VINNOVA ANALYSIS
VA 2015:07

National Research & Innovation Councils as an Instrument of Innovation Governance

Characteristics & challenges

SYLVIA SCHWAAG SERGER, EMILY WISE & ERIK ARNOLD

Title: National Research and Innovation Counsils as an Instrument of Innovation Governance - *Characteristics and challenges*
Author: Sylvia Schwaag Serger - VINNOVA, Emily Wise - Lund University & Erik Arnold - Technopolis Group
Series: VINNOVA Analysis VA 2015:07
ISBN: 978-91-87537-34-9
ISSN: 1651-355K
Published: November 2015
Publisher: VINNOVA - Swedish Governmental Agency for Innovation Systems / Verket för Innovationssystem

VINNOVA - develops Sweden´s innovation capacity for sustainable growth

VINNOVA is Sweden's innovation agency. Our mission is to promote sustainable growth by improving the conditions for innovation, as well as funding needs-driven research.

VINNOVA's vision is for Sweden to be a world-leading country in research and innovation, an attractive place in which to invest and conduct business. We promote collaborations between companies, universities, research institutes and the public sector. We do this by stimulating a greater use of research, by making long-term investment in strong research and innovation milieus and by developing catalytic meeting places. VINNOVA's activities also focus on strengthening international cooperation. In order to increase our impact, we are also dedicated to interacting with other research financiers and innovation-promoting organisations. Every year VINNOVA invests about SEK 2.7 billion in various initiatives.

VINNOVA is a Swedish government agency working under the Ministry of Enterprise, Energy and Communications and acts as the national contact agency for the EU Framework Programme for R&D. We are also the Swedish government's expert agency within the field of innovation policy. VINNOVA was founded in January 2001. About 200 people work here and we have offices in Stockholm and Brussels. Our Director General is Charlotte Brogren.

The **VINNOVA Analysis** series includes publications of studies, analyses, official reports and evaluations that have been produced or commissioned by VINNOVA´s Operational Development and Analysis Division.

National Research and Innovation Councils as an Instrument of Innovation Governance

Characteristics and challenges

SYLVIA SCHWAAG SERGER - VINNOVA, EMILY WISE – LUND UNIVERSITY
& ERIK ARNOLD – TECHNOPOLIS GROUP

Series: VINNOVA Analysis VA 2015:07
ISBN: 978-91-87537-34-9
ISSN: 1651-355X
Published: November 2015
Publisher: VINNOVA - Swedish Governmental Agency for Innovation Systems / Verket för Innovationssystem

Table of Contents

Preface

In the past decade, a growing number of countries have established national councils for innovation or for science, technology and innovation. The interest in innovation councils responds to a growing need for strengthening the coordination, inclusiveness and, ultimately, the effectiveness of innovation policy governance.

In Sweden, the National Council for Innovation and Quality in the Public Sector was established less than a year ago with the aim of supporting and stimulating innovation and change in public services. As the Council's working practices continue to evolve and gel, it is a good time to look outward and compare with others. What is the function, composition and role of councils in different national innovation systems – and how do they reflect the evolving demands on innovation governance? What are some of the challenges that may be experienced, and what are alternative approaches to addressing these challenges?

Sylvia Schwaag Serger, Emily Wise, and Erik Arnold have built on previous international comparisons of national innovation councils conducted by the OECD – providing a comparative analysis of 14 national councils in 12 countries around the world. In addition to comparing key characteristics of national innovation councils, the analysis highlights some new trends in how councils address the evolving demands of innovation governance, and identifies a number of challenges and trade-offs that governments face when trying to set up and run innovation councils.

The authors would like to thank the various interviewees who shared their in-depth insights on the role and functioning of innovation councils in specific national contexts. A special thanks goes to Antti Pelkonen, who provided perspectives not only on the national context, but also broader perspectives on governance challenges and the evolving role of national innovation councils.

The opinions presented in this paper do not necessarily reflect that of VINNOVA. The authors take full responsibility for the content of this paper, and welcome reflections and comments.

VINNOVA in November 2015

Charlotte Brogren
Director General

Sylvia Schwaag Serger
Executive Director
International Strategy & Networks

About the authors

Sylvia Schwaag Serger (sylvia.schwaagserger@vinnova.se) is Executive Director International Strategy and Networks at VINNOVA and Adjunct Professor at Lund University.

Emily Wise (emily.wise@fek.lu.se) is an independent consultant and Research Fellow at Lund University.

Erik Arnold (erik.arnold@technopolis-group.com) is chairman of the Technopolis Group and Professor of International Innovation at the University of Twente.

Executive Summary

In response to a growing need for strengthening the coordination, inclusiveness and, ultimately, the effectiveness of innovation policy governance, numerous countries have established research and innovation policy councils. However, their structural characteristics (e.g. mandate, composition, resources, etc.) differ significantly between countries. The most notable differences are the following:

- *Mandate/task* – whereas most councils have the primary task of providing advice (which, for some, includes producing reports and overseeing policy evaluation), others have a mandate to coordinate policy areas, drive change, and make policy decisions, sometimes including decisions regarding budget allocation. Their role, in this sense, may be either weak or strong.
- *Focus* – an important difference is between a narrow focus on research and innovation programs (or S&T programs) and related budgets, and a broader approach which includes regulations, incentives, education, entrepreneurship, financing (in a broader sense than only focusing on allocation of government funds) and framework conditions
- *'Anchoring'* –some councils are chaired by the head of government (prime minister), while others are led by a minister (usually of economics, science and technology, research or enterprise); yet others consist solely of independent experts who report to the government (the prime minister or a minister within the government)
- *Composition* – some councils consist of experts appointed in their personal capacity ('expert councils') while others consist of policy makers and high-level representatives of ministries, sometimes also including academia and industry ('actor councils')
- *Resources* – councils may have a budget, personnel and an organization enabling them to carry out or commission analyses, or there may only be a minimal secretariat tasked primarily with organizing meetings.
- *'Output'* – councils' primary outputs may be analyses (e.g. annual benchmarking analyses such as the 'Report on Austria's Scientific and Technological Capability' or 'State of the Nation Report' that benchmarks Canada's science, technology and innovation performance), evaluations and recommendations as opposed to decisions, plans and guidelines for future policy

There is a general lack of research and comparative analysis of innovation councils – and, in particular, on their role and impact as an instrument of innovation governance. A recent evaluation of the Finnish Innovation Council reveals some general challenges for using innovation councils as a governance instrument, even when they are chaired by the prime minister with a clear mandate and comprise relevant ministries and other innovation actors. Some of these challenges relate to the need to work more across disciplines, policy areas and ministerial boundaries, but also the need to work proactively and in a forward-looking manner and to include or draw upon relevant perspectives and expertise for policy formulation.

The evaluation of the Finnish council indicates an evolution in the demands on innovation governance – including an increased need for coordinating systemic action, for mobilizing

resources across geographies and stakeholder groups, and for fostering inclusive and dynamic cycles of policy development. These pressures are reinforced by the growing concern to address 'grand' or 'societal' challenges via research and innovation policy.

In this paper, we provide an overview of 14 national research and innovation councils from Europe, North America and Asia. We describe and compare them according to the characteristics identified above, and explore how countries are trying to address the evolving demands on innovation governance in designing or redesigning their innovation councils.

The international comparison shows that a national council's influence or impact is not only determined by its mandate or its composition– i.e. the extent to which the council is composed of high-level decision makers as opposed to 'merely' experts in their own right. Rather, there are many factors – acting in combination with one another – that contribute to councils' impact on innovation policy, including:

- *A mandate, composition and anchoring at top political level to give legitimacy;* in order to be able to have an impact on policymaking, an innovation council must have a combination of relevant, recognized and sought after expertise and anchoring at top political level. The latter could mean that the council reports to or is chaired by the Prime Minister. However, it should be pointed out that the Prime Minister chairing the innovation council or the innovation council reporting to the Prime Minister, are not sufficient determinants of its ability to have an impact.
- *A focus that is relevant and anchored in the national context – taking a broad (instead of a narrow) perspective on innovation and a systemic approach* including aspects such as education, sustainability etc. While it is not realistic to expect the council members to possess all expertise necessary for a broad-based innovation policy, it is important that its composition does not lead to a limited or narrow perspective on innovation – and that the council's mandate and working practices allow it to access competence and examine issues that are outside 'traditional' fields of innovation policy. One challenge is finding the right balance between being focused enough to be able to make meaningful policy recommendations and broad enough to address framework conditions and to secure societal relevance.
- *A mandate, governmental anchoring and composition that fosters receptiveness and willingness on behalf of government to receive and act upon suggestions put forward or decisions made in the council*
- *A focus/approach and composition which acknowledges the increasing internationalization of research and innovation in order to avoid the council (and innovation policy) becoming inward-looking,* e.g. through the inclusion of foreign experts in the council or the establishment of an advisory group consisting of foreign experts who are connected to the council.
- *Resources (budget and staff) that allow the council to produce and/or commission relevant analysis and work with forward-looking activities, which are necessary in order to work proactively and promote broader visibility*

Our analysis also highlights some new trends that demonstrate councils' reaction to the evolving demands of innovation governance. These include a strengthened focus on forward-looking activities (e.g. foresight processes in Germany and multi-annual plans for research and innovation in Japan and South Korea), a greater tendency to involve foreign expertise (in the

case of Austria, Germany, the UK, the Netherlands, Switzerland and Singapore), and more attention to stakeholder inclusion and communication (in the case of Denmark, Canada, and USA).

Finally we identify a number of challenges and tradeoffs that governments face when trying to set up and run innovation councils.

1 Introduction

In the past decade, a growing number of countries have established national councils for innovation or for science, technology and innovation. In this paper, councils are defined as non-temporary bodies composed of experts or high-level stakeholders (or a combination of both), explicitly (for example by law) tasked by the government to do one or several of the following: produce reports, oversee policy evaluation, give advice, coordinate policy areas, drive change, make policy decisions (sometimes including decisions regarding budget allocations).

The interest in innovation councils is not dependent on level of economic development. Both highly developed countries with strong innovative capacity, such as Finland or Germany, and less developed countries, such as Brazil and China, have set up high-level councils reporting directly to the Head of Government or Ministers of economy or research (or their equivalents). What are the rationales, driving forces and expectations that explain the growing interest in national innovation councils as a policy instrument and/or governance mechanism? And how effective are these councils at meeting the expectations placed upon them?

Building on previous analyses of national innovation councils (OECD 2009, 2012; Pelkonen 2006; Pelkonen *et al.* 2014), this paper aims at addressing two main questions:

1 What are the key defining and differentiating characteristics of national innovation councils?
2 How do national innovation councils reflect evolving demands on innovation governance?

In this paper, we provide a brief overview of the literature on this topic before providing an analysis of 14 national councils in 12 countries around the world, comparing their function, composition and role in different national innovation systems – and how they reflect the evolving demands on innovation governance. We conclude with some policy recommendations based on the analysis.

2 Evolving demands on innovation governance

The innovation systems literature explains innovation as being determined by a wide range of inter-related factors spanning different policy areas – emphasizing the importance of interaction among different actors and factors that support innovation (Edquist 1997, Lundvall 1992). According to this view, national innovative capacity is determined not only by a country's research and development (R&D) system and resources, but also by the interplay of factors which enable knowledge to be converted into new products, processes and organizational forms. Arnold *et al.* (2001) refer to these factors as "frameworks for innovation". Silberglitt *et al.* (2006) examine "institutional" capacity, in addition to science and technology capacity, which they define as including "the quality and reach of governance in a country, a banking and financial system that works, an honest and functioning judiciary, and working educational and health systems". More broadly, therefore, innovation councils depend for their functioning on there being high levels of social capital and trust in government.

Governments affect firms', organizations' and individuals' capacity and willingness to innovate, sometimes directly and consciously, sometimes indirectly, and sometimes with inadvertent effects. Thus, governments might design policy schemes aimed at promoting innovation. Often, these policies seek to strengthen research and development – either directly by allocating public funds or indirectly through various incentive schemes – in the hope or expectation that this will lead to more innovation in general or in pre-defined areas. At the same time, the ability and willingness to innovate might be affected indirectly (but significantly) by education, labor market, taxation, competition and other economic policies, and by regulatory and other conditions in a wide range of fields and sectors.

Research and innovation governance encompasses not only the policies and institutional frameworks, but also the interplay between the various actors that together determine the priorities, strategies, activities and outcomes in research and innovation (de la Mothe 2001, Borrás and Edler 2014). As a result, innovation policy governance requires coordination and integration across policy areas, levels of government and various actor groups (Lindner 2012).

In recent years, the need for coordination in innovation policy has increased further due to changes in the nature of innovation, increasing demands and expectations placed on innovation to address societal challenges, and policymakers' view of their own role in innovation systems (Borrás 2009).

The changing nature of innovation refers to an "opening-up" of the innovation process – both in terms of the breadth of actors involved and in terms of geography. The "democratization" of knowledge enabled by the internet has made consumers more aware of "what's out there" and, more importantly, given them the means to communicate their demands and actually take part in

development processes. This has catalyzed companies to include users in the innovation process – thus allowing them to gain better insights into what to produce, and developing new innovations together with users (see Prahalad *et al.* 2004, 2008 and von Hippel 2005, among others). Technological advances have also facilitated knowledge sourcing and development activities with a broader geographic dispersion. In fact, technological change and globalization are mutually reinforcing phenomena, with technological change acting as a "lubricant" for globalization, and globalization (by facilitating the circulation of people, goods, capital and ideas) accelerating the rate of technological change (Archibugi and Iammarino 2002).

A further element of the 'opening up' of the innovation process is the fact that in recent years we have seen a dramatic increase in the knowledge and innovation resources of emerging economies such as China, India and Brazil (TAFTIE 2011 and EU Commission Expert Report 2012). The result has been a change in the global innovation landscape, with new innovation hot spots emerging around the world (Kao 2009, TAFTIE 2011). The growing internationalization of trade and production but also research and innovation adds a further important dimension to a country's innovative capacity (Archibugi and Iammarino 1999, OECD and The World Bank 2009, Prahalad and Krishnan 2008). Thus, innovative capacity within a given country is also determined, firstly, by the ability of firms, researchers and organizations to benefit from and engage in international innovation processes, and, secondly, by the country's ability to attract knowledge and innovation resources (OECD 2014a).

The trends described above make it increasingly important for companies to develop new ways of doing business – accessing external sources of knowledge and managing globally-distributed innovation processes. Chesbrough (2003) refers to this as a paradigm shift from closed to open innovation. Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market.

In addition to innovation processes "opening up" (becoming increasingly participatory and geographically dispersed), governments increasingly focus on innovation to address societal challenges (such as climate change, environmental degradation, epidemics, etc.) – often requiring internationally-coordinated efforts. "Grand challenges" extend far beyond the borders of a single country or region and thus require that countries and regions work together to find solutions.

Related to both the increased participatory nature of innovation and the focus of innovation to address societal challenges, we now see an intensifying discourse (and action) on social innovation. Social innovations are new strategies, concepts, ideas and organizations that extend and strengthen civil society. Social innovation includes the social *processes* of innovation, such as open source methods and techniques and also *innovations which have a social purpose* — like microcredit or distance learning (Mulgan 2007).

The changed nature and enlarged scope of innovation processes (focusing on social issues) has in turn contributed to a broadened scope for innovation policy and policymakers' view of their own role in innovation systems. In addition to regulatory, economic and financial instruments (which are typical of most policy domains), innovation policy also leverages a number of soft

instruments (aimed at improving innovation capacity of actors/agents through voluntary means such as capacity building and public-private partnerships, etc.) and meta-instruments (aimed at providing intelligence to policy design through innovation indicators, policy benchmarks and technology foresight) (Borrás 2009). Whereas regulatory and economic instruments are typically targeted at addressing market failures, soft instruments typically seek to correct or compensate for system failures (Chaminade and Edquist 2006, Smits and Kuhlmann 2004). These instruments focus on stimulating and optimizing interaction between multiple actors and actor groups. The government is one of these actor groups, and can assume a proactive role in mobilizing engagement and catalyzing interaction but also in taking risks (Mazzucato 2013). As governments more clearly stake out a role in innovation systems (both in setting framework conditions, and making investments that address system failures), the question of central governance is 'more at hand' (Borrás 2009, Borrás and Edler 2014, Edquist 2014).

These changes in innovation policy and processes are situated within a wider and more fundamental change in the relationship or 'social contract' (Guston, 2000) between research or science on the one hand and the state on the other. The post-War period, especially the 1950s and 1960s, involved a social contract under which a high trust was placed in the scientific community. The so-called 'linear model of innovation' under which the social contract operated in that period was based on the idea that basic research drove applied research, development and ultimately technological innovation. All that was necessary was for society to fund the research community and await its reward in the form of economic growth and development.

During the 1960s, the social contract began to change. The OECD introduced the idea of 'science policy' as a way to direct research efforts towards societal needs, which at that time were conceived largely in terms of industrial innovation. Politics and policy were increasingly driven by technological optimism, reflected both in various grand, national projects and in the emergence both of innovation agencies (such as STU in Sweden) and an interest in research and innovation studies. In most developed countries, 'top-down' funding and programs aiming to reach specific social ends supplemented 'bottom-up' research funding for basic research. In the period up to 2000 and beyond, there was increasing pressure for taxpayers to see the 'bang for their buck' invested in research and therefore a growing interest in the impacts of research and innovation. A growing understanding of innovation processes drove the current 'National Systems of Innovation' perspective and led to a growing appreciation of the need for holistic innovation policies, spanning the needs of different sectors of society and therefore bringing a need for coordination and governance mechanisms that were not seen as necessary under the linear model of innovation.

We would argue that the social contract has started a significant shift since 2000, as a result of the new policy focus on grand or societal challenges such as climate change. These represent a recognition in policy that the single-minded focus of the previous years on economic and social development has run into resource and other limits. One could even think of it as a kind of neo-Malthusianism. The need for basic research and innovation that was the focus of the previous social contracts naturally does not go away. But the societal challenges demand much higher levels of coordination, and the involvement of more sectors of society than before. Addressing

the societal challenges also demands much more than research and innovation policy: it requires a number of large-scale changes or transitions in socio-technical systems such as energy production and distribution. Managing these transitions involves more actors and an extending scope for governance (Geels, 2010).

Crucially, under this new social contract, the role of government extends beyond reactively tackling 'failures' and into the proactive organization of responses to the societal changes. These simply cannot be addressed through the kind of reactive policies envisaged in economics and seen as politically legitimate in the late 20th Century. While in reality the state has always been a proactive driver of innovation (Mazzucato 2013), the grand challenges and the new social contract legitimize this activity.

These factors (i.e. the changing nature of innovation, increasing expectations placed on innovation to address societal challenges, and policymakers' view of their own role in innovation systems) explain the evolving demands on innovation policy governance.

> *While contemporary innovation policy faces the challenge of being conducive to the increasingly systemic, horizontal and cross-cutting nature of innovation processes, the question is raised whether established governmental institutions and their processes are "fit-for-purpose" to meet the requirements of modern innovation governance.*
> (Lindner 2012: 277)

The evolving demands are grouped into three areas: orchestrating systemic action across policy domains, coordinating governance across geographies, and fostering inclusive and dynamic policy development.

2.1 Orchestrating systemic action across policy domains

Early literature on innovation systems established innovation as an interactive learning process involving various actors, and highlighted that innovation policy (aimed at improving the functioning of innovation systems) must stretch across various policy fields (see e.g. Edquist 1997 and Lundvall 1992). A decade later, academic literature and policy strategies acknowledged a further transition from this "2nd generation of innovation policy" to a "3rd generation of innovation policy" that underlined the need for maintaining a core emphasis on innovation across policy areas – establishing ways of building analysis and action relevant to innovation into all of these policy areas (see e.g. EU 2003 and Edler *et al.* 2003). Governance structures stressed horizontal coordination and the need to develop "integrated innovation policy" strategies (Pelkonen 2006).

More recently, with the increased participatory nature of innovation and a re-orientation of innovation strategies toward addressing societal challenges, we witness the need for governance structures that can direct even more complex systemic action and change.

> *The consequence for governance is a need to foster knowledge resources across bigger parts of society, to ensure that research and innovation policy is holistic in the sense of spanning these diverse social sectors and a requirement to be flexible, in response to the*

> *constantly changing configurations in which knowledge is produced and used.*
> (OECD 2009: 31)

The term "system innovation" is used to refer to broader socio-technical systems, and the system-wide change and policies that are necessary to make economies socially, economically and environmentally sustainable (Geels 2004, Borrás and Edler 2014, Edquist 2014, OECD 2014a).

> *Although many national governments have put sustainability and green growth objectives at the centre of their economic development strategies, achieving this goal will require wide-ranging changes in their underlying economic, technological and social systems, from transport, water and energy systems to modes of consumption and waste management. Ensuring that socio-technical systems move towards greater sustainability is a major challenge for governments but also for civil society.* ***At the core of the transition is a shift in governance structures that not only allows change to occur but also directs and orchestrates some of the changes.***
> (OECD 2014a: 98)

We have thus witnessed a transition from horizontal coordination and "integrated innovation policy" to "system innovation" (i.e. innovating the way societal functions are fulfilled). It is no longer enough just to coordinate across policy areas. Rather, innovation governance structures should now foster a holistic perspective on innovation processes and ensure that policy drives systemic change.

2.2 Coordinating governance across geographies

Linkages within and between different geographical spaces and systems of innovation (on local/regional, national and supranational/global levels) are important because they increase knowledge spillovers and learning, strengthen absorptive capacity, and provide companies with helpful input from related actors (e.g. users, customers, suppliers, companies in related industries, research organizations) (Bunnell and Coe 2001, Bathelt et al. 2004, Cooke 2005, Freeman 2002). Thus, national innovation policy needs to be coordinated with both the supra-national and sub-national levels of government. This also involves coordination among policy actors (e.g. ministries, agencies, and parliament) and actors performing research and innovation (e.g. universities, firms, etc.).

Increasingly, industrial innovation occurs within international networks (Kuhlmann 2001, Kuhlmann and Edler 2003), and a substantial proportion of government research and innovation funding is provided by international sources (in particular European Horizon 2020 and Structural Funds programmes). National innovation policy strategies need to consider the international context, and instruments should be designed to take advantage of and complement those that exist on a supra-national level.

At the same time, growing regionalism necessitates coordination with the sub-national level. The importance of local/regional dynamics (and the functioning of regional innovation systems) has long been acknowledged, and many regions have had very proactive approaches to local

economic development policies – independent of policy guidance or financing from the central government (Sutarauta and Kautonen 2007). Yet with the recent introduction of the concept of "smart specialization"[1] and the introduction of "Research and Innovation Strategies for Smart Specialisation (RIS3)" as a prerequisite for receiving funding from the European Regional Development Fund (ERDF), it has become increasingly important to align national innovation policy governance with the regional level.

In addition to national innovation councils, we also see the emergence of regional innovation councils, whose purposes and composition often mirror those of national councils. Examples include the Research and Innovation Council of the Swedish region of 'Skåne', which was established in 2010, or the Innovation Council of the German state of Baden Württemberg, which existed from 2007 to 2010.

Similarly, at the supranational level, the European Commission set up a 'High Level Group for Research, Innovation and Science Policy Experts' (RISE) in 2014 with the mandate of giving "direct strategic support to the European Commissioner for research, innovation and science to the European Commission" on "how to best use EU research, innovation, and science policy to address the European growth model and to create the conditions for a different type of growth that is smart, economically and environmentally sustainable, and socially inclusive for the EU and associated countries within a globalized world" (European Commission 2014).

Overall one of the general challenges for regional and national councils is that many of the issues which affect innovation capacity and performance are outside their geographic scope. Regarding national councils this includes, for example, EU laws or regulations which might affect innovation incentives within a given country. Similarly for regional levels, national R&D budgets, education policy or laws often have significant impact on innovation actors within the region, but the council's ability to influence these is limited.

2.3 Fostering inclusive and dynamic policy development

As we experience an increasing need for systemic instruments in innovation policy and more interactive (and internationally-dispersed) innovation processes, we also experience a need for changes in processes for policy formulation and learning. In addition to providing a clear and evidence-based strategic direction for innovation policy in the longer-term, innovation governance is now also challenged to find ways to foster dynamism and agile policy development processes through stakeholder inclusion, experimentation and embedded policy learning.

> *Industrial and innovation policies characterised by top-down government interventions are not the right approach to development. Another, more appropriate approach to innovation (and industrial) policy, involves search, experimentation, monitoring, learning and adaptation, all of which need to occur in a context of international openness to knowledge, trade, investment and competition. This new approach also rests on close co-operation with private*

[1] Smart specialization is an innovation policy concept designed to promote the efficient and effective use of public investments in research and innovation. Its goal is to boost regional innovation in order to achieve economic growth and prosperity, by enabling regions to focus on their strengths (see, for example, Foray, David and Hall 2009).

> *and non-governmental actors, who are often better placed than governments to identify barriers to innovation, and point to areas for productive investment or policy action. This new approach relies on a much stronger focus on (diagnostic) monitoring and evaluation, which need to be embodied in programmes and policies from the outset. Such learning should benefit from early and periodic sharing of lessons from policy experimentation at the global level, which will require strengthened mechanisms to identify and diffuse good practices, including through specific knowledge platforms and networks.* (OECD 2014b:15-16)

The importance of policy learning has been highlighted for decades. Among others, Lundvall and Borrás (1998) encourage making use of external and independent sources for policy formulation, enhancing social and political participation in defining policy alternatives, and learning from others – fostering a "fluid perspective of the policy process". These activities help ensure inclusion, transparency, and a sound evidence base in policy formulation. They also support a process of continual renewal.

It is no longer enough to rely on high-level anchoring of innovation policy in the national government, and expect recommendations to represent the plethora of perspectives and automatically "trickle down" into action. Rather, innovation governance structures should now include discursive/inclusive processes (e.g. consultation and active use of networks, interaction with media, and participation in the academic debate) in the formation of policy advice in order to ensure relevance and impact across actor groups on both sub-national and international levels.

> *The concept of governance allows for a larger set of actors to have an influence on the outcome of the strategy formulation processes and the allocation of tasks and budgets. …[I]t deals with the relationships between institutions that form an ensemble. Thus in STI governance we do not look only at policy, but focus on the interplay between the various actors that together determine the priorities, strategies, activities and outcomes in research and innovation.*
> (Boekholt et al. 2002:3)

> *(G)overnance mechanisms need to combine the ability to plan strategically with a role in mediating among stakeholders to produce alignment among objectives. In that sense governance is not just about 'steering' but about creating arenas, to decide the right direction in which to steer, and generate consensus-based commitment to steering in that direction.*
> (Arnold 2011:23)

Responsible and effective innovation governance requires a capacity to measure and benchmark existing conditions and policies, and to develop informed opinions about future conditions – e.g. through foresight analyses and projections – in order to be able to identify challenges and draft strategies and policy recommendations (see for example Borrás 2009, OECD 2012, Edquist 2014 and Stilgoe *et al*. 2013). Such capacities, in turn, include strategic intelligence, policy evaluation and policy learning, and necessitate the involvement of relevant expertise. They also include the ability to identify relevant instruments and formulate adequate policy responses to given situations and conditions.

In addition to foresight and evaluation activities, "experimental policies" (such as challenges, testbeds, networks, charter cities and experimental funds) can be used as an input to policy formulation. Bakhski *et al.* (2011) propose a new view on innovation policy, where the role of the state is to facilitate and enable a broad spectrum of entrepreneurship by seeking to elicit, gather, and even create information with businesses (by conducting experiments, for example). "This new approach to innovation policy will require the development of different government capabilities. In particular, it will require it to have stronger business networks, officials that have direct experience of business, deeper research and evaluation skills and connections to the academic sector, and a culture more oriented towards learning (*ibid.*: 12)."

2.4 Resulting challenges for innovation policy governance

In summary, the demands for orchestrating systemic action across policy domains and geographies, including a variety of perspectives and stakeholder groups in policy processes, and fostering dynamism, learning and adaptation in policy development leads to a number of new challenges for innovation policy governance:

- *Defining relevant focus areas, and facilitating systemic action across policy domains and levels of government*
  As the scope and understanding of innovation expands from research and technology-driven processes in firms, to societal challenge-driven processes involving various groups of actors, there are almost no limits to the policy domains (e.g. industry and education, as well as transport, energy, labour, immigration, etc.) and levels of government that may be affected. The need not just for coordination, but also for facilitating systemic action is a key challenge. This can involve transitions in technological regimes or systems and require a much better connection to non-innovation policies and actors than has been necessary in the past.
- *Engaging stakeholders representing a variety of perspectives not only for "inspiration", but also in the development of policy priorities and approaches for action*
  As innovation processes become increasingly networked and globalized – benefitting from co-creation and integrating complementary areas of expertise, innovation governance is challenged to reflect a common direction from this variety of perspectives.
- *Promoting dynamism and agility, as well as a factual basis for driving change*
  As the nature of innovation changes (related to points made above), the business models and catalysts for innovation also evolve. This necessitates new types of policy approaches – and the flexibility to experiment and adjust these approaches depending on what works. This also necessitates an increasing need for analyses and evidence of what works, and learning how different approaches could be adapted to work better.

3 Policy responses to the need for more effective innovation governance

The term "innovation governance" encompasses a wide range of, sometimes conflicting, responsibilities and functions. OECD (2009) provides a summary of innovation governance functions:

- Providing strategic intelligence: monitoring the innovation system and its processes, evaluation and policy learning
- Engaging technological expertise in innovation policymaking
- Setting directions, priorities and being selective
- Refereeing: adjudicating among competing rationales and building consensus on policy
- Reducing dynamic inconsistency and short-termism
- Horizontal co-ordination and reducing fragmentation in the policy effort
- Vertical steering: guiding agents towards socially desirable goals
- Instituting and coping with change, overcoming lock-ins
- Enabling policy deployment: design of agencies and instruments
- Articulating between regional, national and international levels
- Allocating resources
- Enhancing the profile of research and innovation
- Ensuring "contextual fit"

Given the evolving demands on innovation governance described above, we can add a number of new functions to the list:

- Fostering a holistic perspective on innovation processes
- Developing and aligning policies for systemic action and system change
- Involving a broader range of stakeholders and perspectives in the formulation of policy
- Using "experimental policies" to support agile policy development and learning

Innovation governance functions are fulfilled through a variety of mechanisms, including strategies, agencies, appointments of experts/advisors, commissions and councils. Thus, establishing national councils for science, technology and innovation constitutes one of several ways in which governments have responded to the growing need for more effective innovation governance. Another increasingly widespread response is the drafting of national innovation strategies. According to the OECD (2014a), national strategies for science, technology and innovation can fulfill several purposes:

> *First, they articulate the government's vision regarding the contribution of STI to their country's social and economic development. Second, they set priorities for public investment in STI and identify the focus of government reforms (e.g. funding of university research, evaluation systems). They also mobilise STI actors around specific goals, such as energy, environmental issues or health, and may help steer investments of private actors and increasingly autonomous universities and public research areas or technologies. Third, the elaboration of these strategies can engage stakeholders (the research community, funding agencies, business, civil society, regional and local government) in broad consultations that will help building a common vision of the future and facilitate co-ordination within the innovation system.*
> (ibid.:90)

The functions listed above, such as articulating a vision, setting priorities, mobilizing actors and resources around certain goals and engaging stakeholders for the purpose of building a common vision, are very similar to those that national councils for science, technology and innovation might be expected to serve. Furthermore, according to the OECD, "The process of making an innovation strategy is perhaps more important than the document, as it helps reveal problems, barriers and hidden opportunities and promotes a learning process" (OECD 2014a:92). Again, the function of driving and enabling such processes could also be achieved by setting up a council, depending on the mandate, composition and working methods of the council.

The appointment of 'chief scientists' constitutes a potential alternative mechanism for governments seeking to improve the governance and coordination of science, research or innovation policy. The UK, Australia and the European Commission, among others, have had Chief Scientists or Chief Scientific Advisors. The practice seems to originate with the role of Sir Solly Zuckerman in the UK from 1964. In the case of Australia, for example, the role of the Chief Scientist is to provide "high-level independent advice to the Prime Minister and other Ministers on matters relating to science, technology and innovation".[2] However, the traditional role of the chief scientists tends more to be to deliver scientific advice to inform non-scientific policies ('science for policy') than to govern or coordinate research and innovation policy in the way discussed in this report. In effect, while they can be immensely useful in government (Doubleday and Wilsden, 2013) they are a throwback to the linear model and the post-war social contract, with science rather than society 'on top'.

In some (but by no means all) the countries with chief scientists, the role has evolved to combine the delivery not only of 'science for policy' but also aspects of 'policy for science'. The US government currently has a Chief Technology Officer and a Science Advisor, the latter of which is also the director of the Office of Science and Technology Policy (OSTP).

National academies of science or engineering can also assume the role of providing advice on innovation policy or innovation policy coordination or governance. They often do this by establishing high-level expert groups and drafting reports based on the outcomes of discussions in these groups. Perhaps the most well-known example of such an initiative is the report *Rising*

[2] http://www.chiefscientist.gov.au/about/the-chief-scientist/

Above the Gathering Storm published by the US National Academies of Sciences and Engineering and the Institute of Medicine in 2007 (National Academies 2007).

Another policy response by governments to the challenge of improving innovation governance has been the setting up of temporary expert commissions or task forces. The commissions are frequently tasked with providing written analyses or recommendations for the government's consideration. Such commissions or task forces are also at times set up by national academies. Other similar mechanisms include parliamentary committees which usually consist only of members of parliament (an example is the UK Business, Innovations and Skills Committee of the House of Commons) and productivity commissions (examples can be found in New Zealand, Denmark and Australia).

Innovation agencies might be seen as another instrument with which governments seek to strengthen innovation governance by focusing and channeling their innovation efforts. Tekes, DASTI or VINNOVA are examples of agencies under the ministries of economy, science and technology or enterprise in Finland, Denmark and Sweden, respectively, which were created with the explicit task of promoting innovation. Tekes and VINNOVA also have the task of allocating funding to foster innovation. Enterprise Ireland and the Research Council of Norway are examples of existing agencies which traditionally focused on enterprise development or research, respectively, but, in addition to their initial missions, have been charged with promoting innovation. A common characteristic of the agencies mentioned is that they tend to operate primarily through funding schemes – based on annual budgets they receive from their respective ministry. However, they generally have no mandate and a very limited ability to affect framework conditions for innovation – such as, for example, regulations and standards, education, or labor market or taxation issues. Furthermore, these agencies tend to report to one ministry, such as the ministry of economy, the ministry of science and technology or the ministry of enterprise, thus further limiting their scope and leeway. Other agencies, such as analysis or evaluation agencies, might also fill some of the tasks that might be assumed by a council.

4 Analysis of national innovation councils

As introduced above, innovation councils are one of several mechanisms of national innovation governance – and are used to address a few or many of the functions described in the previous section. Many countries around the world have national innovation councils. Some countries have a multitude of councils (e.g. Belgium and the Netherlands), whereas others may have only one (e.g. Finland). Some councils are only mandated to provide advice, whereas others are charged with coordination and/or setting strategic priorities. Some councils produce regular analyses and recommendations, whereas others are convened purely for discourse. The identification of the relevant council for comparison is not always straightforward, as some countries might have several bodies with similar or overlapping tasks (for example in the case of Germany).

Building on previous analyses of national innovation councils (OECD 2009, 2012; Pelkonen 2006; Pelkonen *et al.* 2014), this paper aims at addressing two main questions:

1 What are the key defining and differentiating characteristics of national innovation councils?
2 How do national innovation councils reflect evolving demands on innovation governance?

The analysis is based on an international comparison of 14 national innovation councils in 12 countries around the world, and more detailed case studies of 9 innovation councils in 8 of these countries. The innovation council descriptions can be found in Appendix I. Data have been collected from a review of documents and websites, and from semi-structured interviews (see Appendix II).

The overall international comparison includes eight countries reviewed in other analyses of innovation councils (OECD 2009, 2012; Pelkonen *et al.* 2014), as well as four additional countries (Germany, US, China and Korea). More recently-established innovation councils in Australia and Sweden, as well as those in Belgium and Singapore are not included in this analysis.

The eight countries included in the more detailed case studies (Austria, Denmark, Finland, Germany, Netherlands, Canada, US and Korea) were selected based on two main factors:

- Representation of different types of innovation councils and different national contexts around the world
- Extended history of the council (to have some reference point of influence/impact and changes over time)

The analysis is divided into two sub-sections. The first sub-section presents an overview of the overall mandate and key characteristics of national innovation councils in 12 countries,

followed by a comparison of key defining and differentiating criteria[3]. The second sub-section summarizes a number of observations across the case studies – highlighting unique characteristics and discussing how the evolving demands on innovation governance are reflected in various cases.

4.1 Key defining and differentiating characteristics of national innovation councils

Previous analyses of national innovation councils (OECD 2009, 2012) have described the functions and types of STI policy councils, based on an international comparison of eight councils in OECD member countries (Austria, Canada, Finland, Ireland, Japan, Netherlands, Switzerland and the UK). This paper builds on these analyses – including additional countries and exploring a number of new dimensions.

The table below presents an overview of the key defining and differentiating characteristics of national innovation councils.[4] More detailed information can be found in the council descriptions in Appendix I.

[3] Building on the framework used in OECD 2009
[4] The information is based on input received as of September 2015.

Table 1 Overview National Innovation Councils

	AUSTRIA	DENMARK	FINLAND	GERMANY			NETHERLANDS
	Council for Research, Technology & Development	Council for Research & Innovation Policy	Research & Innovation Council	Innovation Dialogue	Expert Commission for Research & Innovation	Council of Science and Humanities (Wissen-schaftsrat)	Advisory Council for Science, Technology & Innovation
MANDATE/TERMS OF REFERENCE	Monitor STI performance, programs; Provide strategic advice	Provide strategic advice and holistic perspective	Monitor STI perf. and intl. context; Provide strategic policy guidelines	Provide advice on innovation policy	Monitor STI performance and evaluate innovation system; Provide advice	Provide advice (focused on higher education and scientific institutions)	Provides advice, based on a structured work method
MEMBERSHIP							
PRESIDENT/PM	No	No	Yes	Yes	No	No	No
OTHER MINISTERS	4 (Innovation & Tech, Science & Research, Finance, Education) in advisory function	No	6 (Education, Economy, Finance + Health, Defense, Interior)	3 (Economics & Energy, Education & Research, Special Affairs)	No	No (but State Secretaries from 5 ministries)	No
INDUSTRY	Yes	Yes	Yes	Yes	No	Yes	Yes
ACADEMICS	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FOREIGNERS	Yes	No	No	No	Yes	No	No
NUMBER	12 (of which 8 have voting rights)	9	17	20	6	32 (Scientific Comm.) + 22 (Admin. Comm.)	10
APPOINTED BY	4 each by Min. for Innovation & Tech. and Min. for Science & Research	Minister for Higher Education & Science	Govt	Prime Minister	Federal Ministry for Education & Research, after approval by the Federal Government	President of the Federal Republic of Germany	The Crown (as proposed by Min. of Education, Culture and Science and the Min. of Economic Affairs)
RESOURCES							
BUDGET FOR ANALYSIS	Yes	Limited	No	Yes	Yes	No	Yes
SECRETARIAT	Yes (8)	Yes (3)	Yes (3-4)	Yes (4)	Yes	Yes	Yes (11)
ACTIVITIES/ OUTPUTS							
FORESIGHT	Yes	No	No	No	Yes	Yes	No
EVALUATION	Yes	No	Yes	No	Yes	Yes	No
COMMISSIONS STUDIES	Yes	Yes	No	No	Yes	?	No
OWN REPORTS	Yes	Yes	Yes	Yes	Yes	Yes	Yes
STRATEGIES/ PLANS	Yes	No	Yes	No	Yes	Yes	No

Table 1 Overview National Innovation Councils (continued)

	SWITZERLAND	UK	CANADA	US	CHINA	JAPAN	KOREA
	Science & Innovation Council	Council for Science & Technology Policy	Science, Technology & Innovation Council	President's Council of Advisors on Science & Technology	Leading Group for Science, Technology & Education	Council for Science & Technology Policy	National Science & Technology Council
MANDATE/TERMS OF REFERENCE	Provides advice (focused on higher education, research and innovation)	Provide advice on strategic, cross-departmental STI issues	Integrated and independent advice to govt on STI issues	Advise President; Provide policy recomm. in areas related to STI	Reviews policies and programs and coordinates inter-govt activities	Assess national R&D; investigate, formulate and coordinate S&T policies	Deliberation, advice and coordination of STI policies
MEMBERSHIP							
PRESIDENT /PM	No	No	No	No	Yes	Yes	Yes
OTHER MINISTERS	No	No	No (but deputy ministers)	Yes	At least 7 (incl. Education, Science, Finance)	At least 5 (incl. S&T, Economy, Finance, Education)	13 government delegates
INDUSTRY	Yes	Yes	Yes	Yes	No	Yes	Yes
ACADEMICS	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FOREIGNERS	Yes	Yes	No	No	No	No	No
NUMBER	15	19	Up to 14	18	?	14	25
APPOINTED BY	Govt	Prime Minister	Minister of Industry and Minister of State (S&T)	President	Govt	Govt	Govt
RESOURCES							
BUDGET FOR ANALYSIS	Yes	Limited	Yes?	Yes	No?	Yes	Yes
SECRETARIAT	Yes (11)	Yes	Yes	Yes (3)	No	Yes (around 100)	Yes (steering committee)
ACTIVITIES/ OUTPUTS							
FORESIGHT	No	No	Yes/Limited?	Yes	No	Yes?	Yes/Limited?
EVALUATION	Yes	Yes	No	Yes	No	Yes	Limited (reviews of MSIP evaluations)
COMMISSIONS STUDIES	No	Yes	No?	No	No	Yes	Yes (through special committees)
OWN REPORTS	Yes	Yes	Yes	Yes	No?	Yes	Yes
STRATEGIES/ PLANS	No	No	No	Yes	?	Yes	Yes

Note: Table adapted and updated from OECD (2009), http://www.cincel.cl/documentos/Recursos/CHILE_COUNCIL_FINAL.pdf

National innovation councils can be characterized by their mandate/key activities, focus, organizational anchoring, composition (or membership), resources and support structures, and outputs. These differ significantly between councils and countries. Examples of differences in these defining characteristics are listed in Table 3 below.

Table 2 Comparison of Innovation Councils' Defining Characteristics

MANDATE/TASK	Mandate of advisory support	Mandate also includes coordination and/or strategic planning
	Tasks include formulation of analysis, reports, policy advice	Tasks include coordination and priority-setting for the direction of future research and innovation policy (can include budgetary allocations)
	Ex: German Expert Commission on Research and Innovation, Netherlands, UK, Canada, US	Ex: Finland, German Council of Science and Humanities, China, Korea, Japan
FOCUS/APPROACH	Relatively narrow focus on research budgets, science policy, innovation programs	Broad focus which includes framework conditions for innovation (e.g. education, entrepreneurship, funding, procurement, sustainability, financial policy, regulations)
	Reactive approach: reacting primarily to current challenges through more traditional industrial policy (incl. subsidies)	Proactive approach: using foresight and other analyses and a broad-based, cross-cutting approach to propose and coordinate policies for longer-term sustainable development
	Ex: Austria, German Council for Science and Humanities, Netherlands, Korea	Ex: Denmark, Finland, German Expert Commission for Research and Innovation, UK, US
ANCHORING	An independent entity, hosted within or outside of the government that reports to the government	A government-led entity (Prime Minister or other minister), hosted within a ministry (often Ministry of Enterprise or Education)
	Ex: Denmark, German Expert Commission for Research and Innovation	Ex: Finland, UK, US, Korea
COMPOSITION	Comprised solely of independent experts in their personal capacity	Comprised of policymakers and high-level representatives of ministries, academia and industry in their capacity as decision makers
	Representing a broad range of expertise; can include foreign experts	Generally representing a more limited range of backgrounds and expertise
	Ex: Denmark, German Expert Commission for Research and Innovation, Netherlands, Canada, US)	Ex: Finland, UK, Japan, Korea
RESOURCES	Minimal support that primarily manages meetings	Money and/or people (secretariat) to carry out and/or commission analyses and foresight exercises
	Ex: Denmark, Finland, US	Ex: Austria, Switzerland, Japan, Korea
OUTPUT	Summary of recommendations on particular topics and/or annual reports on performance or state of research, technology or innovation	In addition to other reports, publication of more forward-looking, long-term policy guidelines, visions or plans
	Ex: Denmark, Canada, US	Ex: Austria, Finland, Japan, Korea

Our analysis and particularly the interviews we conducted reveal a number of interesting findings in terms of similarities but also differences in the functions and focus of national innovation councils. Firstly, it is important to bear in mind that councils operate in specific but

also evolving national contexts. Within their national contexts, councils can serve as effective instruments for strengthening various aspects of innovation governance. Similarly, councils' ability to impact governance and policy-making depends on their ability to adjust and evolve. The Austrian Council, for example, has undergone significant changes in its functioning since it was created in 2000.

The majority of the councils we examined serve primarily in an advisory function (Austria, Canada, Denmark, Germany EFI, Singapore, Switzerland, UK, US). Some councils, such as Finland, Germany's Innovationsdialog and Wissenschaftsrat, Japan, Korea and China have a coordinating function – sometimes in addition to an advisory function. Furthermore, the councils in Japan, Korea, China and Finland have a priority-setting or even policy planning function, although in the case of Finland this functioning seems to be weakening. In general one can discern a geographic divide between advisory councils found primarily in Europe and North America and councils with a clear planning and coordination mandate, predominant in the Asian countries we examined.

The majority of councils produce reports of some kind. The councils in Austria, Canada, and Germany produce annual reports benchmarking their countries' performance in science, technology and innovation. Reports, particularly annual reports benchmarking or assessing national science, technology and innovation performance serve several functions. They help provide a common evidence-based foundation for policy discussions in the larger stakeholder community. They also contribute to increasing transparency and accountability of government by assessing results and progress of government initiatives and strategies. Finally, when well publicized and communicated, they provide an effective way to increase both general awareness of innovation issues and visibility of the council that produces it. We find significant differences between councils when it comes to, firstly, formal processes for consulting actors outside the council when drafting reports or recommendations, and, secondly, the degree to which councils work to disseminate among and interact with a wider community of stakeholders around these reports. Regarding the first aspect, in the UK and South Korea consultation of relevant experts or actors occurs through a system of sub-committees or sub-groups. Other countries lack such formal structures and consultation seems to occur more through informal discourse and discussions with relevant experts, or there may be very limited or no consultation, with discussions kept within the council. In terms of dissemination and 'anchoring' of the report among a wider stakeholder community, we see a wide range in the level of ambition. While reports tend to be public, at least in the case of most of the European and North American councils, some countries merely issue their report while others, such as Canada for example, go to great lengths to arrange launch events and to reach out to and engage a large cross-section of the population in discussions based on their reports.

In the case of advisory councils, they can be composed only of experts – usually from academia and industry, or of a combination of experts and political representatives. The councils in Denmark, Switzerland, the UK and the US, as well as the German EFI clearly fit in the former category. The councils in Austria and Canada include Ministers but in an observatory or advisory function. In China, Finland, Japan and Korea, the Ministers are equal or full members of the councils alongside the experts. Whereas advisory councils which include ministers as

equal members can be assured of a minimum level of visibility or 'clout', advisory councils consisting only of independent experts might be viewed as more independent (but may have to work harder to gain status and visibility). Thus, purely expert-composed councils have to prove their worth by showing that they can provide useful advice that actually has an impact.

Overall, when it comes to academic representation, a lot of councils seem to be characterized by a strong representation (over-representation) of established scientists from the natural or technical sciences. Notable exceptions are the German Expert Commission for Research and Innovation which consists primarily of social scientists and economists and the Swiss Council. A minority of councils include foreign experts. Females are typically fewer, and young people are notably absent from most councils.

Most of the councils we have examined here have analytical resources which include both a secretariat and a budget for analyses. Furthermore, in the case of Germany and Austria, a deliberate decision was made to locate their secretariats outside ministries in order to safeguard or strengthen the councils' independence from political interference. An interesting related question is who sets the agenda for innovation councils: the government, the secretariat, the council itself or a combination of the three?

4.2 Challenges in meeting evolving demands on innovation governance

In designing or redesigning their councils, countries have sought to address the evolving demands on innovation governance, described above (i.e. a demand for orchestrating across policy domains and between geographical layers of governance, including various perspectives and stakeholders, and fostering dynamic policy development). However, countries, and councils, encounter a number of challenges in doing so. This sub-section explores these challenges. The analysis draws primarily from the more in-depth review of innovation councils in eight countries[5] (see "analysis and comments" section of cases in Appendix I) – highlighting some unique characteristics and discussing a number of challenges that councils now face as a consequence of the evolving demands on innovation governance.

One challenge for innovation councils is to strike the right balance between independence and credibility, on the one hand, and legitimacy or clout, on the other hand. Overall, relevance can be defined as the ability of the council to impact (or affect) governance and/or policymaking. This ability is in turn dependent on several possible factors: the ability to produce policy-relevant advice, the ability and willingness of governments to listen to and act upon the advice received, or the ability, more generally, to coordinate across policy domains and stakeholder communities. Credible advice, in turn, requires a balancing act between having the courage to address controversial issues if they are deemed to be relevant to a country's innovation capacity – examples we have found include immigration, labor markets, taxation, among others – while not creating the image of constantly criticizing incumbent governments and their actions. A related challenge for councils is to provide forward-looking and proactive advice. As one of the

[5] Austria, Denmark, Finland, Germany, Netherlands, Canada, US and Korea

people interviewed said: “We want the council to ‘think outside the box’; we don’t need yet another body telling us that venture capital is important”.

Another challenge relates to the question of stakeholder inclusion. One could argue that councils are, by their very nature, exclusive, since they are based on the premise of selecting a handful of individuals who are then tasked to discuss issues and formulate opinions. Councils work with varying degrees of transparency or stakeholder inclusion. While the Canadian council provides confidential advice to the Prime Minister and his Cabinet, the US council webcasts all its sessions, presentations and reports. Furthermore, the sessions are open to public participation. In the case of Canada, the ability to provide confidential and independent advice is seen as an important element for driving change. Thus, stakeholder inclusion and transparency might come at the expense of driving change or providing trustworthy, and sometimes unpopular, advice. One reason for this could be that public scrutiny may cause council members to express themselves less freely, or impede government’s ability or willingness to implement suggestions put forward by the council.

Two further areas where councils face specific challenges in addressing the needs of innovation governance relate to, firstly, the demand for coordination, and, secondly, the ability to promote policy experimentation. Overall, based on interviews with council members and stakeholders in various countries, we find that the ability of a council to drive policy coordination tends to be limited. This is because coordination does not happen simply by creating a council and ‘putting the right people around the table’ and expecting ‘the magic to unfold’. Coordination is often hampered by the fact that people are bounded by their contextual, political or other realities or constraints, not because they are not talking to each other or because they are not aware of the need for coordination. More specifically, council members’ primary responsibilities are elsewhere than in the council, and this is often the reason they have been appointed. However, their appointment – on its own – does not change their primary responsibilities (e.g. a finance minister is responsible primarily for the state budget). This finding confirms the observations made in the analysis of councils by the OECD in 2009:

> *“The planning and co-ordination models require significant commitments of ministers’ time by government as well as a willingness across political parties to see research and innovation as permanently central aspects of government policy. It is difficult for politicians to give up some of their autonomy and to participate in such arrangements”.*
> (OECD 2009, p.38)

Figure 1 lists some representative statements from our interviews with members of councils or their secretariats or other relevant stakeholders which illustrate some key features and challenges of councils but also what might determine their effectiveness. The insights are particularly relevant for councils which function primarily as advisory, as opposed to coordinating or even decision-making bodies. For reasons of confidentiality, some of the statements have been slightly modified to make them less easy to link to a specific interviewee, council or country. Statements 1 and 2 provide good examples for why governments might want councils and why they might not. One possible role commonly assumed by government representatives in advisory councils is described in statement 3. Statements 4 and 5 points to the risk of advisory

bodies ‘drifting’ from their original mission and influence. As statement 6 shows, councils need to balance their advice to maintain credibility and influence, a challenge which is accentuated by the tendency of media to pay more attention to negative than positive critique. Finally, statements 7 and 8 provide a succinct summary of what determines the effectiveness of advisory councils, namely the importance of government’s receptiveness to outside advice and the importance of both individuals – in councils, government, ministries, secretariats – and group dynamics.

Figure 1 Representative statements from interviews

Statement 1: The really smart people (in a council) think of things the government wouldn’t have.

Statement 2: Some countries’ governments would never take (or expose themselves to) the risk of appointing an independent advisory body.

Statement 3: The government is primarily represented in the council to listen or to facilitate and prepare for the eventual implementation of the advice produced.

Statement 4: While they [advisory bodies] start with good intentions and got off to a satisfactory beginning, eventually they drifted into advocacy and when that happens, PM and Cabinet members tune out.

Statement 5: Even if council recommendations are not supposed to be decisive, when recommendations are not put into practice, councils become easy targets for criticism.

Statement 6: In order to maintain credibility and influence, councils have to strike a balance: they cannot be seen as sycophants – always endorsing the governments’ decisions, nor do they want to be considered to be ‘eternally negative’ – consistently criticizing government. A related challenge is that councils tend to get much more attention from the media when they criticize government than when they praise a policy or initiative.

Statement 7: The influence [of the council] depends on the receptiveness of the government to [external or independent] advice and its willingness to listen.

Statement 8: A reduced influence can be driven by changes in the political situation, as well as changes in ministers, other members and secretariat staff. Individuals’ interest in the topic, as well as group dynamics, plays a substantial role in the council’s effectiveness.

In an ideal world, relevant advice should lead to policy design and implementation, followed by evaluation and resulting policy adjustments and improvements. This process – of which successful councils are a part – can be quite slow, and the chain is not infrequently broken in several instances, i.e. useful advice might not lead to policy responses, or policy initiatives might not be evaluated in a meaningful way, or evaluations might not trigger policy improvements. Policy experimentation, in turn, requires functioning and nimble chains or feedback loops. Also, most national councils’ composition is fairly traditional, including neither “wild cards” (like designers, anthropologists, students, etc.) nor having clear methods for regular changing of members to ensure dynamism or different perspectives. While there are good reasons for councils’ being comprised of proven and experienced experts who are appointed on a multiannual basis, this also creates challenges in terms of councils’ ability or willingness to engage in experimentation or respond to changes in a highly dynamic innovation landscape.

Finally, no council – regardless of its composition – is immune to the vagaries of ‘political fickleness’. A council’s effectiveness might be impeded by a new Prime Minister or government that might dislike the mandate or composition of a council, simply because it was appointed by its predecessor.

When setting up a council, it is important to have realistic expectations as to what it can achieve even in a ‘best-case scenario’. In particular, a council will never address all national needs for innovation policy coordination, governance or advice. One cannot expect them to do everything i.e. provide relevant advice, oversee policy implementation, direct or guide investments, evaluate policy, encourage experimentation and learning, and mobilize stakeholders.

5 Conclusions

In setting up innovation councils, governments often have high expectations that these bodies will provide useful advice, or evaluate, coordinate or even plan science, technology and innovation policy. Our analysis shows that these expectations are not easily met. Regardless of their primary task, councils face challenges and sometimes conflicting demands or pressures:

> *"The turbulent history of councils internationally suggests both that their form and functioning are hard to get right and that some degree of experimentation is necessary… Some countries have made repeated attempts to organise advisory councils. Their experience suggests that there can be quite a short window of opportunity for a new council to make its mark and justify its continued existence".*
> (OECD 2009, p.38)

Purely advisory bodies risk being marginalized, not listened to or fading into oblivion. At the same time, our analysis shows that they can be very powerful or have a high impact (in terms of influencing policy, budgets, getting advice turned into actions, prioritization) if they succeed.

Councils often fall short of expectations when it comes to coordination; the ambition of policy coordination is particularly tricky to achieve because the council as a mechanism does not address the inherent obstacles to coordination (decision-making, budgetary allocation etc.). There seems to be a general somewhat naïve view in innovation policy that gathering the right people around the table will result in consensus and coordinated action. Ironically, in countries where coordination is most needed – e.g. where there is most fragmentation and lack of integration among policy domains and ministries – achieving coordination through a council appears to also be much harder to achieve, as pointed out by OECD analysis which identifies "*additional limitations to the co-ordinating influence of an advisory council in systems that have strong internal incentives to fragmentation*" (OECD 2009, p.101).

OECD (2009) identified 3 categories of councils: A joint planning model, a coordination model and an advice model. Our analysis of national innovation councils confirms that this is a very useful classification. We would consider adding a fourth category called 'platform for inter-action'. This category could be used to describe councils which don't have a clear mandate or substantial resources to undertake analyses, coordinate or plan policy. Rather, they function more as a 'sounding board', providing the Prime Minister or President, or a minister of science, technology, industry or innovation, with a forum for interacting with a selection of represent-tative high-level stakeholders, usually from industry and academia, but also at times including labor unions, research institutes or other actors.

One could argue that the idea of an innovation council as an overarching coordinating and governance body is outdated and neglects the increasing complexity of innovation dynamics such as open innovation, user-driven innovation, globalization, system resistance to change, etc. However, coordinating councils can still fill an important and needed function in improving

coordination across ministries, but this requires a willingness (on behalf of ministries) to relinquish power to the council (OECD 2009). A further interesting limitation of innovation councils pointed out by some of the experts interviewed is that they tend to be limited to proposing reform, often of an incremental nature, rather than driving radical change. While nearly all countries and systems benefit from continuous improvement in the form of reforms, there might be circumstances where there is a need for radical change. In those circumstances, it might be unrealistic or unproductive to expect a council to provide the necessary impulse or direction.

As was confirmed in the interviews we conducted, a council's ability to influence policymaking relies on a conducive environment defined by a willingness and ability of government to take in advice, by a receptiveness for and tradition of evidence-based decision-making and a vibrant evaluation culture, and by a sufficient amount of trust and social capital within the system. The latter is important to ensure that councils are not taken hostage by vested interests or lobbies. The effectiveness of a council in providing advice that puts ideas right into the heart of decision-making also depends on the pre-existence of other conducive institutional conditions and frameworks, such as a functioning research and innovation system with a recognition of the importance of research and innovation for economic and social development. Thus, councils require a certain 'fertile ground' or conducive framework to be effective. Several of the experts we interviewed observed that once such frameworks start to crumble, e.g. a broad consensus on the importance of innovation as driver of change or on the importance of change, the ability of councils to make meaningful suggestions AND be heard declines.

Overall, councils' success or failure in influencing policy development can also be said to be determined by leadership on behalf of government. Leadership can take several forms. It can be the courage to solicit and receive independent advice, the ability and willingness to get ministries to relinquish power to a coordinating council, the audacity to experiment and take (informed) risks or to drive a forward-looking, long-term policy.

Elements of successful councils include legitimacy, relevance, visibility, stakeholder inclusion, and the ability to provide evidence and analysis. However some of these things can be conflicting. Can an advisory body include ministers, or is that an inherent conflict? Having ministers provides legitimacy, visibility and the potential for strengthening coordination. BUT this can come at the expense of independence, objectivity, transparency and inclusion (becomes elitist and exclusive) – and the ability to drive change (since you are so coupled to politics). Of course, the discussion of how successful councils are depends critically on the definition of 'success' which is not as straightforward as it may seem. We have chosen to define 'success' as the ability to influence policy development. Finally, we would like to point out that in this paper we have not attempted to evaluate councils according to their impact. Rather, we have asked interviewees to share insights regarding working mechanisms, challenges, developments and national contexts.

The increasing complexity of and demands on innovation governance explain the search for instruments and mechanisms, of which councils are one expression. Our paper has shown that councils can address several of the demands of innovation governance, such as expert advice,

agenda setting, coordination of some elements of the innovation system, planning, evaluation, priority-setting, etc. At the same time, councils as a mechanism are faced with a number of challenges and sometimes conflicting demands or expectations that jeopardize their ability to work effectively. Thus, it is important both to set appropriate expectations for national innovation councils (e.g. filling "governance gaps" not addressed by other mechanisms), and to have the insight and flexibility to adjust characteristics of the council in order to meet new demands on governance as they evolve. In particular, their remit needs increasingly to be understood in the context of the 'societal challenges' social contract and not only of the 'research and innovation' context in which most of them were created.

References

Archibugi, D. & Iammarino, S. (1999). "The policy implications of the globalization of innovation" in *Research Policy*, 28: 317-336.

Archibugi, D. & Iammarino, S. (2002). "The globalization of technology. A new taxonomy" in *Cambridge Journal of Economics*, 19: 121-140.

Arnold, E. (2011). Synthesis Report of the International Audit of Research, Development & Innovation in the Czech Republic. Technopolis Group.

Arnold, E., Kuhlmann, S., and van der Meulen, B. (2001). *A Singular Council: Evaluation of the Research Council of Norway*. Ministry of Education, Research and Church Affairs, Oslo; available at www.technopolis-group.com.

Bakhski, H., Freeman, A. and Potts, J. (2011). State of Uncertainty – innovation policy through experimentation, NESTA.

Bathelt, H., Malmberg, A., & Maskell, P. (2004). "Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation" in *Progress in Human Geography*, 28(1): 31-56.

Boekholt, P., Arnold, E., Deiaco, E., McKibbin, S., Simmons, P., Stroyan, J., & Mothe, J. (2002). *The governance of research and innovation. An international comparative study.* Synthesis Report. Technopolis, Retrieved from http://in3.dem.ist.utl.pt/master/03itt/lec_2_4.pdf.

Borrás, S. (2009). *The widening and deepening of innovation policy: What conditions provide for effective governance?* CIRCLE Electronic Working Paper Series, No. 2009/02. Lund, Sweden: University of Lund.

Borrás, S., and Edler, J. (2014). "Introduction: on governance, systems and change" in Borrás, S., and Edler, J. (eds.) *The governance of socio-technical systems"*, Edward Elgar Publishing.

Bunnell, T., & Coe, N. (2001). "Spaces and scales of innovation" in *Progress in Human Geography*, 25(4): 569-589.

Cao, C., Li, N., Li, X. and Liu, L. (2013). "Reforming China's S&T system" in *Science*, 2 August, Vol. 341: 460-462.

Chaminade, C. and Edquist, C. (2006). "Rationales for public policy intervention from a systems of innovation approach: the case of VINNOVA." Working Paper 2006/04. CIRCLE, Lund University, Sweden.

Chesbrough, H. (2003). *Open Innovation*. Harvard Business School Press, Boston.

Cooke, P. (2005). "Regionally asymmetric knowledge capabilities and open innovation; Exploring 'Globalisation 2'—A new model of industry organisation" in *Research Policy*, 34: 1128-1149.

De la Mothe, J., (2001). "Knowledge Politics and Governance" in John de la Mothe (ed), *Science Technology and Governance*. Continuum, London, New York.

Doubleday, R. and Wilsdon, J (eds.). *Scientific Advice in Whitehall*. London: Alliance for Useful Evidence.

Edler, J., Kuhlmann, S., & Smits, R. (2003). *New Governance for Innovation: The Need for Horizontal and Systemic Policy Coordination*. Karlsruhe: Fraunhofer Institute for Innovation Research.

Edquist, C. (1997). *Systems of innovation: Technologies, institutions and organizations*. London, England: Pinter Publishers.

Edquist, C. (2014). "En helhetlig innovationspolitik – varför, vad och hur?" in Mats Ögren Wanger (ed) *Position Sverige: Om innovation, hållbarhet och arbetsmarknad*, pp.59-80, Ekerlids Förlag, Falun.

European Commission (2003). *Innovation Tomorrow.* Luxembourg: European Commission.

European Commission (2012). *International Cooperation in Science, Technology and Innovation: Strategies for a Changing World*. Report of the Expert Group established to support the further development of an EU international STI cooperation strategy. Luxembourg: European Commission.

European Commission (2014). *Annex I – Terms of Reference*. http://ec.europa.eu/research/innovation-union/pdf/expert-groups/terms_of_reference_rise.pdf#view=fit&pagemode=none

Foray, D., David, P., & Hall, B. (2009). "Smart specialization – the concept." Policy Brief No. 9. Expert Group Knowledge for Growth, European Commission, Brussels.

Freeman, C. (2002). "Continental, national and sub-national innovation systems—complementarity and economic growth" in *Research Policy*, 31 (2002): 191–211.

Geels, F. (2004). "From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory" in *Research Policy*, 33 (2004): 897-920.

Geels, F. (2010). "Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective" in *Research Policy*, 39 (2010): 495-510.

Guston, D. (2000). *Between Politics and Science: Assuring the Integrity and Productivity of Research.* Cambridge: Cambridge University Press.

Kao, J. (2009). "Tapping the World's Innovation Hot Spots" in *Harvard Business Review*, March 2009.

Kuhlmann, S. (2001). "Future governance of innovation policy in Europe – three scenarios" in *Research Policy*, 30 (2001): 953–976.

Kuhlmann, S., & Edler, J. (2003). "Scenarios of technology and innovation policies in Europe: Investigating future governance" in *Technological Forecasting & Social Change*, 70 (2003): 619–637.

Lindner, R. (2012). "Cross-sectoral coordination of STI-policies: Governance principles to bridge policy fragmentation" in I. S. I. Fraunhofer (Ed.), *Innovation systems revisited: Experiences from 40 years of Fraunhofer ISI research* (pp. 275–287). Stuttgart: Fraunhofer Information.

Lundvall, B. A. (1992). *National systems of innovation: Towards a theory of interactive learning.* London, England: Pinter.

Lundvall, B.-Å. and Borrás, S. (1998). *The Globalising Learning Economy: Implications for Innovation Policy*. The European Commission, DG XII-TSER, Brussels.

Mazzucato, M. (2013). *The Entrepreneurial State: debunking public vs. private sector myths*. Anthem.

Mulgan, G. (2007). *Social Innovation: what it is, why it matters and how it can be accelerated*. Skoll Centre for Entrepreneurship, Oxford Said Business School.

National Academies (2007). *Rising above the gathering storm: Energizing and employing America for a brighter economic future*. The National Academies Press, Washington DC, http://www.sandia.gov/NINE/documents/RisingAbove.pdf.

OECD (2008). *OECD reviews of innovation policy: China*. OECD, Paris.

OECD (2009). *Chile's National Innovation Council for Competitiveness – Interim Assessment and Outlook*.

OECD (2012). "STI Policy Profiles: Innovation Policy Governance" in *OECD Science, Technology and Industry Outlook 2012*.

OECD (2014a). *OECD Science, Technology and Industry Outlook 2014.*

OECD (2014b). *Making Innovation Policy Work.*

OECD and The World Bank (2009). *Innovation and Growth – Chasing a Moving Frontier*.

Pelkonen, A. (2006). "The problem of integrated innovation policy: analyzing the governing role of the Science and Technology Policy Council of Finland" in *Science and Public Policy*, 33(9): 669-680.

Pelkonen, A., Nieminen, M. and Lehenkari, J. (2014). *Evaluation of the Research and Innovation Council of Finland*. Ministry of Education and Culture of Finland 2014:6.

Prahalad, C.K. and Krishnan, M.S. (2008). *The New Age of Innovation: Driving Co-Created Value through Global Networks*. McGraw-Hill.

Prahalad, C.K. and Ramaswamy, V. (2004). *The Future of Competition: Co-creating Unique Value with Customers*. Harvard Business Press, Boston.

Schwaag Serger, S., Benner, M. & Liu, L. (2015). "Chinese University Governance: Tensions and Reforms" in *Science and Public Policy*.

Smits, R. and Kuhlmann, S. (2004). "The rise of systemic instruments in innovation policy" in *International Journal of Foresight and Innovation Policy*, 1 (1/2): 4-32.

Springut, M., Schlaikjer, S. & Chen, D. (2011). *China's program for science and technology modernization: Implications for American competitiveness*, prepared for the US-China Economic and Security Review Commission, http://origin.www.uscc.gov/sites/default/files/Research/USCC_REPORT_China%27s_Program_forScience_and_Technology_Modernization.pdf.

Silberglitt, R., Antón, S., Howell, D., and Wong, A. (2006). *The Global Technology Revolution 2020: Executive Summary*. Rand Corporation, USA.

Stilgoe, J., Owen, R., & Macnaghten, P. (2013). "Developing a framework for responsible innovation" in *Research Policy*, 42 (9), 1568–1580.

Sutarauta, M., & Kautonen, M. (2007). “Co-evolution of the Finnish National and Local Innovation and Science Arenas: Towards a Dynamic Understanding of Multi-level Governance” in *Regional Studies*, 41 (8), 1085–1098.

TAFTIE (2011). *Innovation Hot Spots in India*. TAFTIE Task Force on Internationalization Strategies.

Von Hippel, E. (2005). *Democratizing Innovation*. MIT Press, Cambridge.

Appendix I: Profiles of National Research and Innovation Councils

As mentioned in the introduction to the analysis, the research and innovation council profile descriptions are based on data from a review of documents and websites, and from semi-structured interviews with council members or other stakeholders in eight of the countries (see Appendix II). For these countries, the profile descriptions include an additional "analysis and comments" section.

Profile descriptions are presented in alphabetical order for each region of the world (Europe, North America and Asia).

Austria: Council for Research and Technology Development

The Austrian Council is comprised of specialized experts, whose primary tasks are to produce an annual report on the performance of science and technology in Austria, to monitor the implementation of programs and initiatives, and to provide advice on future research and innovation policy.

On 11 July 2000, the Parliament established the Council for Research and Technology Development which became a legal entity under public law on 1 September 2004. Whereas the Council initially had a budget allocation responsibility (effectively allocating 600 million Euros of public money for research), this function came to an end after 2007. Since then, the Council has been transformed to operate primarily as an advisory body. The Council's work covers the entire national innovation system, and it may be consulted by both federal and regional institutions.

The Austrian Council consists of eight members with voting rights, four of whom are appointed by the Minister of Science and Research and four by the Minister of Transport, Innovation and Technology. Of the eight appointed members, 3 are men and 5 are women – with one international member (from Korea). Three members are from the private sector, and five are from universities. The Council is currently chaired by Hannes Androsch, entrepreneur, industrialist, banker, and former Minister of Finance and Deputy Prime Minister of Austria, so a well-known profile in Austrian media. The members with voting rights are appointed for a five year term of office and may be reappointed for one further period. The Minister of Transport, Innovation and Technology, the Minister of Science and Research, the Minister of Economic Affairs, Family and Youth and the Minister of Finance or their designated representatives hold seats on the Austrian Council (as advisory members) but have no voting rights.

The Council is under the responsibility of the Minister for Transport, Innovation and Technology who also allocates a budget to the Council.[6] It is supported by a Secretariat which used to belong to the Ministry. Since 2004, it is an independent entity which receives its annual budget from the Ministry. The budget covers the salaries of the staff of the Secretariat, as well providing funding for commissioning reports. According to its homepage, the Secretariat employs 10 people.

On average, the Council meets 4 times per year. Every year the Council agrees on a 'work program', identifying the topics to be addressed. Suggestions for topics can come from Council members, the Secretariat or the ministries. The main output of the Council is an annual report on the scientific and technological performance of Austria – 'Bericht zur wissenschaftlichen und technologischen Leistungsfähigkeit Österreichs,' and significant efforts are made by the Council ensure widespread visibility of the report.[7] The report also monitors progress in the implementation of the Austrian strategy for research, technology and innovation presented by the government in 2011.[8] Together with the Government's own 'research and technology report' the Council's performance report is submitted every year on June 1 to Parliament. In addition to the annual report, the Council commissions analyses and occasionally writes short position papers, both of which are available on its website. Commissioned analyses have focused on issues such as the biotech industry, university governance, medical research, science communication and popularization, barriers to research commercialization, and international research, technology and innovation cooperation. Position papers have addressed university funding and the EU budget, among other things. Also, in 2009 the Council published a forward-looking 'Strategy 2020' for research, technology and innovation in Austria.[9]

Analysis and comments

The Austrian Council benefits from operating within a national context characterized by a strong evaluation culture which is not evident in all countries analyzed here. Its report on Austria's scientific and technological performance measures progress made in meeting goals set in Austria's long-term strategy for research, technology and innovation ('Strategie 2020'). The report – which both benchmarks Austria against other selected countries in a range of indicators and makes concrete recommendations based on the findings – is both a reflection and further manifestation of the acceptance and appreciation of critical evaluation. The Secretariat has a budget for commissioning reports on a wide range of issues.

The Secretariat also devotes resources for strategic communication to anchor the work carried out and the recommendations made by the Council.

The Austrian Council differs from many of the other councils in Europe in that it allocates resources – although to a much smaller extent than previously.

[6] See http://www.rat-fte.at/tl_files/uploads/Hintergrunddoks/0409%20Gesetz%20FTFG%20Rat%20September%202004.pdf
[7] http://www.rat-fte.at/tl_files/uploads/Leistungsberichte/Leistungsbericht2014_final_screen.pdf
[8] http://www.bmvit.gv.at/innovation/publikationen/forschungspolitik/downloads/fti_strategie.pdf
[9] http://test.fluidtime.com/project/austriancouncil/website/tl_files/uploads/Strategie/090824_FINALE%20VERSION_FTI-Strategie2020.pdf

Recently, the Government has strengthened the international perspective of the Council by appointing three foreign members.

Denmark: Council for Research and Innovation Policy

After a recent re-organisation of the Danish Research and Innovation System, the Danish Council for Research and Innovation Policy was formed with a revised mandate focused on providing independent, strategic advice and a holistic perspective on research, technology and innovation policy.

Denmark has a rather long history of using various councils to provide advice to policy formulation, to fund (and guide budget allocations to) research and innovation programmes, and to evaluate how these research and innovation investments have addressed given policy objectives. Councils providing advice on research policy[10] (the last of which was the Danish Council for Research Policy) have operated in parallel to councils providing advice on technology and innovation policy[11] (the last of which was the Danish Council of Technology and Innovation). In addition, the Danish Council for Strategic Research (2003-2014) was initiated to help ensure that strategic research in Denmark was organised to meet challenges facing Danish society.

On April 1 2014, all political parties and the Danish Parliament agreed on a revision of the research and innovation system. Agreed revisions were based on input from previous analyses and peer reviews[12], and aimed at ensuring that public investments in research and development contributed even more to addressing societal challenges and creating growth and employment. Revisions in the system encompassed consolidations and changes in both the structures for allocating funding to innovation, and the structures for providing advice on innovation policy.

A key revision in the structure for allocating funding to innovation was the creation of a new innovation foundation: "Innovation Fund Denmark – the foundation for strategic research, advanced technology and innovation". The foundation merges the Danish Council for Strategic Research, the Danish National Advanced Technology Foundation and the Danish Council for Technology and Innovation into one foundation, with an expected annual budget of DKK 1.5 billion. The Innovation Fund Denmark (IFD) is responsible for allocating grants for research, technology development and innovation, which are based on societal and commercial challenges and needs. The IFD is now *the* public funder (or investor) in applied research and experimental development – and one of the key public actors investing in demonstration and market development. IFD is led by an independent board, which will implement the funds and decide how the instruments can best be prioritised and developed in the future. The IFD Board is comprised of nine politically-appointed members with research and industry expertise, and has the responsibility of determining the overarching strategic investment priorities, defining awards policy and criteria, and making all investment decisions regarding "large scale projects".

[10] Forskningens Fællesudvalg (1965-1972); Planlægningsrådet for forskning (1972-1989); Forskningspolitisk Råd (1989-1996); Danmarks Forskningsråd (1996-2003); Danmarks Forskningspolitiske Råd (2003-2014)
[11] Rådet for Teknologisk Service (1996-2002) and Rådet for Teknologi og Innovation (2002-2014)
[12] Including, e.g., the ERAC peer review of the Danish research and innovation system conducted in 2012

The IFD also has internal analytical capacity to supervise and evaluate projects that have been awarded funding in order to safeguard the progress of the projects.

The structures for providing advice on innovation policy have also been consolidated and changed in order to provide a better integration and policy development mix between research, innovation and higher education policy. The Danish Council for Research and Innovation Policy (DFIR) succeeded the previous Danish Council for Research Policy and the advisory function of the Danish Council for Technology and Innovation[13]. The objective of the Danish Council for Research and Innovation Policy is to further the development of Danish research, technology and innovation for the benefit of society. The Council advises the Minister for Higher Education and Science and the Danish Parliament on research, technology development and innovation at a general level. The mandate and composition of the current council has been adjusted to be more holistic and provide perspectives on the whole chain of the innovation process.

The Danish Council for Research and Innovation Policy is now solely focused on providing independent policy advice that looks at both the research and innovation policy points of view, that considers the interaction between instruments (and the policy mix), and takes a global (rather than national) perspective. The Council may choose its own areas of work and policy advice, or the minister or others may ask the council to give advice on a specific issue.

The council must provide an annual report with its assessment and recommendations on the state of Danish research and innovation. There are no fixed processes to ensure that the minister or Parliament acts on advice or recommendations made by the Council. However, advice is made public through publications, etc.

The Danish Council for Research and Innovation Policy consists of a chairman and eight members that are all appointed by the Minister for Higher Education and Science in their personal capacity. Council members serve for a term of 3 (+3) years. Professor Jens Oddershede is the chairman of the Danish Council for Research and Innovation Policy. Of the nine members, three are from academia, five are from companies (or consultancies), and one is from Vækstfonden. Four members are men, and five are women – all from Denmark.

The Council is responsible for settings its own agenda – for deciding the issues or topics for which their knowledge and advice would have most relevance. At the start of their mandate, Council members identified a list of topics – prioritizing two topics on which to focus efforts in the first year. Work on new topics (identified by the Council, or through requests from Parliament or the Ministry of Research and Higher Education) is initiated on a rolling basis.

The Council is supported by an independent secretariat (of three people) located in the Danish Agency for Science, Technology and Innovation (DASTI). The secretariat supports the council at all levels including facilitating various projects and task forces, conducts or procures analyses, and communicates/disseminates the Council's results and recommendations.

[13] The previous Danish Council for Technology and Innovation has become a part of the Danish Innovation Fund.

Analysis and comments

The recent re-organization of the Danish research and innovation system resulted in a consolidation of organisations and institutions charged with allocating funding to innovation, as well as with providing advice on innovation policy. The re-organization also resulted in a distinct division between those giving policy advice (the Research and Innovation Council), those developing policy (the Ministry of Higher Education and Science with the Danish Agency for STI, and the Ministry of Business and Growth with the Danish Business Authority) and those allocating funding and implementing instruments (Innovation Fund Denmark). The analytical function (including strategic intelligence, policy evaluation and learning) is embedded (to different degrees) in all parts of the governance system.

These changes have helped strengthen the overall system perspective and foster better horizontal and vertical coordination. The composition of the Research and Innovation Council represents a variety of perspectives and experiences and helps to ensure a holistic/systemic perspective. The method of selecting Council members and of setting the Council's agenda also helps to ensure that topics addressed and advice provided are driven by Council members' independent view of what's most important to Denmark (rather than a particular policy agenda).

The Council has adopted "operating principles" and methods of communication[14] that foster a global perspective[15] and inclusive approach to developing policy recommendations for the Danish government. As with the previous Council for Research Policy and Council for Technology and Innovation, there are no formal mechanisms to ensure that the minister or the government follows the Council's policy advice. And with a greater dispersion of analytical activities and resources (located primarily within DASTI and the Innovation Foundation), it is uncertain how smoothly the cycle of policy development, implementation, evaluation/learning will run – nor how the new governance structure fosters agile policy development. As the Council has only been in place for about a year, it is still not known if formal mechanisms and strong embedded analytical capacity are needed for the Council to have an influence on policy development and implementation in Denmark. Time will tell.

Finland: Research & Innovation Policy Council

The Finnish Research and Innovation Council (previously the S&T Policy Council) is one of the most internationally well-known and longest-existing councils. With its high-ranking leadership and influence on policy strategy, it has served as a model for other countries' innovation governance. However, the recent evaluation of the Council found challenges in terms of its ability to drive policy proactively and to address horizontal or cross-cutting policy issues. The Government is currently in the process of formulating revisions to the Council.

The Research and Innovation Council, chaired by the Prime Minister, advises the Government and its Ministries in important matters concerning research, technology, innovation and their utilisation and evaluation. The Council is responsible for the strategic development and

[14] Including organizing conferences to present and discuss Council conclusions and recommendations
[15] Maintaining a global perspective is a key guiding principle of the Council; however, there are no international members of the Council.

coordination of Finnish science and technology policy as well as of the national innovation system as a whole. Building on experience from the Science Policy Council (established in 1963), the S&T Policy Council (now Research and Innovation Policy Council) has existed since 1987.

The mandate of the Council is to assist the Government and its ministries by:

- following national and international developments in research, technology and innovation;
- evaluating the state and developments within the sphere of its authority;
- addressing major matters relating to the development of science, technology and innovation policy and the human resources they entail and prepare proposals and plans concerning these for the Government;
- addressing matters relating to the development and allocation of public research and innovation funding on a preparatory basis for the Government;
- coordinating Government activities in the field of science, technology and innovation policy; and
- executing other tasks assigned to it by the Government

It is both a classical coordinating and advisory body, and a strategy-shaping multi-stakeholder institution, where political decision makers, administrators, academics and industrial experts jointly design and formulate major development lines and actions for national STI policy. The Research and Innovation Policy Council is comprised of the Council, two Subcommittees, and a Secretariat.

The Council is appointed for the duration of a Government term (of four years), except for Government members, whose term on the Council is limited to the duration of their ministerial term. In addition to the Prime Minister (who chairs the Council), the membership consists of the Minister of Education and Science, the Minister of Economic Affairs, the Minister of Finance and a maximum of six other ministers appointed by the Government. In addition to the ministerial members, the Government appoints (ten) other members who represent expertise in research and innovation.

The Research and Innovation Council currently has 17 members:[16] 7 ministers, and 10 government appointees (4 from universities, 2 from companies, and 1 each from the Academy of Finland, Tekes, VTT and the Organisation of Finnish Trade Unions). In addition, 5 permanent experts (from the Prime Minister's Office, the Ministry of Education and Science, and the Ministry of Economy) are participants in (but not formal members of) the council. Of these 22 individuals, 15 are men and 7 are women, and all members are from Finland.

The Council has a science and education subcommittee and a technology and innovation subcommittee with preparatory tasks. These are chaired by the Minister of Education and Science and by the Minister of Economic Affairs, respectively. There are 10 members in each subcommittee (9 from the Council and one permanent expert from the respective ministries). The Secretariat consists of one full-time Secretary General (appointed by the Government) and

[16] see http://www.minedu.fi/OPM/Tiede/tutkimus-_ja_innovaationeuvosto/kokoonpano/neuvosto.html?lang=en

two full-time Chief Planning Officers for each of the subcommittees (appointed by respective ministries). The clerical tasks are taken care of at the Ministry of Education and Culture.

The Council does not have decision-making power over the ministries or agencies, nor do they have a budget of their own, but traditionally the Council has had significant influence through its regular policy guidelines. The cost of the Secretariat, preparatory tasks undertaken by the subcommittees and remuneration for participation in the Council is covered within the state budget.

The Council produces regular guidelines for research and innovation policy which analyse past developments, draw conclusions and make proposals for the future (including levels and division of government research funding, and a selection of operational priorities).[17] Guidelines agreed by the Council are regularly recognized in policy documents produced by the ministries, and the most important recommendations provided by the Government programme. However, priority setting between research themes or technology areas, for example, is not in the remit of the Council.

A recent evaluation of the activities of the Research and Innovation Council (in March 2014) highlighted that changes in the operating environment are fast – and that the Council's status and impact in the system of research and innovation have declined.[18] The evaluation recommended that the Council adopt a more strategic and forward-looking position, with a much clearer international position, and that the Council operate more independently of the administration.

> *The Council can secure a more proactive approach by making greater use of national and international experts and stakeholders in the Council's formative work. The Council could also be more active in arousing discussion in research and innovation policy. To do so, the Secretariat of the Council should be expanded.*
> (Pelkonen et al. 2014)

Analysis and comments

Having the Prime Minister as the chair and the involvement of several ministers has given the Council a high degree of legitimacy. However, top-level governmental anchoring has not ensured that advice is put into practice. In fact, the Council's impact is highly dependent on the political context and the engagement of individual ministers. The structure also creates a level of formality that distances the Council from the broader public debate on innovation policy and actual innovation activities.

The Secretariat plays an important role in designing what the Council is doing (preparing meetings, writing papers, etc.), yet lacks resources to involve stakeholders and help the Council be more active in the popular debate.

[17] The most recent publication was released in March 2015: Reformative Finland: Research and Innovation Policy Review 2015-2020
[18] See http://www.minedu.fi/OPM/Julkaisut/2014/TIN_arviointi.html?lang=en

Although the recent evaluation highlighted a number of positive aspects of the Council (e.g. its role in bringing together politicians and experts, the impact it has had on government programmes and R&D funding), the evaluation also highlighted that the Council's current structure and operating model result in an unnecessary segregation between the areas of education, research and innovation – making it difficult to have a strong position in horizontal policy formulation. The lack of analytical capacity, use of external experts and connection to various stakeholder groups also leads to more reactive (rather than proactive and forward-looking) policy recommendations.

These critiques seem to indicate that the Council is experiencing the effects of the evolving demands on innovation governance – i.e. a greater need for systemic change, more inclusive/discursive processes in policy formulation and increased dynamism.

The evaluation proposed a number of recommendations to improve the Council's operations:

- Involve sectoral ministries in the Council's activities to a greater degree in order to strengthen the horizontal coordination of research and innovation policy and cooperation.
- Rely increasingly on external experts and stakeholders in drafting activities.
- Pursue more strategic activities that draw systematically on foresight and assessments.

A team comprised of representatives from the Prime Minister's office and Directors from the Ministry of Education and the Ministry of Economy reflected on the recommendations and formulated a plan about what should be done going forward. The proposal was presented to the new government (elected April 2015).

Germany: Innovation Dialogue, Expert Commission for Research and Innovation, and Council of Science and Humanities

Germany has a number of expert commissions and councils, both at national and state level. We've identified the three which we think are most relevant for the purpose of this comparison: the Innovation Dialogue, the Expert Commission for Research and Innovation and the Council of Science and Humanities (Wissenschaftsrat).

Innovation Dialogue

The Innovation Dialogue consists of high-level representatives from government, industry, academia, labor unions and research institutes, as well as independent experts. It is chaired by the President of the German National Academy for Science and Engineering (Acatech) and meets 1-2 times a year to discuss previously identified themes of relevance for Germany's innovation policy.

The *'Innovationsdialog'* or 'Innovation Dialogue' is a group of high-level representatives from government, industry and academia. The group meets 1-2 times a year to discuss strategic issues regarding innovation policy. Aside from the German Chancellor, the group consists of the Minister or Education and Research, the Minister of Economy and Energy, and the Chief of Staff of the German Chancellery and Minister of Special Affairs. Aside from the government

representatives, the group is composed of high-level representatives from industry, academia, research institutes and labor unions, as well as independent experts. The members are personally appointed by the German Chancellor. The group is chaired by the President of Acatech, the German National Academy for Science and Engineering (Deutsche Akademie der Technikwissenschaften). According to its homepage, the mission of the group is to provide independent expert advice on framework conditions for research, science and technological development. The group is supposed to follow and observe important developments, insights and trends in the innovation system. The Innovation Dialogue is supported by a secretariat located at Acatech. Each meeting of the Innovation Dialogue meeting revolves around a previously identified theme and the secretariat is charged with preparing dossiers for each meeting on the respective theme. The dossiers also contain recommendations for action which are prepared in coordination with the Ministry of Education and Research and the Ministry of Economy and Energy.

The secretariat consists of a staff of four people and is funded by the Ministry of Education and Research. Since its inception in 2010, the group has met 6 times (as of February 2015) around the following themes:

- Benchmarking innovation systems (September 2010)
- Financing innovative startups and analysis of the German cluster landscape (April 2011)
- Technology areas and service innovations with a high potential for value creation and employment in Germany (February 2012)
- The international dimension of German innovation policy – example Asia (October 2012)
- New innovation potentials for value creation and employment through digitalization (March 2013)
- International benchmarking of innovation systems and STEM (Science, Technology, Engineering and Maths) education as a challenge for innovation policy (October 2014)
- ICT and digitalization and the future of value creation in the German economy (April 2015)

Looking at the themes, there is a strong focus on linking innovation to information and communication technologies (ICT) and digitalization, but also education and employment.

Expert Commission for Research & Innovation

The Expert Commission for Research and Innovation is composed of academic experts from different areas of relevance to research and innovation. Its mandate is to provide the government with comprehensive analysis and evaluation of Germany's innovation system, and with evidence-based advice on research and innovation policy. The Commission reports directly to the Chancellor Angela Merkel.

The Expert Commission for Research and Innovation (Expertenkommission Forschung und Innovation - EFI) was created in 2007 and is composed of academic experts from different areas of relevance to research and innovation. Its mandate is to provide the government with comprehensive analysis and evaluation of Germany's innovation system, and with evidence-based advice on research and innovation policy. A key task is to provide a comprehensive analysis of the strengths and weaknesses of the German innovation system in an international

comparison. The Commission reports directly to the Chancellor Angela Merkel. The most important instrument of the EFI is its annual report on research, innovation and technological performance in Germany. Furthermore, EFI evaluates Germany's position as a location for research and innovation on the basis of the latest research findings. The EFI presents proposals for national research and innovation policy.

The members of the Expert Commission for Research and Innovation are appointed by the Federal Ministry for Education and Research, after approval by the Federal Government for a period of 4 years. Equal participation of women and men in accordance with the Act of Filling Positions of Federal Bodies is encouraged. The Commission currently consists of 6 members, all of which are academics, and one of whom is foreign. In selecting the members, great care is taken to identify academics who are 'anchored in reality' and understand the complexities of policymaking (interview with the Chairman of EFI, February 2015). In addition, the independence and objectivity of the experts is emphasized. Thus, according to the statutes of the EFI, experts may not belong to government or a legislative body at national or federal level. Furthermore they may not be representatives of industry associations, labor unions or employer organizations.

According to the law of appointment the Expert Commission for Research and Innovation is responsible for:

1 Combining the interdisciplinary discourse with regard to innovation research of economic and social sciences, economics of education, engineering and natural sciences and the engineering perspective and
2 Providing scientific policy advice on:
   A Presentation and analysis of structures, trends, performances and perspectives of the German research and innovation system in a temporal and international comparison
   B Assessment of high priority questions of the German research and innovation system
   C Development of possible actions, and action recommendations, for the development of the German research and innovation system

The EFI is supported by a secretariat which was previously hosted by the Fraunhofer Institute for Innovation System Research (ISI) and located at the Technical University in Berlin. The secretariat is currently hosted by the 'Stifterverband für die deutsche Wissenschaft' – a "business community initiative advocating long-term improvement of the German education and research landscape" (website). The host organization only supports EFI in terms of administrative services and has no authority regarding the direction or contents of the Commission's work. The secretariat has a staff of 6 people. In addition, the EFI is annually allocated a budget of around 550 000 Euros by the Ministry of Education and Research for commissioning relevant analyses.

In the establishment of the EFI, the German government took great care to ensure, firstly, the objectivity and independence of the commission from political or other interference or lobbying and, secondly, the relevance of the advice provided. The former manifests itself in the decision

to locate the secretariat outside any ministry. Furthermore (and this is quite unique for innovation councils or similar bodies), the government created a process for ensuring the impact of the advice provided by the EFI. Thus, in the law governing the establishment of the EFI, the government commits itself to respond publicly to the proposals presented every year by the EFI in its annual report. Specifically, the EFI presents its annual report including policy recommenddations in February, and a few months later the government responds to the recommendations in a parliamentary discussion. Every two years, the Federal Government gives a written answer to the EFI report in the Federal Government Report on Research and Innovation (Bundesbericht Forschung und Innovation).

In order to ensure the policy relevance of its work, the EFI has established communication channels with the relevant ministries and also has regular meetings with the relevant officials in the ministries. The EFI also has regular dialogues with different stakeholder groupings in order to ensure its anchoring in reality.

German Council of Science and Humanities (Wissenschaftsrat)

The German Council of Science and Humanities has been a powerful forum and effective platform for dialogue between science and policy-making since 1957. The Council works with working groups and committees to analyze issues of relevance for higher education and research, and it makes recommendations which have had significant impact on policy-making.

The German Council of Science and Humanities (Wissenschaftsrat) provides advice to the German Federal Government and the State (Länder) Governments on the structure and development of higher education and research. It produces recommendations on the development of science, research and higher education, with the aim of ensuring that German science and humanities remain competitive at national, European and international level. The recommendations of the Wissenschaftsrat involve considerations concerning quantitative and financial effects and the implementation of such considerations, always taking into account the demands of societal, cultural and economic life.

The Wissenschaftsrat issues recommendations and prepares reports that are relevant, primarily to two fields of science policy:

- scientific institutions (universities, universities of applied sciences and non-university research institutions), especially their structure and performance, development and financing,
- general issues regarding the system of science and higher education, selected structural aspects of research and teaching, and the strategic planning, appraisal and governance of specific fields and disciplines.

The Wissenschaftsrat is an important instrument of cooperative federalism for the advancement of science in Germany. The scientists and high-level representatives in its ranks work with representatives of both the Federal Government and the *Länder* governments, maintaining a continuous dialogue between the scientific community and policymakers on central issues concerning the German science system. In this way the Wissenschaftsrat mediates not only

between scientists and policymakers, but also – in line with the federal structure of German politics – between the Federal Government and the Länder governments.

The Wissenschaftsrat is funded by the Federal Government and the governments of the 16 Länder. It consists of two commissions, the Scientific Commission and the Administrative Commission, which meet in the Plenary Assembly to take decisions concerning the adoption of recommendations and reports, in particular. Its members are academics and government representatives (from federal and state governments) at state secretary level.

Analysis and comments

When it comes to the existence of different mechanisms for strengthening innovation governance, Germany distinguishes itself from many of the other countries analyzed here in terms of the level of ambition. The high level of ambition is reflected in the amount of resources allocated for analysis, in the co-existence of numerous expert and high-level consultation, coordinating or advisory bodies for research and innovation policy, in the efforts to ensure the provision of independent and evidence- and research-based policy advice, but also in the government's commitment to actually listening to the advice produced.

In addition to their own resources (in terms of secretariats and budgets to commission analysis), the different commissions benefit from a well-established foresight unit in the Ministry of Education and Research. The co-existence of the Innovation Dialogue, the EFI and the Wissenschaftsrat – in addition to several other groupings – creates an ambitious but also complex system of consultation, coordination and advice. Significant analytical resources and the combination of independence from political influence (EFI), balanced with fora that include relevant stakeholders (Innovationsdialog and Wissenschaftsrat) seem to promote a critical, evidence-based but also constructive policy discourse. The German EFI differs from most other councils in that it only consists of academics and does not include high-level representatives from industry. According to the Chairman of EFI, great care is taken to ensure that members are 'grounded in reality' and have a documented ability to provide policy-relevant advice.

Netherlands: Advisory Council for Science, Technology and Innovation

The Dutch Advisory Council for Science, Technology and Innovation (AWTI) operates as a national policy think tank – providing advice to the government and parliament through a structured work method. The 10 advisory council members are supported by a Secretariat office with 11 full-time staff members.

The Advisory Council for Science, Technology and Innovation (AWTI) is one of the most long-lived advisory councils, having been in existence for more than 50 years, including its predecessors. The AWTI advises the Government and the Parliament on policies related to scientific research, technological developments and innovation. The official task of the council is to: '…advise the government and the States-General [the Dutch Parliament] on national and international policies with respect to science, technology and innovation, with special attention to the connection between science, technology and innovation and its impact on economy and

society'. The AWTI advises the government on longer-term research policy debates and issues. In contrast to some of the other advisory councils, the AWTI does not carry out systematic policy evaluations. Rather it seeks to provide advice on future policy direction.

Between 2003 and 2010, in addition to the AWTI, there was also a so-called "Innovation Platform" that was tasked with coordinating innovation and innovation policy in the Netherlands. With a network-style structure, and supported by a project office, experts and representatives from relevant sectors were involved in various project teams (see OECD 2009 for an analysis of its operation). The Innovation Platform was mainly an informal organisation. It had the formal status of a committee of the Cabinet, but the consultation was mainly informal. Yet, there was high-level political ownership. The Platform was chaired by the Prime Minister, and the ministers of Education and Economic Affairs were members. Parallel to the innovation platform, a committee of experts provided programme-level advice and decisions on large-scale investment programmes in the knowledge economy. Whereas the AWTI's primary task is to provide strategic policy advice, the primary task of the Innovation Platform was to advance policy implementation or to 'make things happen'. The Innovation Platform was strongly inspired by the Finnish council and experience.

The AWTI provides advice when it is applied for or when the council deems it necessary, although it is quite uncommon for the AWTI to provide unsolicited advice. In most cases the AWTI will advise on knowledge and innovation policies as requested by the Ministers of Education, Culture and Science (OCW) and Economic Affairs (EZ), but sometimes the other governmental departments will also turn to the AWTI for advice. It is also possible for the council to formulate advice as part of a request of the Second Chamber or the Senate, or even on its own initiative. In actual fact the council rarely receives a request for advice from the Parliament. However, it does discuss its advisory reports with parliamentarians who also use the AWTI's reports in their debates with the Cabinet. Examples of recent topics include: strategy for public investments in large-scale research facilities, creating value from societal challenges, the higher education system, status and development of the top sector policy – the current Dutch industrial policy approach – and support to regional hot spots of innovation.

Following an application for advice, the council will form an advice track. This is where the advice is outlined, as well as a decision made on the process: whether a background study should be done, whether anybody needs to be interviewed, the work conferences that need to be organised, the literature to be studied and/or the places that need to be visited. The AWTI relies heavily on the input and interaction with several parties involved in the area relating to the advice. In most cases, a project group is formed out of the members of the council that have a special involvement with the formulation of the advice. This group consists of about two to three council members that have a close affinity with the topic and two to three staff members who do most of the research and the writing. The group also works on the formulation and dissemination of the advice, for example by hosting workshops or conferences or communicating with the press.

Over the course of its preparation, which usually takes about a year, every advice is discussed at least four or five times in the plenary council. It starts out with a document on the interpretation

of the questions to be answered and the issues involved, and ends with several consecutive drafts of the advisory report.

At the end of the track the advice text is discussed in the council, usually on several occasions. The council has to agree with the core text before the advice is published. Generally, drafts are shared with civil servants at the ministries, with experts in the field and other interested parties. The advice becomes public the moment the chairman offers the advice to the respective minister(s). The publication is always accompanied by a press-release and sometimes a conference.

The AWTI publishes its advices in differing documents: reports, advisory letters and background studies. Furthermore, it also publishes a weekly AWTI e-mail alert, annual reports and an evaluation report (once every four years). All advice is made publicly available. The Minister in question – usually the Minister of Education, Culture and Science or the Minister of Economic Affairs has to respond to advice provided by the AWTI in Parliament.

The advisory council consists of a maximum of 10 members, each originating from different sectors of society, such as research institutes and trade and industry. The members do not represent any special interests but have been selected on the basis of their expertise. Currently, a majority of the 10 members are from academia, with areas of specialization ranging from natural sciences, engineering and technical fields, to economics and political science. Seven members are men, and three are women – all from the Netherlands.

The council is supported by a Secretariat office. The office consists of seven scientific staff members and four supporting staff members. The office prepares the advices of the Council and provides the Council with general aid with its related duties. The AWTI has a budget for commissioning background studies. However, its advisory reports are generally written by the secretariat with continuous input from the Council members.

Analysis and comments

An important feature of the AWTI's advisory function is that it can provide recommendations on issues that it feels are important without having to wait to be asked to do so by Ministers. Thus the AWTI can put on the table questions it considers important and these are then addressed in Parliament. In practice, however, the council rarely gives unsolicited advice since unsolicited advice is seldom welcome and is often considered to be 'inconvenient' advice. Rather, the council makes great efforts to interact with ministries and relevant actors in reaching a consensus on the needs and topics for policy advice.

The AWTI attaches great importance to ensuring transparency in its processes, from formulating work plans and identifying areas for policy advice to circulating drafts of advisory reports and disseminating final documents. Transparency is seen as an important tool for anchoring advice and ensuring its chances of having an impact.

Similar to the Austrian Council, the current Chair of the AWTI is a senior political figure, in this case a former minister of foreign affairs. In general, however, the council has not been

associated with particular political preferences, and tries to stay far away from the political debate.

Reporting to two ministries as is the case for the AWTI can sometimes create tensions, particularly when the ministers belong to different parties – in the case of coalition governments.

Switzerland: Science and Innovation Council

The Swiss Science and Innovation Council (SSIC) is the advisory body to the Federal Council for issues related to science, higher education, research and innovation policy. The goal of the SSIC, in conformity with its role as an independent consultative body, is to promote the framework for the successful development of the Swiss higher education, research and innovation system.

As an independent advisory body to the Federal Council, the SSIC pursues the Swiss higher education, research and innovation landscape from a long-term perspective. One of the key tasks of the SSIC is to evaluate governmental programs for the promotion of research and innovation and to provide opinions on research and innovation policy initiatives. Thus, SSIC has been tasked by the government to evaluate aspects of the Swiss National Science Foundation. It has also been requested to provide input on the development of biomedical research and various aspects of the higher education system.[19]

The SSIC has 15 members, mostly from academia, several of whom have an international background (either foreigners or people with significant experience working abroad). Only 2 members seem to have relevant business experience. The SSIC has previously been criticized for what has been seen as an overly academic composition (OECD 2009). The members of SSIC are appointed by the Swiss government. An interesting feature of the SSIC is that, compared to most other councils analyzed here, it is not as dominated by academics from the natural or engineering sciences. Almost half of its members are from the social sciences or humanities.

The SSIC meets five times a year and creates working groups to address specific topics. In its work program for 2012-2015, the SSIC identified the following areas for discussion: research and research promotion; innovation policy; higher education; legislation for science and innovation policy. The SSIC has a secretariat of 11 people.

Overall, the SSIC combines ‘reactive’ policy advice – i.e. providing input on concrete areas as requested by government – with studies and input of its own initiative. In recent years, it has commissioned analyses and published position papers on performance measurement and quality assurance in research, on broadening the notion of innovation, on talent management for an innovative Switzerland, to mention just a few.

[19] http://www.swir.ch/images/stories/pdf/de/arbeitsprogramm_2012_2015.pdf

UK: Council for Science and Technology

The British Council for Science and Technology (CST) is a non-departmental public body that advises the Prime Minister on strategic science and technology policy issues through regular meetings (four times a year). Additional advisory services are provided through sub-groups.

The Council's remit is to advise the Prime Minister on strategic science and technology policy issues that cut across the responsibilities of individual government departments, taking a medium to longer-term approach.

The CST reports directly to the Prime Minister. Its terms of reference are to advise the Prime Minister on the strategic policies and framework for:

- sustaining and developing science, engineering, technology and mathematics (STEM) in the UK, and promoting international co-operation in STEM
- fostering the practice and perception of science, engineering and technology as an integral part of the culture of the UK
- promoting excellence in STEM education
- making more effective use of research and scientific advice in the development and delivery of policy and public services across government
- promoting STEM-based innovation in business and the public services to promote the sustainable development of the UK economy, the health and quality of life of UK citizens, and global sustainable development

The CST is an advisory non-departmental public body, sponsored by the Department for Business, Innovation & Skills (BIS), and supported by a secretariat based in the Government Office for Science in BIS. The CST meets four times a year, in March, June, September and December. Its work programme is developed by its members in discussion with the government. From 2014 to 2015, the CST's priorities are: energy, STEM education in schools, and the UK science landscape. The Council publishes its analysis and recommendations on specific issues related to these topics (e.g. economic and social costs of electricity shortfalls), as well as other reports on science and technology policy (e.g. funding for scientific research and innovation, genetic modification technologies). In addition, the CST publishes annual reports on the activities and achievements of the Government Office of Science, and triennial reviews of the CST.

The government can ask CST to consider particular issues, but the council is under no obligation to agree to these requests if it believes that other work would be of greater value. The council decides the approach to each area of work on a case-by-case basis. It can also provide advice to government as it thinks best, for example through meetings, letters or published reports. Parallel to the CST, several parliamentary committees in the areas of science, technology and innovation provide analytical input and influence Governmental policymaking decisions. The House of Commons Science and Technology Committee provides evidence to policymaking decisions, while the House of Lords Science and Technology Committee has a broader remit to "consider science and technology". The latter committee scrutinizes Government policy by undertaking cross-departmental inquiries. The House of Commons

Business Innovation and Skills Committee is appointed by the House of Commons to examine the administration, expenditure and policy of the Department for Business, Innovation and Skills (BIS) and its associated public bodies. Each of these committees is comprised of members of Parliament.

Council members are senior figures from the fields of science, engineering and technology. They are appointed by the Prime Minister, in line with guidance from the Office of the Commissioner for Public Appointments. CST invites non-members to join sub-groups and advise on specific pieces of work.

The council is co-chaired by the Government Chief Scientific Adviser and an independent chair. The council has 18 additional independent members. The current council has 11 members from academia, five from companies, two from the financial sector, and one each from a national research council and the government. 14 members are men, and six are women – with one international member (from the US). Members are appointed for a period of 2½ years. Appointments are not remunerated, but members are reimbursed for travel and subsistence costs while on CST business.

Canada: Science, Technology & Innovation Council

The Canadian Science, Technology and Innovation Council provides independent policy advice to the government through biennial benchmarking reports and responses to specific questions. The Canadian council is comprised of a majority of members from the private sector.

The Science, Technology and Innovation Council (STIC) is an important element of the Government of Canada's 2007 Science and Technology (S&T) Strategy: Mobilizing Science and Technology to Canada's Advantage. The 2007 S&T Strategy recognized the importance of effective, independent and integrated advice on science, technology and innovation (STI) issues to help inform government decision-making. To meet this need, STIC was established in October 2007 to provide external advice to the federal government. STIC replaced a number of existing S&T advisory bodies, including the National Science Advisory, the Biotech Advisory Committee and the IT Advisory Committee to consolidate this advisory function into one council.

STIC has a dual mandate. Firstly, it provides the government with confidential and evidence-based advice on science, technology and innovation policy issues. Secondly, it produces a biennial ‘State of the Nation’ report on science, technology and innovation in Canada.

The Council consists of a Chair and up to 17 other members. The Chair is appointed by the Prime Minister and Cabinet; the other 17 people are appointed by the Minister of Industry in consultation with the Minister of S&T. STIC members serve for three-year, renewable terms. As of February 2015, STIC is chaired by a university professor and is comprised of 5 representatives from academia, including 4 current or former University Presidents, 8 high-level representatives from industry, one CEO of an innovation center and 2 deputy ministers (one from the Ministry of Health and the other from the Ministry of Industry – see STIC homepage). Of the 15 Council members, six are men, and ten are women – all from Canada.

The deputy ministers who are members of STIC don't serve in any working group and don't take part in any of the advice functions. According to the chair of STIC, they serve as a resource to the Council in the sense that their role is to educate the council as to how government operates and to facilitate implementation of advice once it is accepted.

STIC is supported by a Secretariat staffed by federal public servants of Industry Canada. The Secretariat provides analytical, advisory, and administrative services to the Council.

Regarding its advisory function, the advice provided by STIC is always 'reactive' in the sense that it responds to a specific request by the Prime Minister or a member of his Cabinet. Thus, STIC does not provide 'unsolicited' advice, i.e. take the initiative to proffer recommendations on topics of its own choosing. According to the Chairman of STIC, the principle of providing relevant advice and only in response to a request by Government, and thus of being at the service of the Prime Minister and Cabinet, differentiates STIC from previous advisory bodies and explains its success and staying power. Thus, "while they [previous advisory bodies] started with good intentions and got off to a satisfactory beginning, eventually they drifted into advocacy and when that happens, PM and Cabinet members tune out".[20] A further important feature of the advice provided by STIC to the government is that it is confidential.

When STIC receives a formal request for input by letter, the Chairman of STIC puts together a Sub-Committee or Working Group on the issue in question. The Working Group or Sub-Committee is composed of STIC members and only on rare occasions has there been a need to bring in external experts to ensure competency on a topic. The Working Group is assisted by research staff who prepare background information on the issue to be examined. The working group prepares a draft advice letter and brings it to STIC; STIC provides comments and the advice letter is revised accordingly. Then it gets sent in to whoever asked for the advice. The timespan for this entire process is usually 3-4 months.

Examples of topics on which STIC has been requested to provide advice include procurement, clinical research strategy, talent initiatives, among others – indicating the wide range of areas STIC is expected to cover and the broad approach to science, technology and innovation policy taken by the government. A further example of the advisory function of STIC is when it was asked to provide input in the preparation of Canada's strategy for science, technology and innovation "Seizing Canada's moment: Moving forward in science, technology and innovation 2014".[21] This input was acknowledged in the strategy which stated: "With advice from the Science, Technology and Innovation Council, we have identified areas of particular focus within each of the five research priorities that are of strategic importance to Canada".[22]

The second principal task of STIC is to produce a biennial 'State of the Nation' report where it assesses Canada's science, technology and innovation system and performance in an international context by comparing it to relevant other countries. In particular, it identifies

[20] Telephone interview with Howard Alper February 12, 2015
[21] https://www.ic.gc.ca/eic/site/icgc.nsf/vwapj/Seizing_Moment_ST_I-Report-2014-eng.pdf/$file/Seizing_Moment_ST_I-Report-2014-eng.pdf
[22] ibid, p.20

relative strengths and weaknesses in science, technology and innovation. According to the STIC website, the reports "provide a common evidence base for decision-making by government, industry, and academia, and serve as a vehicle to engage the various partners of Canada's STI ecosystem". The report is an ambitious undertaking with 7-8 people working full time on its compilation. A lot of effort goes into communicating and disseminating the report to a broad audience. Thus, in addition to launching the press conference, STIC partners with boards of trade or chambers of commerce to present the report in different provinces and municipalities around Canada. The purpose of the report is to raise awareness and understanding of the role of science, technology and innovation and to provide a baseline or evidence base for meaningful and inclusive discussion among a broad spectrum of the Canadian population. The Chairman of STIC explains the differences between the two functions fulfilled by STIC: "The advice is for the leadership; the state of the Nation report is for the nation". An additional function of the reports, according to the Government, is to increase transparency and accountability of the use of public funds.[23]

Analysis and comments

Since its creation in 2007, STIC has established itself as a credible and influential advisory body in science, technology and innovation policy. A key factor to its success appears to have been the combination of providing confidential, demand-driven advice and producing a highly visible and publicized biennial report on the state of science, technology and innovation. STIC seems to have met a demand in the government, and not least the Prime Minister's Office, firstly, for expert input on key issues affecting science, technology and innovation and, secondly, for transparency and accountability by reporting on "the results of Canada's science, technology and innovation performance" (p.16). Furthermore, the State of the Nation reports have contributed to stimulating a stakeholder-inclusive discussion on science, technology and innovation policy. Critical to STIC's success is therefore also the willingness and receptiveness by the government to procure and listen to independent, expert advice, to allow the monitoring and measuring of Canada's innovation performance, and thus, indirectly, the performance of the government in promoting science, technology and innovation, and, not least, to engage in a public debate on innovation policy. The government's willingness to invite independent expert input to innovation policy is also reflected in the creation of an expert group in 2010 which was asked to carry out an "independent, external Review of Federal Support to Research and Development", called the 'Jenkins Panel'. The group was also asked to "provide advice on how to improve Canada's support to business innovation".[24]

Overall, the role of STIC, but also the government's view on innovation policy are summarized well in the national strategy for science, technology and innovation released in 2014:

> *Strong governance and reporting practices help deliver and demonstrate results. Requiring accountability and transparency in the use of public funds puts the responsibility on those who are supported by tax dollars to show how these investments make a measurable*

[23] https://www.ic.gc.ca/eic/site/icgc.nsf/vwapj/Seizing_Moment_ST_I-Report-2014-eng.pdf/$file/Seizing_Moment_ST_I-Report-2014-eng.pdf p.16
[24] https://www.ic.gc.ca/eic/site/icgc.nsf/vwapj/Seizing_Moment_ST_I-Report-2014-eng.pdf/$file/Seizing_Moment_ST_I-Report-2014-eng.pdf p.58

difference in people's lives. With public resources, it is important for people and organizations funded with taxpayer dollars to demonstrate a net benefit for Canadians. A focus on demand-driven research for innovation will further encourage the use of public investments to create and sustain jobs and growth.

This was recognized in the 2007 Strategy in part through the creation of the Science, Technology and Innovation Council. As an external advisory body, the Council reports on the results of Canada's science, technology and innovation performance. Over the past five years, the Council has increased transparency and accountability through three State of the Nation reports on Canada's system. The reports have also enabled the federal government to measure and monitor Canada's innovation performance over time. [25]

US: President's Council of Advisors on Science & Technology

The President's Council of Advisors on Science & Technology (PCAST) consists of high-profile members from academia and industry that provide policy recommendations on a wide range of issues including education, research, innovation, the future of manufacturing, etc.

Beginning in 1933 with President Franklin D. Roosevelt's Science Advisory Board, each President has established an advisory committee of scientists, engineers, and health professionals. Although the name of the advisory boards has varied over the years, the purpose of each remains the same—to provide scientific and technical advice to the President of the United States.

PCAST is an advisory group of the nation's leading scientists and engineers who directly advise the President and the Executive Office of the President. It is based at and supported by the Office of Science and Technology Policy (OSTP). PCAST makes policy recommendations in areas where understanding of science, technology, and innovation is key to strengthening the economy and forming policy. Some of the recent topics addressed include: advanced manufacturing, nanotechnology, education technology, big data and security, and systems engineering in healthcare. All meetings are open to observers from the general public (through advanced registration) and are presented through video webcasts. In addition, each meeting includes a public comment session (either submitted in advance in writing, or presented orally). PCAST publishes summary reports on many of the topics.

Council members are appointed by the President – drawn from industry, education, research institutions, and other NGOs. The council is administered by an Executive Director. PCAST has 18 members, approximately half of which are from industry. This industry-focused composition helps the council formulate more realistic and operational/pragmatic advice. PCAST is jointly chaired by Professor John P. Holdren, Assistant to the President for Science and Technology and Director of the Office of Science and Technology Policy (OSTP) in the Executive Office of

[25] https://www.ic.gc.ca/eic/site/icgc.nsf/vwapj/Seizing_Moment_ST_I-Report-2014-eng.pdf/$file/Seizing_Moment_ST_I-Report-2014-eng.pdf p.16

the President, and Eric Lander, the President and Director of the Broad Institute of MIT and Harvard. Assistant Directors of the OSTP tend to attend PCAST meetings.

PCAST is supported by a staff of 3 people, who provide stewardship of the Council, organize its bimonthly meetings, work with its program of analyses that culminate in policy recommendations to the President and the Administration, and lead efforts to promote the implementation of PCAST recommendations. In practice the OSTP also receives considerable support from OSTP staff.

PCAST provides key input to setting the innovation policy agenda, and its recommendations are passed on to relevant agencies responsible for implementation. Yet with a very large and diffuse innovation system (with several other players providing strategic policy advice), the PCAST's reach and impact may be limited.

While PCAST is first and foremost an advisory body, the National Science and Technology Council (NSTC) has the primary responsibility for the operational coordination of the government's science and technology policy. This includes the responsibility for setting clear national goals for federal science and technology investments, and for preparing research and development strategies that are coordinated across federal implementing agencies to form investment packages aimed at accomplishing multiple national goals. Thus, "[t]his Cabinet-level Council (the NSTC) is the principal means within the executive branch to coordinate science and technology policy across the diverse entities that make up the Federal research and development enterprise".[26]

Analysis and comments

The broad composition of members and topics addressed allows PCAST to foster coordination across a broad range of policy areas. In addition, PCAST's recommendations and policy advice have high visibility – feeding directly into the executive branch. (PCAST meets periodically with the President – differentiating it from other bodies that provide S&T policy advice.) However, PCAST is one of many different councils or bodies advising and influencing policy formulation and implementation in the US. The National Academies are one example of a body that advises or influences policy-making. The National Academies act under congressional charter (for the parent National Academy of Sciences) but are outside the government to preserve independence. Their advice can be narrow and targeted to an agency, or they can sponsor a study (or broader report) that speaks more to the nation at large and the Federal Government overall. This type of advice was exemplified in the report *Rising Above the Gathering Storm* (National Academies 2007), which was described as "an agenda for American science and technology" and received a lot of public attention. Furthermore, coordination across the numerous different departments, government branches, states and stakeholder groups is still a significant challenge.

A very interesting (and unique) feature of PCAST is its very open and transparent way of working – encouraging comments from the public, allowing observers to participate in

[26] https://www.whitehouse.gov/administration/eop/ostp/nstc

meetings, and communicating to the general public through webcasts of its regular meetings as well as through various documents and reports.

Rather than being a definitive advisory body, PCAST might more accurately be described as a 'platform' or 'sounding board' for the US President to interact with relevant stakeholders.

China: Leading Group for Science, Technology & Education

The Leading Group for Science, Technology and Education (LGSTE) is primarily a body for coordinating and setting priorities in science, technology and education policy across different ministries and policy domains.

The Chinese government has a tradition of working with so-called 'Leading Groups' on designated topics to set priorities and coordinate policies. These groups usually consist primarily of ministers. The most relevant leading group for innovation policy has been the 'Leading Group for Science, Technology and Education (LGSTE). The group has been chaired by the Prime Minister or the State Councilor (a rank below the Vice Prime Minister but above most ministers) and comprises ministries relevant for S&T policy, including the minister of finance, as well the Presidents of the Academies of Science and Engineering, the Director of SASTIND (State Administration for Science, Technology, and Industry for National Defense), and the President of the National Natural Science Foundation of China (NSFC). The Group was originally established in the 1980s as 'Leading Group on Science and Technology' (OECD 2008, Cao *et al.* 2013 and Springut *et al.* 2011), with education being added to its mandate in the 1990s. According to Cao *et al.* 2013, "The LGSTE studies and reviews major S&T and education policies and programs, and coordinates important inter-governmental activities". Several experts we interviewed indicated that the LGSTE plays a significant role in deciding on the overall budget for science and technology funding.

In 2014, to follow through with its announcement of a significant reform in the science and technology governance system, the Government created the "Leading Group for Science and Technology Reform and Innovation System Development". Cao *et al.* (2013) provide a rather critical assessment of the LGSTE:

> *"The LGSTE has not fully functioned in macro-level coordination between agencies and central and local governments. Although the LGSTE is chaired by the premier, the issues on science, innovation, and education are probably less important than others in his portfolio. Real leadership is normally held by a vice premier or state councilor, who may also have other priorities and whose power depends on position in the party and state administrative apparatus. The LGSTE is operated within a secretariat bureau under the general office of the State Council, which has many other responsibilities and priorities, with neither sufficient manpower nor incentive to coordinate. Ad hoc in nature, the LGSTE is not involved in the budgeting process. It has never issued an official document in its own name and has failed to take actions on interruptions of the S&T system. For example, when severe acute respiratory syndrome (SARS) struck China in early 2003, lack of coordination made it*

> *difficult for researchers under different jurisdictions—civilian and military; central and local; and health, science, and technology—to respond in a timely and effective fashion". (p.460)*

They conclude that "[t]he current LGSTE mechanism has failed in coordinating efforts at various government agencies" (Cao *et al.* 2013, p.461).

In addition to the LGSTE, the Chinese government has a tradition of consulting independent experts, usually from universities or the Academies of Science or Engineering, on policy matters (see for example Schwaag Serger *et al.* 2015). Furthermore, the Chinese Academy of Engineering has repeatedly functioned as an advisory body to the Government on research and innovation policy, both on its own initiative and at the Government's request. In general, however, providing expert advice is usually a rather informal process dependent on personal relations and interactions. Overall, there are few formalized channels or mechanisms for providing relevant policy advice.

Japan: Council for Science, Technology and Innovation (CSTI)

The Council for Science, Technology and Innovation (CSTI) is perhaps one of the most powerful councils (in the international comparison), serving as an important forum for policy formulation, coordination and resource allocation

The CSTI has the following tasks:

1 it investigates and discusses basic policies concerning S&T,
2 it investigates and discusses S&T budgets and the allocation of human resources,
3 it assesses Japan's key research and development.

> *"Under the leadership of the Prime Minister and the Minister of State for S&T Policy, the Council serves as the headquarters for the promotion of S&T policy; it overlooks all of the nation's S&T, formulates comprehensive and basic policies, and conducts their overall coordination."*
> http://www8.cao.go.jp/CSTI/english/panhu/introduction.pdf

The Council for Science, Technology and Innovation (CSTI) is chaired by the Prime Minister and convenes once a month. The CSTI has strengthened its position recently, so far mainly manifested in the rhetoric. The council also oversees the implementation of the Science & Technology Basic Plan, recently launched a comprehensive strategy for Science, Technology & Innovation, and makes budget proposals after input from the ministries. CSTI should thus exercise considerable control over science, technology and innovation, including making more efficient use of the S&T budget.

Members:

- Ministers of S&T Policy, Economy, Finance, Education, Internal Affairs and Communication and Chief Cabinet Secretary;

- 3 members from industry, 3 academics, President of Science Council, “Those who have excellent knowledge of S&T are appointed from academia and industry with the approval of the Diet” http://www8.cao.go.jp/CSTI/english/panhu/introduction.pdf

Key activities /responsibilities:

- supervises production of S&T Basic Plan (produced every 5 years)
- produces “Policies for the Allocation of Resources including the S&T Budget” (annually) and the “Action Plan for the Implementation of Important S&T Policy Measures” (annually)
- has responsibility for evaluation of strategic government-funded R&D

The CSTI works, among other things, with expert panels on Basic Policy, Promotion Strategy for Prioritized Areas, Evaluation, Bioethics, Management of Intellectual Properties.

The CSTI secretariat has a staff of around 100 people (http://www8.cao.go.jp/CSTI/english/panhu/p2_roles_of_theCSTI.pdf).

Japan's highest science advisory panel plans to be more active in implementing the current administration's policies and in directly funding research. The new activism is intended to help it foster innovation, a central pillar of the new economic growth strategy of Prime Minister Shinzo Abe.

> *"We have been weak in providing strategy advice in the last 2 or 3 years," said Yuko Harayama, an executive—or full-time—member of Japan's Council for Science, Technology Innovation. Speaking at a press briefing today, Harayama said the policy council "just waited for related ministries to form a budget and submit it" for review. "It was a passive way to coordinate."*

Chaired by the Prime Minister, the council also hopes to break new ground by directly funding its own cross-ministry programs. Harayama said that the new approach will be reflected in next year's budget that will be unveiled at the end of August.

Academic scientists are worried that the push for an economic payoff from research expenditures will stifle curiosity-driven research. Harayama said the council would not be giving top-down orders but rather working with the ministries and other actors in the science and technology sphere.

Harayama, who was previously deputy director of the Organization for Economic Cooperation and Development's Directorate for Science, Technology and Industry in Paris, said the panel is thinking about a new type of scientific administrator within the government who would have broad authority to manage the pursuit of specified research objectives. She cited the U.S. Defense Advanced Research Projects Agency as a model, where projects can be started and stopped with a minimal amount of red tape. Currently, she says, there is little follow-up or leadership by government managers once a project's budget is fixed.

She also pointed out that she is the first woman to be one of the two full-time members of the council responsible for the bulk of its day-to-day work. (The council includes Cabinet members,

experts from the scientific community nominated by the prime minister and approved by the legislature, and the president of the Science Council of Japan, the nation's largest academic society.) She thinks having more women in decision-making positions will generate "new thinking," and she promised "to promote women in the science and technology field by putting pressure on universities." She said that she hoped the industrial sector would follow suit." http://news.sciencemag.org/2013/07/japans-science-policy-council-expands-role

In 2013, the Council released the first draft of a Comprehensive Science, Technology and Innovation Strategy, calling for fundamental changes. Among other things, the draft proposed giving the Council a sizeable annual budget to fund science. If implemented this would mark a significant change in the character of the council which so far has only been an advisory body. http://www.nature.com/news/japan-aims-high-for-growth-1.13082

Korea: National Science & Technology Council

Similar to Japan's Council for Science, Technology and Innovation (CSTI), the Korean Science and Technology Council has a far-reaching mandate to formulate and coordinate science and technology policy, and it has significant control over the government's R&D budget. It is considered the "highest consideration and decision commission" in the field of science and technology policy.

The National Science and Technology Council (NSTC) has played a role in Korean Science and Technology policy since 1973. The Council's mandate (established by law) is to adjust policies for human resources and regional technological innovation, adjust research and development plans and projects, and deliberate on the operation, etc. of the research and development budget and other matters related to the major policies and innovation of science, technology and industrialization. The Council's leadership, composition and specific tasks evolve over time – driven by changes in governmental leadership and the broader institutional landscape.

The Council was reformed in 2013 to become the highest consideration and decision commission in the field of science and technology policy. Its mandate is to contribute to economic revival and national growth welfare, to promote a creative economy and to create new industries and qualitative jobs through empowerment of creative science technology innovation and advancement of the investment system. Since this reform, the Council is co-chaired by the Prime Minister[27] and a high-level representative of the private sector[28], and has the role of "establishing the vision for national S&T development" to achieve a creative economy.

The Council has the role of deliberating on far-ranging issues such as coordination of labor policy and local technology innovation policy related to innovation and major policies of science, technology and industrialization; and coordination of R&D policies, programmes and budgets among ministries. Administrative tasks of the Council (R&D planning, budget

[27] Previous Councils have been chaired by the President, or a presidential appointee.
[28] In this context, the term "private sector" or "businesses" generally refers to individuals working within academia or research institutions, rather than companies.

allocations and adjustments, and evaluation of R&D projects) were transferred to the Ministry of Science, ICT, and Future Planning (MSIP).

The NTSC is comprised of 13 members from government and 10 private delegates. The Council is co-chaired by the Prime Minister and a high-level representative of the private sector. The current private sector co-chair is Jang-moo Lee, who is on the boards of the Climate Change Center and the Korean Advanced Institute for Science and Technology, and former president of Seoul National University (and former professor at the Department of Mechanical and Aerospace Engineering).

The organization of the National Science & Technology Council is comprised of a plenary session, a steering committee, 8 expert committees, 4 special committees (at present), and 2 consultation committees. The *plenary session* deliberates issues related to the establishment and coordination of major policies for science technology and the efficient operation of the national R&D business budget. The plenary session meets 3-4 times per year, and addresses a number of agendas (or topics) at each meeting. The agendas addressed at plenary sessions can range from deliberation and decisions on long-term strategic plans, to advice on new policy mechanisms, to discussion on new administrative practices. Examples of these agendas (from the December 2014 session) include: support schemes for scientists, the 3rd Energy Technology Development Plan (for 2014-2023), management of patents from government R&D, 1st comprehensive plan for improving carbon reduction, regulation improvement for implementing 'Creative Economy', core equipment development strategy for Industry Engine project, 3-year practice plan of S&T for disaster response, and revision of the detailed rules of operation for the NSTC.

The *steering committee* has the role of providing practical counsel for issues related to science technology policy, and conducting a pre-examination on the issues for deliberation and decision by the plenary session. (In this way, the steering committee acts as the secretariat of the council.) The chair of the steering committee is the Vice Minister of Science, ICT and Future Planning. Public sector members are government officers from 19 different government departments including the Ministry of Science, ICT and Future Planning (MSIP); the Ministry of Trade, Industry and Energy (MOTIE); the Ministry of Strategy and Finance; the Ministry of Education; the Ministry of Defense; and the Korean Intellectual Property Office. Private sector members are professors and researchers from universities and R&D institutions (such as Seoul National University, Chung Ang University, Korean Institute of Science and Technology, and Gwangju Institute of Science and Technology). The steering committee holds bi-monthly meetings (6 times a year).

The seven *expert committees* have the role of pre-examination of the issues/agendas for the steering committee, including: reviewing and coordinating the R&D budget in each field, advising on the investment direction for major R&D businesses, connecting and coordinating between businesses, distributing and coordinating R&D budgets, etc.. There are expert committees on the following topics: Life Science and Welfare, Key Infrastructure Technology, Advanced Convergence Technology, Energy and Environment, Big Science and Public R&D Coordination, Evaluation, and Policy Coordination.

Special committees (currently four[29]) are constructed to temporarily and intensively discuss special issues that are currently under deliberation. *Consultation committees* perform consultations on the policy fields of Basic Research Promotion, and Regional Science and Technology Promotion. Tasks include conducting analysis, developing master plans and policy recommendations.

Analysis and comments

The NSTC is not only ONE council, but rather a broader organizational structure that has the responsibility for analysis, policy development/formulation, strategy and priority setting, and overall coordination of all policy areas related to science and technology policy. The entire structure encompasses more than 300 high-level representatives from government and academia, as well as individuals from the corporate sector. The NSTC is not an independent organization, but is rather part of the Ministry of Science, ICT and Planning (MSIP). The budget for the Council is covered by the MSIP.

Although the overall role of the Council as the body responsible for advising, coordinating and deciding/planning science and technology policy in Korea has remained the same since its inception, the specific mandate, organizational anchoring and composition of the council has changed over time. The current NSTC does not have responsibility for budgetary allocations (rather this was transferred to the Ministry of Science, ICT and Planning), is co-chaired by the Prime Minister and a high-level representative from the private sector (rather than the President), and has expanded representation from high-level private sector experts (as members of the plenary session and in expert committees).

With representation from a very broad range of policy areas, the NSTC seems well-equipped to address the demands for horizontal coordination and systemic change. On the other hand, the agenda issues addressed by the NSTC – as well as the composition of the core group and its various committees – seems very tied to central governmental priorities. This may limit the ability of the Council to address certain issues, or incorporate sub-national/international perspectives and expertise in their deliberation and policy formulation.

The elaborate structure and working methods demonstrate a well-resourced and prioritized role of the Council – and of science and technology policy more generally. At the same time, it is not clear how the structure – particularly with the current division of responsibilities between the NSTC and MSIP – addresses the demands for dynamism and "agile policy development".

[29] The current topics of the four special committees are: Civil-Military Technology, Multi-Department Technology, Innovation in Engineering College, and Future Growth Engine

Appendix II: List of Interviews

Howard Alper, Chairman of the Science, Technology and Innovation Council (STIC), Distinguished University Professor at the University of Ottawa (telephone interview 12 February 2015)

Arthur Bienenstock, Professor Emeritus of Photon Science, Stanford University, Former Assistant Director for Science, Office of Science and Technology Policy (OSTP) (14 April 2015)

Paul Diederen, Adjunct Director, Dutch Advisory Council for Science, Technology and Innovation (AWTI), (telephone interview 24 September 2015 and email exchange 25 September 2015)

Ludovit Garzik, Head of Secretariat, Austrian Council for Research and Technological Development (9 March 2015)

Dietmar Harhoff, Professor, Managing Director Innovation and Entrepreneurship Research, Max Planck Institute for Innovation and Competition
Honorary Professor at the University of Munich, Chairman Expert Commission for Research and Innovation (telephone interview 2 February 2015)

Karin Kjær Madsen**,** Senior Advisor at Ministry of Higher Education and Science; Head of the Secretariat for the Danish Research and Innovation Policy Council (telephone interview 28 January 2015)

Torben Orla Nielsen, Innovation & Research Counsellor, Danish Innovation Centre in Seoul, Korea (email exchange 13 February 2015)

Antti Pelkonen, Senior Scientist, VTT Technical Research Centre of Finland, Innovations, Economy and Policy; Author of "Evaluation of the Research and Innovation Council of Finland" (telephone interview 22 January 2015)

Luc Soete, Professor, Rector Magnificus and Professor International Economic Relations, Maastricht University, Member Advisory Council for Science, Technology and Innovation (AWT), Netherlands, Chair, High Level Group Research, Innovation, Science Expertise (RISE), European Commission (telephone interview 12 June 2015)

Charles Wessner, Professor of Global Innovation Policy, Georgetown University (telephone interview 22 January 2015)

VINNOVA´s publications

November 2015

See VINNOVA.se for more information

VINNOVA Analysis

VA 2015:

01 Årsbok 2014 - *Svenskt deltagande i europeiska program för forskning & innovation*

02 Samverkansuppgiften i ett historiskt och institutionellt perspektiv

03 Långsiktig utveckling av svenska lärosätens samverkan med det omgivande samhället - *Effekter av forsknings- och innovationsfinansiärers insatser*

04 Företag i Tåg- och järnvägsbranschen i Sverige - *2007-2013*

05 FoU-program för Små och Medelstora Företag - *Metodologiskt ramverk för effektanalyser*

06 Small and beautiful - *The ICT success of Finland & Sweden*

07 National Research and Innovation Councils as an Instrument of Innovation Governance - *Characteristics and challenges*

VA 2014:

01 Resultat från 18 VINN Excellence Center redovisade 2012 - *Sammanställning av enkätresultaten. (For English version see VA 2014:02)*

02 Results from 18 VINN Excellence Centres reported in 2012 - *Compilation of the survey results. (For Swedish version see VA 2014:01)*

03 Global trends with local effects - *The Swedish Life Science Industry 1998-2012*

04 Årsbok 2013 - *Svenskt deltagande i europeiska program för forskning och innovation.*

05 Innovations and new technology - *what is the role of research? Implications for public policy. (For Swedish version see VA 2013:13)*

06 Hälsoekonomisk effektanalys - *av forskning inom programmet Innovationer för framtidens hälsa.*

07 Sino-Swedish Eco-Innovation Collaboration - *Towards a new pathway for shared green growth opportunity.*

08 Företag inom svensk massa- och pappersindustri - *2007-2012*

09 Universitets och högskolors samverkansmönster och dess effekter

VA 2013:

01 Chemical Industry Companies in Sweden

02 Metallindustrin i Sverige 2007 - 2011

03 Eco-innovative Measures in large Swedish Companies - *An inventory based on company reports*

04 Gamla möjligheter - *Tillväxten på den globala marknaden för hälso- och sjukvård till äldre*

05 Rörliga och kopplade - *Mobila produktionssystem integreras*

06 Företag inom miljötekniksektorn 2007-2011

07 Företag inom informations- och kommunikationsteknik i Sverige 2007 - 2011

08 Snabbare Cash - *Effektiv kontanthantering är en tillväxtmarknad*

09 Den svenska maritima näringen - *2007 - 2011*

10 Long Term Industrial Impacts of the Swedish Competence Centres

11 Summary - Long Term Industrial Impacts of the Swedish Competence Centres. *Brief version of VA 2013:10*

12 Företag inom svensk gruv- och mineralindustri 2007-2011

13 Innovationer och ny teknik - *Vilken roll spelar forskningen. (For English version see VA 2014:05)*

14 Företag i energibranschen i Sverige - *2007-2011*

15 Sveriges deltagande i sjunde ramprogrammet för forskning och teknisk utveckling (FP7) - *Lägesrapport 2007-2012*

16 FP7 and Horizon 2020

VINNOVA Information

VI 2015:

01 Insatser för innovationer inomHälsa

02 FFI Årsrapport 2014 - *Samverkan för stark svensk fordonsindustri och miljöanpassade samt säkra transporter*

03 Social innovation - Exempel

04 Social innovation

05 Årsredovisning 2014

07 Innovation för ett attraktivare Sverige - *Underlag till regeringens politik för forskning, innovation och högre utbildning 2017-2027 - Huvudrapport*

VI 2014:

01 Tjänsteinnovationer 2007

02 Innovationer som gör skillnad - *en tidning om innovationer inom offentliga verksamheter*

03 Årsredovisning 2013

04 VINNVÄXT - *A programme renewing and mowing Sweden ahead*

05 *Replaced by VI 2015:01*

06 Din kontakt i EU:s forsknings- och innovationsprogram

07 VINNOVA - *Sveriges innovationsmyndighet. (For English version see VI 2014:10)*

08 Visualisering - *inom akademi, näringsliv och offentlig sektor*

09 Projektkatalog Visualisering - *inom akademi, näringsliv och offentlig sektor*

10 VINNOVA - Sweden´s Innovation Agency *(For Swedish version see VI 2014:07)*

VI 2013:

01 Branschforskningsprogrammet för skogs- & träindustrin - *Projektkatalog 2013*

02 Destination Innovation- *Inspiration, fakta och tips från Ungas Innovationskraft*

03 Inspirationskatalog - Trygghetsbostäder för äldre

04 Challenge-Driven Innovation - Societal challenges as a driving *force for increased growth. (For Swedish version see VI 2012:16)*

05 *Replaced by VI 2013:14*

06 Årsredovisning 2012

07 Trygghetsbostader för äldre - *en kartläggning*

08 Äldre entreprenörer med sociala innovationer för äldre - *en pilotstudie kring en inkubatorverksamhet för äldre*

09 Fixartjänster i Sveriges kommuner - *Kartläggning och sanhällsekonomisk analys. (For brief version see VINNOVA Information VI 2013:10)*

10 Sammanfattning Fixartjänster i Sveriges kommuner - *Kartläggning. (Brief version of VINNOVA Information VI 2013:09)*

11 *Replaced by VI 2014:10*

12 *Replaced by VI 2013:19*

13 När företag och universitet forskar tillsammans - *Långsiktiga industriella effekter av svenska kompetenscentrum*

14 *No longer available*

15 Handledning - *för insatser riktade mot tjänsteverksamheter och tjänsteinnovation*

16 *Replaced by VI 2013:22*

17 Innovationer på beställning - *tidning om att efterfråga innovationer i offentlig sektor*

18 *Replaced by VI 2014:06*

19 Arbetar du inom offentlig sektor och brinner för innovationsfrågor? - *VINNOVA är Sveriges innovationsmyndigthet och arbetar för att offentlig sektor ska vara drivkraft för utveckling och användning av innovationer*

20 Programöversikt 2014 - *Stöd till forskning och innovation*

21 OECDs utvärdering av Sveriges innovationspolitik - *En sammanställning av OECDs analys och rekommendationer.*

22 Att efterfråga innovation - *Tankesätt och processer*

VINNOVA Report VR 2015:

01 Bumpy flying at high altitude? - *International evaluation of Smart Textiles, The Biorefinery of the Future and Peak Innovation*

02 From green forest to green commodity chemicals - *Evaluating the potential for large-scale production in Sweden for three value chains*

03 Innovationstävlingar i Sverige - *insikter och lärdomar*

04 Future Smart Industry - *perspektiv på industriomvandling*

05 Det handlar om förändring - *Tio år som följeforskare i Triple Steelix*

VR 2014:

01 Vägar till välfärdsinnovation - *Hur ersättningsmodeller och impact bonds kan stimulera nytänkande och innovation i offentlig verksamhet*

02 Jämställdhet på köpet? - *Marknadsfeminism, innovation och normkritik*

03 Googlemodellen - *Företagsledning för kontinuerlig innovation i en föränderlig värld*

04 Öppna data 2014 - *Nulägesanalys*

05 Institute Excellence Centres - IEC *-En utvärdering av programmet*

06 The many Faces of Implementation

07 Slututvärdering Innovationsslussar inom hälso- och sjukvården

VR 2013:

01 Från eldsjälsdrivna innovationer till innovativa organisationer - *Hur utvecklar vi innovationskraften i offentlig verksamhet?*

02 Second Internationel Evaluation of the Berzeli Centra Programme

03 Uppfinningars betydelse för Sverige - *Hur kan den svenska innovationskraften utvecklas och tas tillvara bättre?*

04 Innovationsslussar inom hälso- och sjukvården - *Halvtidsutvärdering*

05 Utvärdering av branschforsknings-programmen för läkemedel, bioteknik och medicinteknik

06 Vad ska man ha ett land till? - *Matchning av bosättning, arbete och produktion för tillväxt*

07 Diffusion of Organisational Innovations - *Learning from selected programmes*

08 Second Evaluation of VINN Excellence Centres - *BiMaC Innovation, BIOMATCELL, CESC, Chase, ECO2, Faste, FunMat, GigaHertz, HELIX, Hero-m, iPACK, Mobile Life, ProNova, SAMOT, SuMo & Wingquist*

09 Förkommersiell upphandling - *En handbok för att genomföra FoU-upphandlingar*

10 Innovativa kommuner - *Sammanfattning av lärdomar från åtta kommuner och relevant forskning*

11 Design av offentliga tjänster - *En förstudie av designbaserade ansatser*

12 Erfarenheter av EU:s samarbetsprogram - *JTI-IKT (ARTEMIS och ENIAC)*

Production: VINNOVA's Communication Division
November 2015

VINNOVA - strengthening Sweden´s innovativeness

VINNOVA SE-101 58 Stockholm Sweden OFFICE: Mäster Samuelsgatan 56
+46 (0)8 473 3000 VINNOVA@VINNOVA.SE VINNOVA.SE