	Poland		Ireland
Italy	Portugal		Luxembourg
Lithuania	Slovakia		Macedonia
Norway	Slovenia		Romania
Sweden	Turkey		Serbia
Switzerland			Spain
The Netherlands			
United Kingdom			

Source: Adapted from Mejlgaard *et al* 2012a

Table 4: Innovation index; 2013 country score

Country	Innovation score
Switzerland	0,84
Sweden	0,75
Denmark	0,73
Germany	0,71
Finland	0,68
Luxembourg	0,65
Belgium	0,63
Netherlands	0,63
Ireland	0,61
United Kingdom	0,61
Austria	0,60
Iceland	0,59
France	0,57
Slovenia	0,51
Cyprus	0,50
Estonia	0,50
Norway	0,48
Italy	0,44
Czech Republic	0,42
Portugal	0,41
Spain	0,41
Greece	0,38
Serbia	0,36
Hungary	0,35
Slovakia	0,33
Croatia	0,31
Lithuania	0,29
Poland	0,28
Macedonia	0,25
Romania	0,24
Latvia	0,22
Turkey	0,22
Bulgaria	0,19

Source: European Commission 2014

Figure 2: Dendrogram, cluster solutions

Table 5: Cluster distributions / mean score across the four components

	Cluster 1: Science central	Cluster 2: Science peripheral	Cluster 3: Science disregarded
Use of science in policy-making (%)			
Highly formalised / high impact	85	25	0
Less formalised / considerable impact	15	50	6
Formalised / low impact	0	25	6
No formalisation / low impact	0	0	88
Science communication (%)			
Consolidated	85	25	0
Developing	15	75	69
Fragile	0	0	31
Public participation in science governance (%)			
Formalised / high involvement	85	0	6
Formalised / low involvement	15	0	44
Not formalised / high involvement	0	25	6
Not formalised / low involvement	0	75	44
Innovation performance			
Mean score	0,61	0,57	0,34
St.d	0,13	0,1	0,18
Countries included in cluster	Belgium, Denmark, Estonia, Finland, France, Germany, Italy, Netherlands, Norway, Portugal, Sweden, Switzerland, UK	Austria, Ireland, Luxembourg, Spain	Bulgaria, Croatia, Cyprus, Czech Republic, Greece, Hungary, Iceland, Latvia, Lithuania, Macedonia, Poland, Romania, Serbia, Slovakia, Slovenia, Turkey

Figure 3: Cluster membership

ⁱ A number of ongoing projects are currently developing such measures. The recent Res-AGorA project aimed to monitor RRI across 16 countries (see www.resagora.eu) and the MoRRI project has developed 36 indicators for RRI, and data collection has recently been fielded across 28 EU member states (see Ravn *et al* 2015).

ⁱⁱ The individual country experts are listed on p. 9-10 of the MASIS synthesis report, which can be accessed here: https://ec.europa.eu/research/science-society/document_library/pdf_06/monitoring-policy-research-activities-on-sis_en.pdf.

ⁱⁱⁱ More information on the contents and methodology of the MASIS project can be found in Mejlgaard *et al* 2012b. Results from the project were also reported in a special section of *Science and Public Policy* in 2012 (39:6), see <https://academic.oup.com/spp/issue/39/6>. After the completion of the MASIS project, the 'Responsible Research and Innovation in a Distributed Anticipatory Governance Frame. A Constructive Socio-normative Approach' (Res-AGorA) project took responsibility for maintaining the MASIS data intact. The individual MASIS country reports can be accessed at <http://www.morri.res-agora.eu/masis>. Res-AGorA also continued the work started in MASIS building on the same methodology (cf. Lindner *et al* 2016; Mejlgaard and Griessler 2016).

^{iv} See Mejlgaard *et al* 2012b for further description of categorisations.

^v See European Commission 2014 for description of individual indicators and calculation of the composite measure.