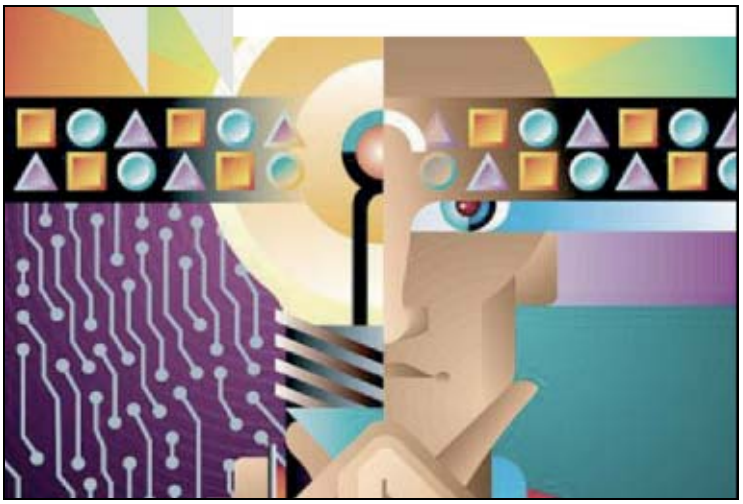
Chile's National Innovation Council for Competitiveness

Interim Assessment and Outlook



OECD

April 2009

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FOREWORD

This report is a follow-up on the Review of Chile's Innovation Policy.* It was requested by the Chilean National Innovation Council for Competitiveness through the Under-Secreatary of Economy, and was carried out by the OECD Directorate for Science, Technology and Industry (DSTI) under the auspices of the Committee for Scientific and Technological Policy (CSTP).

This report draws on the results of a series of interviews with members of the Chilean National Innovation Council for Competitiveness and other stakeholders of Chile's innovation system. This report was drafted by Erik Arnold (consultant to the OECD, Director, Technopolis Group), with contributions from Gernot Hutschenreiter (Country Review Unit, DSTI, OECD), and under the supervision of Jean Guinet (Head, Country Review Unit, DSTI, OECD).

This report owes much to officials of the Secretariat of the Council, its Executive Secretary, Leonardo Mena, and Marcía Varela, who helped in providing background information and organised the interviews. The participants in the interviews in Chile, and other individuals who supported the OECD team throughout the process were of great help.

* See www.oecd.org/sti/innovation/reviews.

CONCLUSIONS AND RECOMMENDATIONS

Background

The Review of Chile's Innovation Policy (OECD, 2007a) noted the existence of a number of market and systemic failures that need to be corrected in order to effectively foster innovation and enable Chile to achieve high, sustainable growth. It noted that Chile's resource base, its economic development and record of disciplined, forward-looking economic policy provide a solid platform for further growth. But in order to realise the potential, policy needs to tackle a number of issues, notably Chile's comparatively low investments in research and development (R&D), over-emphasis on research as compared to innovation in the funding system, shortfalls in the formation of human capital and a deficient innovation culture across the national innovation system.

The Review emphasised the role of government policies in addressing these weaknesses and fostering strengths in the Chilean innovation system. It acknowledged three bold decisions taken by the Chilean Government that are of central importance for an accelerated maturation of Chile's innovation system: the creation of an National Innovation Council for Competitiveness (*Consejo Nacional de Innovación para la Competitividad* – CNIC) entrusted with the mission of proposing guidelines for a long-term national innovation strategy, the establishment of the Innovation for Competitiveness Fund (*Fondo de Innovación para la Competitivida* – FIC), using an additional stream of revenue derived from a levy on mining to implementing strategic objectives; and the introduction of an R&D tax incentive to motivate private-sector participation in research and development activities.

This report follows up on the Review of Chile's Innovation Policy, providing an interim assessment of Chile's National Innovation Council for Competitiveness together with some analysis and documentation of OECD experience that may be useful for its further development.[1]

The National Innovation Council for Competitiveness

The National Innovation Council for Competitiveness was formed with the mandate to advise the Government on how to develop a holistic innovation policy, with the overarching aim of increasing GDP per head quickly enough to repeat the doubling of the previous fifteen years. A key instrument for this was the newly-created Innovation for Competitiveness Fund (FIC), including an additional stream of revenue, derived from a levy on mining, for supporting innovation, and part of the CNIC's role is to advise the Government how to use the FIC. Currently, the CNIC's role also includes a 4-yearly evaluation of achievements against the strategy set out by the CNIC as well as evaluating Corfo and Conacyt.

The CNIC was originally set up by presidential decree in 2005 as an interim body that had a mandate to develop an initial national strategy for innovation and competitiveness. When it reported in 2006, the President expanded its membership a little and made it into a permanent body. The Council then deepened

1 At the time of the OECD review team's fact-finding mission to Chile in 2006, the CNIC was rather new and little could be said about its performance. This report is based upon interviews, mainly with Council Members, conducted in November 2007 and a subsequent review of documents and international experience. It is thus able to provide a first assessment of the early life of the Council.

its strategy work, producing Volume 1 of its White Paper ("*Towards a National Strategy*") early in 2007 and Volume 2 at the start of 2008. In parallel, CNIC launched its flagship "clusters" programme.

The conclusions of this report are based on the fact that the Council is still young and in development. This means, first, that any assessment must be based on its initial steps and not on a longer track record and, second, that the recommendations must be "formative", supporting its further development. The Council is still at a stage where it can, and indeed should, adjust its mode of operation.

Achievements

Overall, the CNIC's structure and performance to date are promising. Even though it is still comparatively new, it has started to generate some important outcomes. Notably, the CNIC has

- *established itself as a credible advisor to Government*, putting more holistic policies in place, assisting in increased public investment in human capital development, industry-relevant research and the promotion of industrial innovation and the beginnings of a better co-ordination and possibly simplification of Chile's fragmented and complex research and innovation support system.
- *launched its flagship "cluster" programme initiatives* which has enabled the Council clearly to introduce more selectivity in innovation policy and the relevant government budget, while detaching it from "capture" through its own legitimacy, reinforced by the use of external analysis. It also provides axes around which needed horizontal co-ordination can be established and relationships built between national and more local implementation of innovation policy. It thus makes significant demands on the ability of other actors to work together on "horizontal" projects that cross administrative boundaries and potentially knit together the regional and national levels.
- *triggered organisational change in innovation governance* likely to improve the functioning of the government's part of the innovation system. Notably, the establishment of the Ministerial Commission for Innovation (*Comité de Ministros para la Innovación* – CMI) set up in 2007 to act as the Council's counterpart within Government means that the Council now has the needed interface to Government and to an implementation apparatus that allows its recommendations to become reality[2].

The Councils structure and performance are consistent with much good international practice and constitute a basis for the Council to function as an effective innovation and research policy advisor to the Chilean Government over the longer term. The analysis in this report, including the experience with similar councils operating in a number of OECD Member countries, suggests that the CNIC largely conforms to a variety of desired characteristics, notably the Council has:

2 The CMI's principal task is to implement public policies on innovation while, at the same time, co-ordinating the different public entities related to the development of human capital, science, business innovation and the development of a culture of innovation. It is chaired by the Minister of Economy and its other members are the Ministers for Education, Finance, Foreign Relations, Agriculture, Public Works, and Transport and Telecommunications. The CMI administers the Innovation for Competitiveness Fund (FIC), which reached some USD 169 million in 2008, and is responsible for co-ordinating the different public agencies that form the National System of Innovation for Competitiveness (*Sistema Nacional de Innovación para la Competitividad*, SNIC).

- *assembled the relevant stakeholders*, whose input and agreement is needed in order to make holistic, national innovation and research policy recommendations. Its composition and status make the Council socially and politically legitimate.
- *researched and delivered a strategy* (White Paper) that addresses key issues that need to be tackled in order to improve Chile's innovation performance and reach the overarching goal of doubling per-capita income over fifteen years.
- *contributed to the emergence of a consensus* about innovation policy needs, although it will require more time and a greater communications effort to establish this more fully.
- *shown that it is sufficiently independent* in order to act as a change agent. Its position tends to be more authoritative if it detaches itself from the task of proposing detailed allocations of budgetary resources.
- *created and collated the "strategic intelligence" needed* to analyse deficiencies in the innovation system and propose a national innovation strategy.
- *become a place at which critical information about the Chilean innovation system is collected and analysed and an* "*arena*" in which national research and long-term research and innovation policy can be discussed by stakeholders and decision-makers.

Weaknesses and challenges

In its initial phase, the Council's operations have also shown some weaknesses. These include the following:

There has been some degree of ambiguity about the precise *role* of the Council, notably:

- *A lack of clarity concerning the scope of responsibilities and operations of the Council*.
- *An erosion, in the longer term, of the role of the Council as an independent and neutral advisor on holistic innovation policy* by an obligation to make detailed budgetary recommendation, such as on the allocation of FIC resources.
- *A strong focus on time-consuming long-term strategy development*, acknowledging the magnitude of the task of devising a national strategy for the first time.

The *legitimacy* of the Council tends to be undermined by at least the following factors:

- *The Council's legal basis in a presidential decree as opposed to parliamentary law* is seen in some quarters as inadequate, given Chile's traditions of legalism.
- *Despite involving members of the academic community, the Council has yet to obtain the full engagement of the universities*. The science and higher education communities does not seem to have yet developed sufficient trust in the ability of the Council to balance fairly the different views and interests of the various stakeholders.

The *interface* between the Council and the policy system has not always operated smoothly in the past. This was in part related to:

- *An insufficiently holistic approach in budgetary allocations.* As in other countries, the budgeting process (involving bilateral negotiations between the Ministry of Finance and spending ministries) is structured in a way that does not allow holistic decisions to be taken about policies that extend "horizontally" across ministries. The creation of a Ministerial

Committee for Innovation – as a policymaking counterpart to the Council – is an important step and opens new opportunities to tackle this issue, e.g. by striving to establish a virtual innovation budget.

Some problems may have been acerbated by some weaknesses in communicating. Notably:

- *Shortcomings in the communication of the Council* with the public as well as with specific stakeholders in research and innovation. The Council's style and tone have appeared, at least for some time, rather academic to many.
- *The Council's role in allocating FIC financial resources appears to have been exaggerated in the public mind,* reducing the Council's ability to be (and to be perceived as) a neutral advisor rather than a participant in the competition for research and innovation-related resources.

Recommendations

Two categories of recommendations follow from the analysis in this report. One set that would need to be addressed by the Government; and a second that should be tackled by the CNIC itself.

Recommendations for the Government

Sharpen the tasks of the Council

In order to let the Council perform its role as strategic advisor on innovation for competitiveness, the Government, while providing it with the best conditions to do fulfil them, should focus the tasks of the Council, notably:

- *Seek strategic advice on long- and medium term issues from the Council*.
- *Ensure that the responsibility for detailed allocation of budgets, including the resources of the FIC, is with the Ministerial Committee for Innovation (CMI)*. The latter should be obliged to demonstrate to the public (via the Council) that FIC resources are not being used to displace ordinary budget resources.
- *Develop a process whereby the CMI can draw up and possibly negotiate a joint, cross-cutting innovation budget*.

Strengthen the legal basis of the Council

- *Put enabling legislation for the Council before Parliament*; the current legal basis of the Council in a Presidential decree appears insufficient to give it the required legitimacy in the Chilean context.

Broaden the basis of the Council

- *Open up the arena to more participants*. The Council is an arena in which the directions of long-term research and innovation policy is debated and influenced. It has taken steps to consult with external stakeholder groups but will need to do so to a still greater degree (e.g. as its work takes on a more regional dimension). However, this should not lead to an increase in the number of Council members, which appears rather high already.

- *Make efforts to involve the science and education communities more closely.* This should be done while maintaining the principle that Council members sit as individuals and not as representatives of specific institutions. One opportunity is engaging academics in temporary working groups as suggested here.
- *Make an effort to get an explicit international perspective into the Council*. This could be achieved, for example, by appointing one or more non-resident members, either foreigners or Chilean expatriates.

Recommendations for the Council

Clarify the role of the Council

The Council's task is essentially to provide an arena for policy debate for building a consensus on strategic issues and to advise the Government on how to achieve a holistic, whole-of-government science, technology and innovation policy that will support the goal of doubling per capita income over fifteen years.

The Council itself should:

- *Make all effort to establish research and innovation as subjects of broad political agreement*, thereby tackling dynamic inconsistency by shifting incentives towards policy with a longer-term horizon.
- *Focus its advice on long and medium-term issues*. At the macro level, it should continue to devise longer-term visions for the innovation system and seek consensus about realising these. At the meso level, it should focus on identifying and tackling major medium-term bottlenecks to the development of the innovation system.
- *Continue efforts to realise a workable system of evaluation and to foster a "culture of evaluation"*.[3]
- *Consult widely and mobilise (groups of) Council members and external stakeholders*, especially for tackling medium-term issues. This could be done by setting up temporary working groups made up of some Council members, stakeholders and external experts. Assembling such groups to devise solutions for problems identified and then develop these ideas to the point where they can be endorsed by the Council, and the Ministerial Committee for Innovation and handed over to an agency or ministry for implementation.[4] This could have the added effect of mobilising those whose agreement and interest is needed in order to reach solutions.
- *Better combine the long-term macro perspective with the shorter-term perspective* through these temporary working groups, connecting the Council both to longer-term policy needs and to shorter-term initiatives that bring political rewards in terms of increased credibility of policy makers as actors in innovation policy and helps to overcome time inconsistency.
- *Increase the engagement with the regions and encourage their development of strategic capabilities.* A key role of the Council is co-ordination: vertically, horizontally and over time. Co-ordination needs now also to encompass the regional dimension.

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[3] See Chapter 5 on the Council's ambition in this field and related OECD experience.

[4] The Dutch Innovation Platform's way of working could inspire the Council here.

- *Consider triggering a review or evaluation of CORFO and CONICYT* with a view to ensuring that they are well adapted to their mission of implementing a holistic innovation policy. These institutions are of key importance in implementing the national innovation strategy.
- *Consider streamlining the organisation of the Council* in order to render its work most efficient, e.g. by reducing the number of members, the establishment of an executive board comprising a small number of members, or by other means.

Initiatives for selective policies

The Council has many options to give focus and foster excellence and relevance of research by proposing well-founded selective policies. For example, more recent generations of selective instruments such as competence centres and regional innovation networks are multi-purpose in character – combining selectivity with tackling systems failures such as poor connectivity between academia and industry.

In this context, the following recommendations emerge for the Council:

- *Continue to develop selective policies but combine, where adequate, the use of selective instruments with competitions* (e.g., competitive calls), using actors' self-organisation to reveal areas of potential strength, rather than relying solely on analysis and planning,
- *Take precautions that over time, the use of selective instruments migrates from a top-down to a more bottom-up mode*. Actions to strengthen beneficiaries' strategic intelligence capabilities may be needed in order to enable this, and will in any case have benefits in the form of improved ability to develop and implement other measures aimed at fostering development and innovation.
- *Strengthen the regional dimension of innovation policy*. So far the Council's focus has been largely national. As it develops more selective policies, the opportunities for focusing attention on individual regions increase.
- In this context, *undertake more explicit interaction and consultation with the regional level* to make sure this group of actors is "signed up" to the common innovation and competitiveness mission and works in ways complementary to the Council. Its proposal to encourage and co-operate with regional innovation strategies would provide a good basis for doing this but needs to be complemented by interaction with regional cluster activities.

Concerning policy initiatives in specific areas, the following recommendation emerges for the Council:

- G*ive more consideration to the relevance of innovation support instruments in the following three areas:* First, the class of instruments that increase companies' absorptive capacity through human capital mobility. Second, instruments to exploit the capabilities of the research institutes and technology centres in supporting and developing technological capability in business. Third, means to increase companies' organisational capabilities in areas like innovation management and design.

Improve communication

An increased communication effort is necessary in order to bring about the change needed in research and innovation culture in Chile. Notable, the Council should:

- *Contribute more to the continuing effort to raise the profile and understanding of innovation and research* to a level where they are broadly accepted as long-term national concerns, standing above or apart from special interests and occupying a largely uncontroversial position "above" many aspects of national politics. This is hard to achieve and must be seen as a medium term goal, but it is necessary in order to reduce the effects of dynamic inconsistency by building strategies that survive changes of Government.

- *Develop and deploy an explicit and more visible communications strategy.* The Council needs to gain a higher profile with the general public, opinion-formers and political parties, promoting the importance of research and innovation and demonstrating its own impact. [5] The Council also needs to become more visible and communicate more with specific stakeholders in research and innovation. Exploit the fact that there is still a window of opportunity to establish a more active image for the Council.

5 In this respect the Netherlands Innovation Platform provides useful models through conferences, consultations and use of the media.

BACKGROUND

Chile was among the first countries – and the second non-member country after China – to take part in the OECD's new round of innovation policy reviews[6], shortly after the new National Innovation Council for Competitiveness (*Consejo Nacional de Innovación para la Competitividad – CNIC*) was set up. The Review of Chile's Innovation Policy (OECD, 2007a) contains a comprehensive assessment of Chile's innovation system, focusing on the role of government. It pointed to promising developments in research and innovation policy against a background of an overall innovation performance that needed improvement. The Review also pointed to a number of challenges in the performance of Chile's national system of innovation, notably:

- A culture, typical of many resource-based economies, of viewing technology as a set of "black boxes" that can be bought or sold, as opposed to placing innovation and technological capabilities in the centre of entrepreneurship.
- Lack of "innovation culture" within much of the business sector.
- Low business expenditure on R&D.
- Lack of trust among business enterprises.
- Shortage of specialised human resources, notably postgraduate S&T personnel and innovation managers.
- Poor-quality and irrelevance of work performed in research institutes.
- Underdeveloped supporting financial market mechanisms (risk and equity capital).
- Insufficient networking and clustering of firms.
- Weak university-industry links.
- Unexploited opportunities to exploit the presence of R&D-performing multinational enterprises (MNEs).
- Under-exploitation of the core of competent companies in the economy.
- Inadequate exploitation of opportunities to enter new niches based on existing resources and competences (such as high-value tourism).

In addition – and of particular importance in the present context – the Review found Chile suffered from important deficiencies in innovation governance, which included:

- Political centralisation resulting in limited capacity for innovation governance distributed across the innovation system as a whole.
- Geographical concentration of power and intellectual capital in innovation governance.

[6] See www.oecd.org/sti/innovation/reviews.

- Weak governance of overall innovation policy, with especially strong competition between CONICYT and CORFO, reflecting the tension between economy/industry and education/research ministries that can be observed in many countries.
- Fragmentation of instruments operating below critical mass.
- Gaps in policies, especially those (*e.g.* cluster policies) that would require trust, co-operation and co-ordination among multiple actors and those addressing non-traditional beneficiary groups, such as SMEs).
- Low role of business in a national R&D effort that is over-focused on public sector research, especially in the universities.
- Poor articulation between R&D in the knowledge infrastructure (universities and research institutes) and industry.
- Policy emphasis on R&D rather than innovation, knowledge diffusion, technology transfer and technology-based entrepreneurship.
- Unbalanced policy mix, over-focused on research as opposed to innovation.
- Reluctance to be cleverly selective in innovation policy. While a prudent stance avoiding "capture" by special interest groups is commendable, this may lead to policy that is insufficiently (sector-) specific.
- Limited use of programming as a device to focus projects' efforts on socially desirable goals, leading to fragmented, project-based efforts.

With respect to the "governability" of the national innovation system, there are at least three types of coherence must be ensured by co-ordinated policies:

- *Horizontal*: ensuring that the various players in different policy areas are aligned and working to a common agenda (and thus also reduce the danger of "capture").
- *Vertical*: ensuring that the development and execution of policies are consistent (coherent) with the objectives of the overall innovation strategy (tackle the problems of agency).
- *Temporal*: referring, firstly, to tackling "dynamic inconsistency", but also to ensuring that the policies created now continue to be effective in the future; this requires mechanisms that reveal potential inconsistencies and provide new perspectives and paths to change.

The Review of Chile's Innovation Policy was able to make some general suggestions about the Council based on OECD experience. However, the Council as an institution was too new at the time for a sound assessment of its progress or to make recommendations based on its performance. A separate follow-up visit was therefore arranged in November 2007 by two members of the OECD Country Review Unit and an external consultant, in order more closely to focus on the work of the Council. The team interviewed a number of key stakeholders in the Council[7] and reviewed the available background documentation from the Council. The results of that visit and subsequent follow-up research are reported here.

Chapter 1 outlines the history and activities of the National Innovation Council for Competitiveness. Chapter 2 provides an overview of similar science and innovation Councils in eight OECD Member states.

7 Carlos Álvarez, Celia Alvariño, Ricardo Barrenechea, José Miguel Benavente, Nicolás Eyzagiurre, Virginia Garretón, Vivian Heyl, Claudio Maggi, Servet Martínez, Leonardo Mena, Bernardita Méndez, Bruno Philippi, María Olivia Recart, Rodrigo Rivera, and Marcia Varela.

More details on these eight Councils are provided in the Annex. Based on the review of theses eight Councils as well as the small literature available it is possible to state a number of desiderata for councils such as the CNIC – always recognising that these are subject to needs and circumstances in the local context. Chapter 3 on selectivity and clusters discusses the Council's flagship cluster initiative and its role in Chilean innovation policy. Chapter 4 attempts to provide an assessment of the Council's performance so far. Chapter 5 contains an outline on how to monitor evaluate progress in improving the performance of Chilean the innovation system and how the Council might itself be evaluated. It provides information on what can be learned from international practice about how these evaluations should be dealt with.

CHAPTER 1 - THE NATIONAL INNOVATION COUNCIL FOR COMPETITIVENESS

This Chapter describes the innovation system context, the history and main activities of the National Innovation Council for Competitiveness (CNIC). The CNIC was originally set up by presidential decree in 2005 as an interim body that had a mandate to develop an initial national strategy for innovation and competitiveness. When it reported in 2006, the president expanded its membership a little and made it into a permanent body. The CNIC then deepened its strategy work, producing Volume 1 of the White Paper "Towards a National Strategy" early in 2007 and Volume 2 at the start of 2008. In parallel, CNIC launched its' flagship "clusters" project that both exerts significant demands on the ability of other actors to work together on "horizontal" projects that cross administrative boundaries and potentially knit together the regional and national levels.

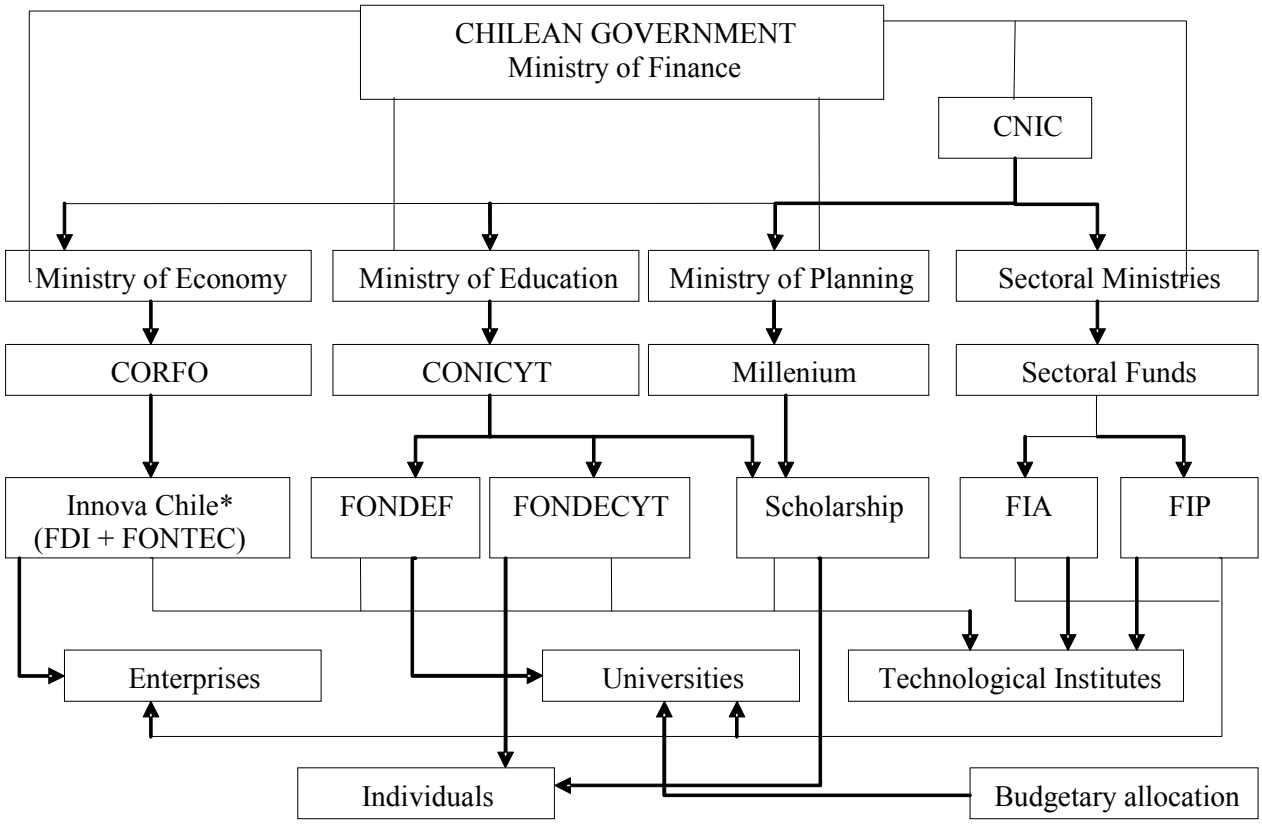
The context of the Council

The Council sits within the institutional landscape shown in Figure 1.1 which reflects a fairly standard division of labour among ministries and their agencies, with separate "chimneys" for the Economy, Education and other sectoral Ministries. Having a Ministry for Planning is rather unusual among OECD countries, but it does not play an important role in co-ordinating or governing innovation or research policy. Despite the substantial progress in innovation policy made during the past decade, there has been impatience with the rate of change and especially the degree to which it has been possible to raise the rate of innovation in business – which is, after all, the part of the innovation system that translates knowledge into economic performance and jobs.

CORFO, the Corporation for the Development of Production, was set up in 1939, operating as an innovation and development agency both nationally and in the regions. CONICYT, the National Commission for Science and Technology Research, was set up during the 1960s. Many of the other organisations shown in Figure 1.1 are of more recent date. Both the Inter-American Development Bank and the World Bank have been significant funders of new programmes and instruments in recent times. Overall, the system shows a rather high degree of fragmentation. Funding for the research institutes was made dependent upon their performance in serving industry already in the second half of the 1990s – a period where there were also sectoral initiatives in R&D support (OECD, 2007a). At the start of the new millennium, both CONICYT and the Ministry of Planning launched Centres of Excellence programmes, which is an important step towards "de-fragmenting" the research landscape.

The National Economic Development Plan of 2001 made science, technology and innovation capabilities one of six national priorities and triggered the formation of the Chile Innova programme, which inter alia supported a number of sector- and platform-oriented initiatives. As stated in the OECD Review of Chile's Innovation Policy, this started a process of co-ordination among agencies – at least at programme level – and underpinned the development of a cluster-based approach that had been pioneered by Fundación Chile (Box 1.1).

Figure 1.1. Institutional profile of Chile's innovation policy making



** FDI and FONTEC were merged into Innova Chile in 2006.*

Source : OECD.

The OECD Review of Chile's Innovation Policy has warned against devolving policy functions to funding agencies, and maintained that it is wise to rigorously separate policy from delivery.[8] Chilean innovation policy making was on the way to become decentralised to the extent that it is uncoordinated and therefore both contains goal conflicts and fails to exploit the opportunities available from collective action. The situation was exacerbated by the fact that many of the agencies' boards act in a highly independent manner: there are difficulties of "vertical steering" in the sense that agencies are overly independent of their principals. The Review therefore regarded the formation of the CNIC as an important opportunity to make innovation policy making more effective, not least by generating a more holistic view.

8 In this context the Review states: "It is somewhat surprising that in Chile, where a strong economic culture is pervasive among public servants in charge of macroeconomic policy, thinking about innovation policy seems so far to have had little theoretical underpinning, such as agency theory, public choice theory and new public management concepts" (OECD, 2007a, p. 169).

Box 1.1. Fundación Chile: A Chilean international best practice

Fundación Chile is the largest private non-profit organisation for the promotion of innovation in Chile. Founded in 1976 by the Chilean government and the US ITT Corporation, its core mission is to transfer state-of-the art technology, management techniques and human skills to natural-resource-intensive sectors in alliance with local and global networks.

Fundación Chile has developed and original and effective model for transferring technologies and developing innovative responses to economic opportunities. It creates new companies and joint ventures, carries out R&D, adapts foreign technology for product and process innovation for client companies in the public and private sectors, and fosters the creation of technological consortia and the diffusion of technology to SMEs.

Achievements include:

- Creation of pioneering salmon firms and provision of technological services that were fundamental for the take-off of the industry in Chile.
- Abalone and turbot farming.
- Development of the technological concept of vacuum-packed meat and other innovations.
- Quality control and certification of fruit for export.
- Introduction of new berry species and varieties in Chile.
- Associative development in the forestry industry, which led to the implementation of new forestry management models.
- High-quality wine production.
- Furniture for export.
- Lota tourist circuit.

In recent years, Fundación Chile has been increasingly active in the field of biotechnology (forestry genetics and DNA vaccines for aquaculture, among others), financial engineering and information (venture capital), and management. Its activities in the areas of skill upgrading focus on lifelong learning, distance education, the use of ICT in education and management education.

Source: OECD (2007a) based on www.fundacionchile.cl.

The interim Council

The Council was first established by presidential decree as an interim body by President Lagos in December 2005, inspired by a visit of key officials and stakeholders to Finland in 2004. The interim Council was supported by a secretariat drawn from staff of the Ministry of Economy and was tasked to:

- Draw up guidelines for a national plan for innovation and competitiveness.
- Propose ways to strengthen the national innovation system by increasing the effectiveness of innovation policies and policy instruments, in particular by considering options for institutional reform.
- Propose criteria for the allocation, prioritisation, use and evaluation of public resources for innovation funds, programmes and projects, and in particular to make annual proposals on the uses of the Innovation Fund for Competitiveness (FIC) (CNIC, 2006).

A major achievement of the interim Council was the publication of its final report (*Informe Final*) in February 2006 (CNIC, 2006) [9]. The report proposed:

- Strengthening the innovation system by formalising and making permanent the National Innovation Council.
- That in a small country like Chile, innovation policy necessarily has to be *selective*, for example through focusing on certain industrial clusters.
- In order to develop an entrepreneurial and innovative culture, the education and training systems need to expand at all levels.
- Increasing innovative capacity through increased numbers of researchers across the regions, enabling their participation in innovation.
- A massive increase in the recognition of the need to innovate by industry.
- A deliberate effort to promote business innovation through clusters, diffusing good practice and promoting technology-based start-ups and encouraging multinational enterprises (MNEs) to locate R&D facilities in Chile.
- The need to provide the private sector with appropriate incentives through reform of capital markets and the careful design of tax incentives so as to avoid their "capture" by special interest groups.
- The development of networks and organisations to improve the inter-linkage of industry and the knowledge infrastructure, including the public research institutes, which can contribute a practical orientation.
- Increasing the proportion of use-oriented research to provide increased "demand pull".
- An annual, incremental increase in the funding of individual research and "centres of excellence".
- Upgrading of the labour force (especially in key areas such as English language, mathematics, sciences and literacy) through increased vocational training and life-long learning.
- A decisive increase in the numbers of scientists and engineers employed in R&D and innovation through changes in higher education curricula and the provision of incentives for companies to employ more professionals.
- A significant year on year increase in the amount of national resource devoted to innovation, in all the dimensions discussed in the report.

In addition, the interim Council proposed that the permanent Council should be made up by:

- The Ministers of Finance, Economy and Education.

9 The report (CNIC, 2006) lists the following Council members: Edgardo Boeninger Kausel (President); Minister of Finance - Nicolás Eyzaguirre Guzmán: Minister of Economy - Jorge Rodríguez Grossi; Minister of Education - Marigen Hornkohl Venegas; Juan Asenjo de Leuze; Eduardo Bitrán Colodro; José Joaquín Brunner Ried; Juan Claro González; Servet Martínez Aguilera; Patricio Meller Bock; Bruno Philippi Irarrázabal; Executive Vice President of CORFO, Oscar Landerretche Gacitúa; President of CONICYT - Eric Goles Chacc; Executive Secretary – Sub-secretary of Economy - Carlos Álvarez Voullième.

- Two further Ministers appointed for a fixed term by the President of the Republic.
- Three entrepreneurs from a list of ten proposed by the Confederation of Production and Commerce.
- Three scientists selected from a list of ten proposed by the Chilean Academy of Sciences.
- Two experts in human capital chosen from a list of six to be proposed by the rectors of the accredited universities.
- Two experts in public policy, one of whom shall chair the Council.
- Two specialists in skills, productivity and quality, chosen from a list of six, to be proposed by the major trade unions.
- The Executive Vice-President of CORFO and the President of CONICYT.

The Council and the first volume of its White Paper

In response to the report of the interim Council, President Michelle Bachelet re-formed the Council in May 2006, with a mandate to advise the President of the Republic on all aspects related to policies in the area of innovation, including the education of specialised human resources and the development, transfer and diffusion of technology. The mandate of the Council set out in Decree No. 505 is to:

- Publish strategic proposals.
- Establish mechanisms to consult and enter dialogue with relevant actors, especially the regions.
- Propose a national strategy for innovation for competitiveness.
- Propose how to allocate the FIC's financial resources.
- Undertake studies.
- Make proposals for institutional redesign.

The CNIC decided to devise a national strategy in two steps. The first was to present a deepened diagnosis of the situation in January 2007. It intended to publish a second volume of the White Book in the middle of 2007 that would make a greater number of tactical recommendations, proposing institutional changes where necessary and identifying the competitive challenges for the sectors prioritised.[10] It held a number of internal meetings and then convened 8 consultative workshops held in August to October 2006. These gathered 249 proposals from 173 participants that cover a very broad range of possible interventions.

The Council presented the first volume of the White Book (National Innovation Strategy) in January 2007 (CNIC, 2007); it was endorsed by President Bachelet shortly thereafter.

This report explains the urgency of boosting the rate of innovation in Chile, because innovation drives total factor productivity (TFP), which in turn is drives the economic growth necessary to improve equity and quality of life of the Chilean population. It argues that Chile must not complacently continue to rely on exploiting its natural resources but step up to the challenges posed by new technological opportunities in these and other fields. Current levels of R&D investment and of production of R&D-

10 CNIC minutes 2 November 2006 and 25 April 2007.

capable people are wholly insufficient to achieve the needed modernisation. Whereas in the late 20th Century Chile responded well to the perceived challenge to "export or die" it must now tackle the new need to "innovate or stagnate" – even though this course involves uncertainties. The Council therefore suggested a strategy of focusing on national clusters that would use existing resources and capabilities to build the foundations for innovation. This involved moving beyond the earlier strategies of export-led growth towards innovation-led engagement with the global economy. While all the important actors must be involved, the engagement of the business sector was vital to achieving this. The Council argued that poor innovation performance was rooted in weaknesses within the business sector, education, the knowledge infrastructure and the links among these, as well as in the public innovation support system.

The overarching goal of the strategy is to double Chilean GDP per capita over the next fifteen years to 2021, repeating the doubling of the previous fifteen. To achieve this, the strategy states that:

- Total Factor Productivity must rise, driven by greater knowledge-intensity, technological change, human capital and innovation.
- Average years of schooling must rise to 12 by 2010 and 14 by 2021, while the proportion of the cadre of 18-24 year olds entering higher education must rise from 43% today to nearly 80% by 2021; Chile should make significant progress in the results achieved in OECD's international PISA evaluations.
- R&D investment should rise from 0.68% of GDP in 2004 to some 2.3% by 2021 and that the business share of this R&D investment should rise from 37% to 50% of that total.
- Dependence upon a small number of economic sectors must be reduced. At the time, the 25 main items comprised 76% of exports. This should fall to below 50%.
- The country's position as measured by international innovation and economic indicators should improve.

It underscores that becoming a knowledge economy means adding value to sectors where Chile has demonstrated comparative advantages while also supporting key emerging sectors. Its diagnosis is that there are significant challenges to be overcome in the areas of human capital (both in the schools and in higher education), R&D investment and in diversification of the economy so that it is not so specialised and dependent upon a small number of sectors as it is today. The White Paper addresses key issues, taking a very conscious in its choice of approach. Notably by:

Taking a prudent stance regarding the rationale of government intervention. The CNIC takes a prudent and well-funded stance as regards the scope of what it suggests the state should do. Notably it stipulates the following (Chapter 4): The actions of the government must be restricted to a subsidiary role, correcting the market and system failures which affect the innovative process: problems of appropriability, information failures, intangibility of assets and network failures. However, it must also be careful to avoid government failures which could reduce its effectiveness and even make the public endeavour fruitless: dynamic inconsistency, capture and problems of agency. The action of the State must maintain an adequate balance combining the strengths from neutral public policies and the need to incorporate selection criteria of the potentials of the national economy and the failures or obstacles faced by the country in developing them, which must emerge from a non-arbitrary analysis and not be influenced by pressure groups.

Adopting a comprehensive approach. The strategy is comprehensive in its approach, offering a comprehensive and holistic picture of policy needs. A considerable part of the discussion is theoretical, and reflects current thinking in the "innovation research community". Its key elements are to

- build a strong platform for human capital that will substantially expand tertiary education, especially in technical areas, and will support the formation of highly specialised human capital in STI;
- enhance research capacity, with an emphasis on applied research;
- foster innovation within enterprises inter alia through the development of stronger interfaces with research groups and new models to promote technology transfer;
- generate a pro-active culture of innovation within Chile's society;
- set in place a robust governance structure for the innovation system;
- build STI capacity in Chile's regions in areas linked to their economic specialisation; and g) develop a range of supporting infrastructures ranging from better roads through regulations to workforce skills.

The strategy emphasises the importance of infrastructure and innovation culture in enabling a successful innovation strategy. "The concept of innovation is still not very clear in Chilean society and it is expressed differently in the various segments and spheres of activity". In part this can be tackled by generalising the "strong export culture in which competition and innovation are key factors of survival" that prevails among Chile's successful exporters.

Taking a balanced approach to funding science and innovation. The strategy covers not only innovation but also science funding. The balanced approach to applied and fundamental research is worth quoting at some length:

> "Is it necessary for a relatively poor country such as Chile to target a share of its public resources to fund basic scientific research? Is it not enough to have a handful of trained professionals capable of reading the scientific publications that are produced elsewhere?
>
> The answer is Yes, it is necessary, but not only because it is very difficult for a researcher to fully appropriate the benefits of producing knowledge, but also because home-grown basic science will give the country the capabilities to understand new knowledge or to adopt the new technologies that emerge from it. Why? Because highly trained people possess something that is not entirely transmittable through their research papers: a tacit knowledge that can only be transmitted through a direct interaction and in the doing with the academic and scientific communities, with companies and the other agents of their environment. Only when this tacit knowledge is applied, can the country acquire the capabilities for producing local knowledge as well as obtaining and appropriating knowledge that emerges elsewhere. Moreover, it is only through these means that Chile can wholly participate in global innovation networks.
>
> Furthermore, a significant part of the public funding for first-class basic science should respect the freedom to choose the areas of study, because otherwise at least three threats emerge: *i)* the loss associated to an incomplete supply of basic knowledge required to drive the production endeavour; *ii)* depriving the country of knowledge that could be essential in the future even though today it may not seem to be so; and *iii)* the possible curtailing of ideas or knowledge that appear unexpectedly during the execution of scientific work and that can be valuable in areas that are not directly related to that research.
>
> However, the allocation of public funds in this area should fulfil various criteria: *i)* certify transparency in the supply and the excellence of those who receive; *ii)* ensure the tacit transfer of knowledge; *iii)* adequately foster the development of a growing supply of researchers; *iv)* impede the occurrence of cross-subsidies among related institutions; *v)* ensure the tracking of the

implementation of projects; and *vi)* ensure accountability, with regard to project spending and those responsible for approving it." (CNIC, 2007, Chapter 2)

Adopting a broad concept of innovation. It also considers aspects of innovation often neglected in such discussions – not only the need for "absorptive capacity" in industry, based on higher education and research-relevant skills, but also the significance of what it calls "organisational assets" – namely capabilities in organisation, project management and design in enabling companies to innovate. It also stresses the need for developing wider innovation and management capacities among SMEs. It raises issues about the need to improve the quality and efficiency of both the schools and the universities that arguably go beyond the Council's remit, but that nonetheless need to be tackled because they are "show-stoppers": no matter what measures are taken in innovation policy, unless these educational reforms are achieved the innovation measures can have little effect.

Acknowledging the importance of the regions. The report argues the importance of the regions and the need to integrate them into the overall innovation strategy. It proposes to rely on CORFO and CONICYT to be the two main pillars for implementing its strategy and raises questions about the role of the national technological institutes, suggesting that their activities are insufficiently tied to national needs.

Finally, the form of the CNIC itself is debated (Chapter 3 of the report). The report considers three models: First, "simply advising" government; second, functioning as an autonomous body, with its own resources for implementing its advice; and a third model. This third, chosen model "sees the Council as an autonomous body that proposes a long-run strategy and consistent with that strategy recommends the use of all public funds for innovation, but the Government is responsible for deciding what commitments to actually make and to directly execute the policies. This separation is essential, because it allows the Council to thoroughly fulfil other essential tasks: to supervise autonomously and with the technical skills the execution of the strategy adopted by the Government, to periodically review the foundations and directions of the strategy and, above all, to caution society when the system deviates from the objectives laid out, which may be due to the failures in the market as well as to the failures of the State or government".

The report argues that the CNIC cannot solely be comprised of independent "good women and men" because it needs the knowledge of the key stakeholders about both needs and how best to implement policies. Its composition must therefore provide the needed checks and balances to ensure that it is not "captured" by special interests.

> "Thus, it is proposed that the National Council of Innovation for Competitiveness be presided by a renowned expert in public policies, who should not be a public employee – who will be appointed by the President of the Republic and ratified by the Senate with a simple majority – and comprised of people with renowned experience in the scientific, business, labour, educational and public policy spheres. The Ministers of Finance, Economy and Education and the Executive Vice-President of Corfo and the President of Conicyt are also included, although only with the right to express opinions. In order to appoint the advisors, the proposal is to leave the first of these appointment processes in the hands of the President of the Republic. The gradual appointment of members of the Council, should in turn seek to maintain the balance with respect to the expertise of members, which is also determined by the President of the Republic, although based on proposals originating from the Council itself."

The White Paper also states in this context: "While this proposal does not define the exact number of members, there is a unanimous opinion in the Council that the total of 17 members, which is the number today, is excessive" (CNIC, 2007, p. 107).

Shortly after accepting the first White Paper, the President created the Ministerial Committee for Innovation supported by the Ministry of Economy, whose task is to act as the counterpart of the Council in government, receiving the Council's advice and overseeing its implementation.

The second volume of the White Paper

The CNIC published a second volume of its White Paper in January 2008. It further stressed the need to move towards a knowledge economy, in line with developments in much of the rest of the world. It also points out that in a time of increasing global specialisation, Chile cannot afford to try to be good at everything and must therefore specialise. It argues that Chile must build its innovation strategy on three major pillars:

- High-quality, life-long learning.
- A science and technology system orientated towards social needs.
- A proactive and innovative business enterprise sector.

In each case, the CNIC proposes concrete measures intended to secure the goals it suggests.

The report argues that *human capital* development is a major challenge, to which the education and training system must respond through growth with social equity. Chile needs to progress by:

- Establishing a system of flexible life-long learning covering not only initial education but also subsequent re-skilling and re-training.
- Developing an integrated system of higher education and qualifications, in order to allow people not only to acquire high-level skills and qualifications but also to navigate non-traditional courses through the education system and enable mobility.
- Develop a system of technical and vocational education based on skills relevant to work.
- Modernise university curricula so that they are relevant to national and international needs.
- Strengthen and increase the throughput capacity of the system of higher education and associated qualifications.

The CNIC proposes to tackle these issues through the creation of a system of life-long learning, securing the quality and relevance of education and qualifications and increasing the capacity of the education system, especially to tackle technology-intensive areas and those parts of the economy where incomes are low.

Science for development is the second challenge, which must be tackled by:

- Finding a new balance between curiosity-driven and "relevant" research.
- Deciding on which great questions to focus publicly funded research.
- Designing a funding system to meet the challenges – tackling the full costs of research, assuring quality through peer review and respecting national priorities while being internationally networked and multidisciplinary.
- Strengthening research capacity.

To tackle these needs, the CNIC proposes to strengthen and increase the activities of the science base, providing incentives to encourage research in strategically relevant areas; reform the science funding

system, which will still be focused on CONICYT; and to provide the grant funding needed to meet the national challenges through training researchers, strengthening institutions, quality-assuring postgraduate training, increasing doctoral training, ensuring the system can absorb the increases in manpower and encouraging immigration by relevant researchers.

Improving *innovation in business* is the third challenge, and addressing it has to involve an element of selectivity. The main needs identified in the report are:

- Incorporating new knowledge into production by raising the level of R&D.
- Encouraging the diffusion of new technologies.
- Supporting innovative entrepreneurship.

To do this the CNIC proposes to strengthen the development of clusters through road mapping, increasing relevant research capacity and attracting foreign direct investment. It aims at:

- Incorporating new knowledge into production processes by forming R&D consortia, increasing support funding, increasing innovation skills among company managements, improving the tax treatment of business R&D and increased development and protection of intellectual property rights.

- Strengthening technology diffusion by establishing a network of technology institutes, creating a network of technology brokers, setting up world class technology diffusion centres for ICT and other technologies needed by innovating firms and creating incentives for innovation among companies currently operating at low technological levels.

- Increasing innovative entrepreneurship through busies incubators, promoting spin-offs from existing companies, encouraging greater availability of seed and venture capital, developing instruments to encourage business angels and reducing the way bankruptcy currently tends to prevent entrepreneurs from trying again with new business ideas.

The report also further considers the Council's role in the governance of the public part of the innovation system. It argues that three models can be found internationally: the dominant player model (Ireland, Switzerland, Singapore); a fragmented, thematic model (South Korea) where different sectors pursue their own innovation policies and a division of labour (Finland, Netherlands, Germany) that depends upon the coexistence of two main "pillars", in the case of Chile CORFO and CONICYT. It firmly supports the "division of labour" model and argues that Chile should therefore develop on the basis of its existing main research and innovation agencies. The CNIC should be strengthened by giving it a basis in parliamentary law and made into a permanent part of the state, advising the president on the key aspects of a long term national strategy for innovation. The scope of the CNIC's work should encompass not only the work of the research and innovation agencies but the whole national system of innovation, whose progress it should evaluate annually. The Council should also work with the development and implementation of regional innovation strategy and report its progress. The Government should publish the strategy. The number of members of the CNIC should be reduced and its work should be enriched by the opinion of a group of international experts from time to time.

The report argues that making the Council's work effective requires raising the status of the Ministerial Committee for Innovation (CMI), to be headed by the Minister for Economy, and more clearly defining its role, which should essentially be to implement the CNIC's strategy. The CMI should take responsibility for the whole of national innovation policy, not just the FIC and should implement selective policies to strengthen individual clusters within the economy. Reforms are needed to strengthen the

executive agencies responsible for the "human capital and science" pillar and the "innovation and business development" pillar.

The report also concludes that the regions should be integrated into the definition of innovation policy and proposes that this should be done through the development of regional innovation strategies within the framework of the national innovation strategy, which should promote a balance of development between "central" and less well developed regions while supporting regional specialisation and the development of institutional capacity in the regions.

There has been impatience in some quarters with the amount of time that the Council took in order to establish an intellectual framework and report its ideas. While this criticism is understandable it has to be acknowledged that since this was the first real attempt at a national innovation strategy producing a document that is at once analytically coherent and a basis for consensus building took some time.

The Clusters Programme

During 2007, the CNIC commissioned a series of studies from the Boston Consulting Group of eight sectors with apparently high growth potential (BCG, 2007a, 2007b). The initial study had the character of a "search and screen" assignment, considering some 66 potential sectors with high growth potential and filtering this number down to 11, based on a combination of sectors' growth potential and the likely costs of intervention. Eight of them were prioritised for action in 2007 and the other 3 are being more closely studied during 2008. The eight priority sectors comprise even mixes of medium and high growth sectors and low or medium expected intervention effort required. The studies of the eight clusters all looked at the availability and needs for action on human capital, science and technology research capacity, infrastructure, legal and political systems, finance and trade. They disaggregated the value chains in each cluster, looking for the factors that drive value creation, described Chile's position and potential in international competition, identified existing initiatives and gaps, estimating the size of potential impacts and developed rather detailed road maps of potential initiatives – classifying these according to their urgency and their likely impacts. During the studies, the consultants interviewed many people in the clusters but it is clear that considerable follow-up action is needed to engage the stakeholders fully in the proposed processes and to transfer "ownership" of the clusters from the analysts to those who will work with the clusters. Specific agendas were developed for each cluster (Table 1.1).

Table 1.1 Cluster agendas from CNIC's White Book II

Mining. To maintain a position of global leadership in mining and to promote links among members of the cluster Promote networking among the members of the cluster Develop a knowledge management system for the cluster Promote innovation in the sector, ensuring that R&D incentives are competitive Evaluate specific incentives to the mining exploration Assist in the development of suppliers to the mining industry and promote inward investment by such firms Assess the usefulness of creating test centres to assist in developing goods and services for mining **Aquaculture**. To be the world-wide leader in production of salmon and to diversify into other species and products Develop foods for different species to be farmed Identify and to develop options of new non-salmonid species Improve hygiene Improve and/or to implement environmental control mechanisms Modernize the regulatory framework of the sector **Tourism**. In order to turn to Chile into a well-known and prestigious destination with strength in niches such as eco-tourism, adventure, cruises, etc Improve the positioning and international tourist promotion of Chile Increase the number of destinations and to encourage the development of more tourism products Improve the quality of the education and level of qualifications of people who work in tourism Adapt the regulatory framework and marketing of the sector Improve linkages within the cluster **Processed foods**. In order to consolidate Chile's position as a producer of high added value foods Extend the systems for market intelligence and market development of markets Promote the image of Chile as a food exporter Improve production capacity, improving co-ordination between producers of raw materials and food processors and transferring new technologies to small and medium companies Focus and to increase investment in R&D Improve institutional linkages within the sector **Fruit growing**. In order to maintain Chile's world-wide leadership in primary fruit growing Further market development, promoting Chilean fruit exports and strengthening Chile's image as a food exporter Increase capacity, developing specific lines of credit for the sector and improving manpower productivity	Adapt the labour legislation to the specificities of the agricultural sector Develop R&D programmes for the sector Develop infrastructure **Offshoring**. In order to become the regional leader in high added value offshoring services Develop human capital in areas of interest for offshore services Provide education relevant to the needs of offshore services Attract FDI and embed the foreign companies in Chile's economic fabric Improves linkages within the cluster Adapt the regulatory and legal framework to the needs of the cluster **Pork and Poultry**. In order to maintain high rates of export growth of exports Improve productive capacity; the SAG institute for agriculture and forestry should tackle the future needs of the sector in the areas of qualifications, certification and inspection of export plant Increase the interaction between the private sector and the research sector in order to stimulate applied R&D Increase capacity for the diagnosis and monitoring of diseases Proactively manage the relations with the countries to which pork and chicken products are exported Compile information on the world market, related to health and food safety **Financial services**. In order to increase to reach and strength of the Chilean financial sector, building from a domestic platform to become a possible regional centre Increase the proportion of the population having access to banking services, developing the use of instruments for payment and a universal system of credit rating Further expand the derivatives market Develop more progressive investment rules Reform the tax system Increase the qualifications of professionals in the sector and institute a national system of certification for finance professionals

Source: CNIC (2008).

International networking needs to be a key part of the clustering process. Foreign network and cluster projects tend, according to the CNIC, to fall into three categories: opportunity networks, based on the common pursuit of business opportunities; research-based networks; and networks aiming to build human capital. In many cases, of course, networks have multiple functions, sometimes beginning life in one of these three categories and then successively invading the others and the role of the network or cluster

activities broadens. CNIC saw Chile's cluster activities as lying well behind those of the more developed countries (especially Europe, where considerable policy effort has been put into creating international networks within the EU). CNIC therefore recommends not only national action to strengthen key clusters but also establishing a policy of creating or joining international networks concerned with innovation, research and human capital development. International co-operation should be an assessment criterion in allocating public funds for research, development and human capital formation and the national clusters should have a strategic objective of developing international networks.

The CNIC has identified six major areas that would be promoted by cluster development:

- Increasing the interactions among the actors in the relevant clusters.
- Strengthening the national image in the clusters.
- Monitoring technological changes.
- Pre-competitive R&D relevant to the clusters.
- Increasing the social responsibility of companies in their communities.
- Attracting investment.

The clusters activity has become a "flagship" project for the CNIC. In addition to addressing key parts of the economy with high potential for growth, these cluster projects also illustrate the need to work across the areas of responsibility of many ministries and agencies.

Strategic intelligence

The CNIC made recommendations in all three strategy documents about how to allocate FIC financial resources, though the reasoning for the particular allocation chosen is not presented. A positive aspect is the allocation of some resources for strategic intelligence to the CNIC itself, for example enabling the National Innovation Survey to be conducted in 2007. The first volume (2007) reported that studies had been commissioned on Chile's innovation policy (by the OECD), the scholarships system, intellectual property, R&D, the scientific technological centres, and a diagnosis of the innovation culture in Chile. A study leading to the institutional redesign of the technological institutes was postponed, as CNIC was unable to find a supplier.

Implementation

Implementation is not the business of the CNIC, whose job is to define strategy. CNIC's counterpart is the Ministerial Committee for Innovation – the five ministers who sit (without a vote) on the Council. Its agreement is needed to implement the strategy and the CNIC's recommendations about how to allocate FIC resources. As a result, the main labour of implementation will be done by the agencies of the ministries concerned, especially CONICYT and CORFO. This is quite a long line of communication, so it is important that the heads of these agencies sit on the Council and are therefore in effect already committed to its strategy.

During 2007, CONICYT increased the number of postgraduate scholarships it offers, introduced a *financiamento basal* funding scheme to support inter-university networks of excellence and set up a number of technology diffusion measures, in line with the thinking of the CNIC. CORFO extended its schemes relating to the generation of public goods, development, precompetitive innovation and market entry, individual company projects and technology transfer via special calls aimed at the mining, tourism, offshoring and aquaculture clusters. In 2008, it is recruiting cluster managers for the aquaculture, food,

mining and tourism clusters[11] and beginning to organise its services so that they fall into Cluster Programmes. This is laying the foundations for greater cluster identity and networking among cluster members.

Many of the clusters are, of course, not new. While the BCG reports appear not mention them, there are already many small clusters in fruit growing as well as Innova Minera in Mining, the Chile Salmon Cluster and others in other areas. CORFO has "business platforms" in mining, food, tourism and food processing and has in fact been supporting clusters since about 1990. Its Innova Chile arm has been especially active; so the CNIC initiatives in many cases build upon established activities, greatly increasing their chances of success compared with trying to establish clusters from scratch.

CORFO's regional and multi-programme structure means that it is well positioned to tackle wide-ranging initiatives such as clusters and to embed them regionally. However, once the requirements of the cluster projects start to cross the boundaries of ministries' responsibilities – as, for example, when it is necessary to set up new education and training courses – the need for co-ordination increases. In principle this should be tackled by the Strategic Public and Private Cluster Council, which reports to the Ministerial Committee for Innovation (Figure 1.2) and whose main objective is to drive the growth and competitiveness of each Cluster and strengthen Chilean national and regional development.

The Executive Secretariat for Clusters is proposed to be responsible for:

- Acting as an Executive Secretary for the Strategic Public and Private Cluster Council.
- Promoting environmental conditions and integration of public and private actions related to each Cluster.
- Creating and developing the overall Cluster Programme and its strategic agenda.
- Designing and running certain projects.
- Receiving assessment and monitoring reports from the individual Cluster programmes.
- Reporting the progress of the overall Cluster programme.

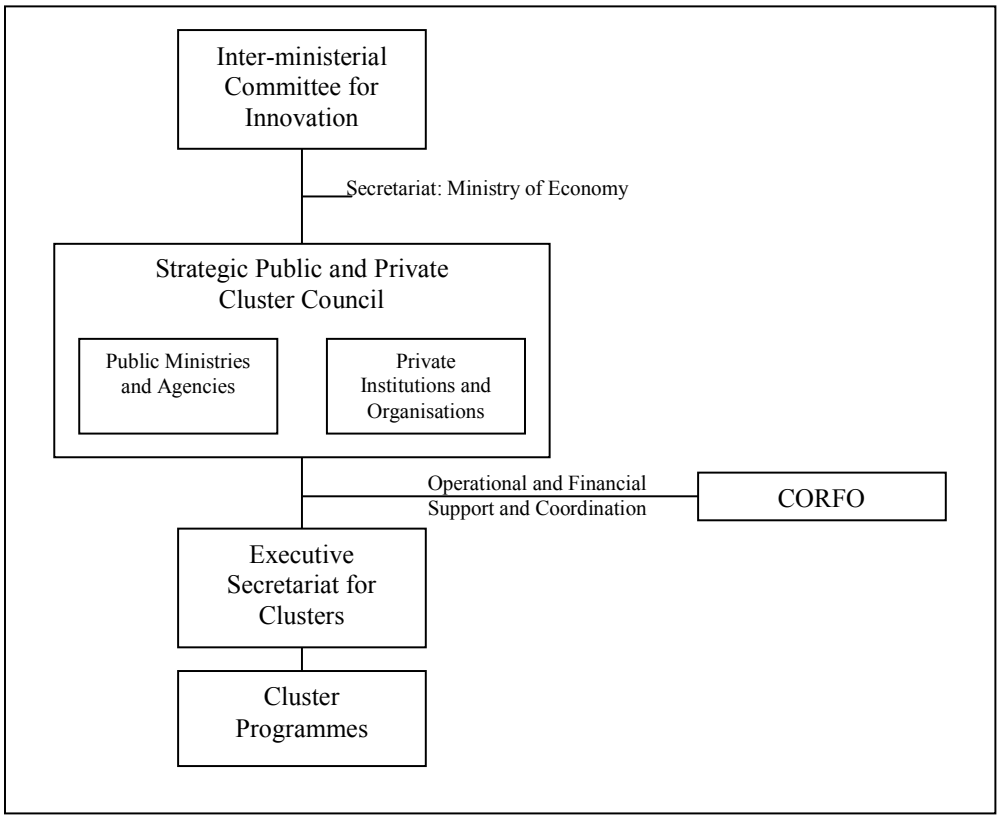
Each individual cluster will then have its own council to:

- Articulate, co-ordinate and strengthen the environment and public and private institutional around each Cluster.
- Communicate with the Cluster.
- Validate the lines of action of the Strategic Agenda.
- Guide the Executive Secretariat of the Cluster in implementing the Strategic Agenda and establishing a monitoring programme.

Each of these councils will be chaired by a Strategic Public Authority and will report to the Ministerial Committee.

11 www.corfo.cl accessed 24 March 2008.

Figure 1.2. CNIC Implementation structure



Source : CNIC Secretariat.

While the Ministerial Committee has been functioning since early 2007, at this stage the lower-level structures are largely under construction.

CHAPTER 2 - INTERNATIONAL EXPERIENCE OF INNOVATION GOVERNANCE AND ADVISORY COUNCILS

The interest in the governance of funding systems for research, technological development and innovation (RTDI) in recent years appears to have been triggered by a combination of the New Public Management movement, the central role attributed to institutions in the new "innovation systems perspective" and a feeling among European R&D funders that that a lot was learnt during the 1990s about how RDTI instruments worked but that ignorance remained about how to govern RTDI funding systems. There is now a small literature on the subject, which this Chapter exploits. However, there is very little written about advisory councils like the CNIC, therefore a survey has been conducted of eight OECD councils in order to generate lessons. These are explored in the second part of this Chapter. Case studies of the eight councils are provided in the Annex.

Innovation governance

There are also more fundamental reasons why governance has become important. Gibbons and his co-authors argued in *The New Production of Knowledge* (1994) that the mode of production of knowledge has been changing. Disciplinary research ("Mode 1" in Gibbons' terminology), focusing on refining theory and resolving empirical puzzles within traditional scientific structures remains important, but the growth in knowledge production has been in "Mode 2". In this mode, which is enabled by the spread of research-capable people out of the universities and cross society (not least into industry), knowledge is produced in the context of application, so it is essentially use-orientated, generally interdisciplinary and is produced by constantly-changing teams of actors. Godin (1998) rightly criticised Gibbons *et al*. for getting their history wrong – Mode 2 is in fact the original mode of knowledge production, while Mode 1 is largely an invention of the past couple of hundred years – but, as the growth of business expenditure on R&D in recent years well illustrates, Mode 2 is clearly the dominant mode now. 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. As Gibbons more recently remarks:

> "Under these new conditions science and technology policies … and innovation policies … can no longer be regarded as functionally separate. Indeed, this is already the case in many countries where, under the label "science and technology policy" or research policy, it is actually "innovation policy" which is being pursued. Generally, this is done with only meagre success because the presuppositions of older science policy thinking linger on and continue to structure the thinking of policy analysts and decision makers. In the new phase, innovation policy, if it is to be efficient, will supplant the older science and technology policy thinking. It will be a new type of innovation policy predicated upon a broader understanding of the innovation process and of the constitutive role of knowledge and the knowledge producing institutions in it. A key element in this new understanding is already becoming clear. It is that people in their fungibility, multicompetence and capacity to connect with others are the crucial resource" (Gibbons, 2001).

On this argument, there is a little-explored conflict between the rigidities of the New Public Management and the flexible and changing governance requirements of the innovation systems (Marceau, 2001). The pervasiveness of knowledge generation also means that governance has an increasingly

technical content (Skolnikoff, 2001). This requires a better mixture of technical and policy capabilities than may have been needed in past governance. Governance must be both holistic and technically literate.

Evaluations of funding agencies have found that RDTI system governance is a critical factor explaining their effectiveness (Arnold, Kuhlmann and van der Meulen, 2001; Arnold *et al.*, 2004). A comparative study of governance in eight countries (Arnold and Boekholt, 2002) found that key governance functions included:

- Setting directions - including the development of a strategic approach to government intervention in RDTI.
- A referee.
- Horizontal co-ordination.
- Co-ordinating the production of knowledge.
- Strategic intelligence.
- Vertical steering: guiding agents towards socially desirable goals.
- Enhancing the profile of research and innovation.[12]

The later OECD MONIT project (OECD, 2005) reviewing innovation governance in a slightly wider set of countries suggested that some of the challenges facing innovation governance were:

- Competing rationales.
- Short-termism in resource allocation.
- Strategic priorities overtaken by the mechanisms of new public management regimes.
- Different views and understanding of innovation policy.
- Different imperatives for different policy areas.
- Perceived division of labour between policy areas.
- Fragmentation and segmentation.
- Competition and personal ambition.

MONIT focused on the policy cycle as an organising device for the study and concluded, inter alia, that governments need governance capabilities to handle:

- Balancing imperatives.
- Developing appropriate knowledge bases.
- Developing a strategic horizontal approach.
- Designing agencies.
- Developing pragmatic public-private interfaces.
- Integrating learning in governance practices.
- Developing and implementing action plans with monitoring and reporting systems.

[12] Arnold and Boekholt (2003).

- Improving evaluation and learning.
- Conducting meta-evaluations.

While these studies advanced our understanding of RDTI governance considerably, they were somewhat static in their analysis, devoting much attention to structures and inter-organisational relationships and less attention to processes. In the absence of well-developed theory of governance, the implicit goodness criterion sometimes tends to be "Is it neat?" It may well be that a good governance system has not only to have aspects of neatness but also some untidy aspects that relate to experimentation (including natural selection amongst instruments) and policy learning that challenges existing structures.

In order to take better account of dynamics, it may be useful to learn from the thinking of Edqvist and Hommen (2008) and others about innovation systems as *process-performing* systems. Edqvist, for example, proposes ten processes, but there are also other accounts and there is not yet a comprehensive or generally agreed list – nor a theoretical basis for saying what should be on or off such a list. Governance will have to be considered from a *change* perspective: what is needed in order to allow RTDI governance systems to cope with or encourage change? Correspondingly, governance has to be also considered as *lock-in generating*.

Existing studies of governance appear to devote too little attention to at least four areas:

- One is the question of resource allocation (and, in effect, battles about resources within the governance structures). Clearly, a governance system must allocate resources, but the question is where and how this is done. There is some evidence (for example from Austrian experience) that advisory councils like the CNIC risk becoming part of the battle among stakeholders if they themselves allocate resources.
- A second is the role of governance in combating "dynamic inconsistency" – that is, the inconsistency between the time scales and incentive structures under which political decision-makers live and the governance needs of the innovation system, which tend to involve much longer time horizons. While this is much discussed in Chile, there is little discussion of it in these terms elsewhere, though there is a general understanding that advisory councils can combat short-termism.
- Third, some countries tend to have coalition governments for long periods. This gives a more personal and party-political dimension to co-ordination within the innovation system. In particular, where different partners within a coalition control different Ministries, horizontal co-ordination becomes more difficult because it confronts differences between party-political agendas.
- Fourth, there is interdependence among different levels of innovation governance – regional, national and international.

This short summary of the issues currently perceived in studies of research and innovation governance suggests that we can usefully assess the Council's performance against the following dimensions (not all of which are necessarily desirable features of councils).

- 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 (including from the New Public Management approaches / practices).
- Policy deployment: design of agencies and instruments.
- Articulating between regional, national and international levels.
- Allocating resources.
- Enhancing the profile of research and innovation.
- Contextual fit: the degree to which the Council's design and behaviour function well in the specific context of Chile.

OECD experience with science and innovation councils

Councils to advise governments on science and innovation are a long established phenomenon in many OECD countries, though their success is highly variable. Historically, the function of these councils has tended to follow contemporary thinking about the role of science and technology in innovation. Up to the 1980s, councils tended to focus on science and then started to take on technology questions, in line with the somewhat linear thinking of those times. More recently, innovation has tended to become more central so that councils aim to influence the "innovation system" as a whole – including, but not only, science and technology. This fact is not always reflected in the names of the councils; for example, the Finnish Council takes a systemic approach to science, technology and innovation but has not updated its name to reflect this, apparently on the grounds that it already changed its name once, adding "technology" to its original title of science policy council.

Eight councils in OECD Member countries

This section summarises some characteristics of eight science and innovation councils in OECD Member countries, chosen to reflect a range of practice. More detailed descriptions of these councils are provided in the Annex.

The *Austrian Council for Research and Technology Development* was set up in 2000, against a context of highly fragmented governance, lack of clarity about roles – especially in the division of labour between ministries and agencies – and uncertainty about the national direction. It was a direct response to the perceived need for Austria to achieve better research and innovation performance in the light of the European Union's Lisbon Agenda of improved innovation and competitiveness, and related national goals. Its role is advisory, but it is listened to by government and has had a significant influence on policy – though there are also other important influences, such as the agendas of the major research and innovation agencies. The Council's *Strategy 2010* focuses on short-medium term actions and is symptomatic of the Council's near-term engagement with the innovation system.

Canada's Science, Technology and Innovation Council was established in 2007 and replaces three former councils in an attempt to provide a single source of holistic advice to government across science and innovation in support of the new national science, technology and innovation strategy. However, despite the fact that its remit covers science as well as innovation, the Council is appointed by the industry

minister and supported by a secretariat housed within that ministry. Having been established in 2007, little evidence is yet available about the council's performance and it has so far published nothing. The intention appears to be that it will focus on giving (sometimes private) advice to government rather than being an outwardly orientated source of strategic intelligence, although it is also in the process of commissioning external studies. To date, Canada's industry-ministry dominated advice system appears to have had limited influence on overall R&D and innovation policy, but the new council structure is expected to improve this.

The *Finnish Science and Technology Policy Council* provides the source of inspiration for many recent attempts to co-ordinate national research and innovation policy. Chaired by the Prime Minister and containing other innovation ministers as well as academic and industrial people, the council has a successful history of setting broad strategic directions in research and innovation policy, including the very daring decision during the recession of the early 1990s, which coincided with the collapse of the Soviet Union and Finland's largest export market, to increase national R&D spending. The council publishes a review of science, technology and innovation once during the term of each government. Recently, it has focused on the importance of internationalisation and the R&D funding agencies have modified their funding instruments to reflect this new priority. While the Council is generally seen as having been very important during the 1990s, there is less agreement about the centrality of its role today (Pelkonen, 2006), when the Finnish innovation system is arguably in much better shape that in the earlier days of the Council.

The *Irish Advisory Council for Science, Technology and Innovation (ASC)* was set up in 2005 as the successor to the Irish Council on Science, Technology and Innovation (ICSTI: 1997-2005). The major difference between the two bodies is that the number of members was halved (from 25 to 12) and that the responsibility of approving government S&T funding priorities was taken away from the Council. In parallel, Ireland created the post of Chief Scientific Advisor, modelled on the UK's Chief Scientist. The ASC interfaces between research and innovation stakeholders and the government, tackling and recommending policy on issues such as internationalisation, absorptive capacity and researcher careers. During the past eight years or so, Irish economic and technological development has been very rapid and has involved the injection of greatly increased funding into the higher education system. This "education ministry sphere" has therefore developed its own parallel set of governance structures and advisory bodies that operate separately from the ASC and the "industry ministry sphere".

The role of the *Japanese Council for Science and Technology Policy* was redefined in 2001 and the council reconstituted so that it no longer had a narrow focus on advising the prime minister about science policy but brought six sectoral ministries together with academics and industry to co-ordinate policies for the innovation system. It is an operative organisation that meets weekly, using its 100-strong secretariat to devise plans and sets relevant budgets, so it combines the roles of advice giving and policymaking.

The *Netherlands* has separate councils for science and technology, on the one hand, and innovation on the other. The Netherlands has a strong consultative tradition and it has enjoyed a proliferation of advisory bodies, whose numbers were reduced in the first years of this century. The *Council for Science and Technology Policy (AWT)* has survived this process and responsively advises government on longer term research policy debates and issues. The *Innovation Platform*, set up in 2003, brought ministers (Prime Minister, Ministries of Education and Economic Affairs) into the process, inspired by the Finnish model. It communicates widely and consults broadly, identifying problems in the innovation system and launching projects intended to lead to their resolution, often through the eventual launch of a new instrument.

Table 2.1. Some characteristics of science and Innovation councils

	Austria	Canada	Finland	Ireland	Japan	Netherlands IP	Switzerland	UK
	Austrian Council	Science, Technology and Innovation Council	Science and Technology Policy Council	Advisory Council for Science, Technology and Innovation	Council for Science and Technology Policy	Innovation Platform	Science and Technology Council	Council for Science and Technology
Established	2000	2007*	1963	2005*	2001*	2003	2000*	1993*
Own law	Yes	Pre-existing	Yes	Pre-existing	Yes	No	Yes	No
Mission / Terms of Reference	Advice, networking, strategic intelligence	Advice (may be secret)	Develop the NIS, co-ordinate ministries, advice	Advice, interface with stakeholders	Strategy, co-ordination of ministries	Analyse NIS needs via projects and propose interventions	Advise on science policy; Evaluations	Advise Prime Minster on S&T
Membership								CSA Chairs
PM, President	No	No	Yes	No	Yes	Yes	No	No
Other Ministers	Yes	3 deputy ministers: health, trade, industry	7 other ministers	No	6 other ministers	Ministers of education and industry	No	No
Industry	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Academics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Foreigner(s)	Yes (1)	No	No	No	No	No	Yes (1)	No
Appointment	BMVIT, BMBWK	Industry Ministry	Government	Industry ministry	Cabinet office	PM	Government	PM
Members	8 (12)	18	23	12	15	17	12	17
Controls budgets?	Additional appropriation	No	Directional	No	Yes	No	No	No
Own reports	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Studies?	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Influence?	M/H	?	H	M	H	H	M	M
Secretariat?	8	Yes	3	Forfás	100 people seconded from ministries	8-10 people	7 people	Yes
Consult stakeholders?	Working groups	?	No	Yes	Yes	Yes	Yes	Yes
Communications	Reports Awareness campaigns	Reports, secret advice	Reports	Reports	Plans, budgets	Reports, extensive working groups and conferences	Reports	Reports; dialogue with PM
Evaluates	(No)+	No	No	No	Expert sub-group	No	Occasionally	No
Uniqueness	Parallel Science Council	Yes	Yes	Parallel Education Council	Yes	AWT in parallel provides S&T advice to the same ministries	Yes	Yes

* Continuation of a previous council +Evaluation activity established together with a national R&D evaluation network.

In contrast, the *Swiss Science and Technology Council* is made up wholly of academics and – despite its name – is rather narrowly focused on science. The traditionally non-interventionists stance of the Swiss state is reflected in the fact that there is no other council working on technology and innovation. In practice, these issues are handled by agencies and the Council has little influence on the totality of innovation policy.

The *UK's Council for Science and Technology* has been reorganised several times. It has the function of advising the prime minister about science, technology and research policy and makes a growing number of excursions into broader innovation policy, especially where this involved cross-ministry co-ordination. The Chief Scientist (Chief Scientific Advisor) co-chairs the Council and has the additional task of ensuring that policy advice to government contains a scientific component. The CST appears chiefly to tackle incremental improvements needed to the innovation system and does not set overall innovation policy or strategy.

Benavente (2006) describes the Irish and UK models as "dominant actor" models, meaning that the advice function is provided from within the sphere of a particular ministry: in these cases the ministry of industry. This is certainly the case for Ireland, where actors from the health and higher education areas bitterly resent the fact that the national arena for research and innovation policy discussion is within the industry ministry's territory. It is less obviously the case in the UK. The Office of Science and Innovation (formerly Office of Science and Technology) originated within the Cabinet Office and was moved to the industry ministry once its functions had become routine. However, it has been at pains to point out that it is "*in* the Department of Trade and Industry but not *of* the Department of Trade and Industry" (interview with David King, 2002) and in practice it functions as an independent actor. In the present sample, however, Benavente's category is certainly relevant not only to Ireland but also to Canada and the criticism his categorisation implies is probably generally valid.

The fact that five of the eight councils considered are reorganised versions of previous committees underlines the degree to which these things are hard to get right (and that requirements are changing). The Norwegian experience – as reported by Arnold, Kuhlmann and van der Meulen (2001) – of experimenting with such committees for 50 years without finding a consistently good recipe would also support that idea. It appeared that the key success factor in Norwegian research and innovation advice was the quality of the personal relationship between the chair of the current committee and the government. Work on research and innovation governance (Arnold and Boekholt, 2002) also underlined the importance of personalities and personal relationships.

Most of the councils have been established via legislation. The fact that the UK and Dutch ones have not reflects national legislative practice rather than a difference in status. The prime minister chairs three of the councils, though these tend to have two levels of meeting, with working meetings taking place in the prime minister's absence. Four involve other ministers and a fifth (Canada) involves deputy ministers. Most include representatives of a wide range of sectors of society, especially making sure that the span the industry and education ministry spheres. However, as mentioned above, the Swiss Council involves only scientists. The Irish and Canadian Councils, which sit within the "industry ministry sphere", both contain numbers of academics but no representatives of the governance structures from the "education ministry sphere", limiting what they can say with authority about holistic policies that span the industry and education ministry spheres.

Most of the councils are national in composition. Only two contain a foreigner – a sacrifice of external perspective that seems roughly analogous to a large company operating without any non-executive directors.

The Japanese Council has budget planning and allocation as a central task. It therefore has a secretariat of about 100 civil servants, seconded from the ministries represented in the Council. Other councils' secretariats amount to a generous handful of people. The education and industry ministries jointly provide the secretariat to the Finnish Council, thereby uniting the two important but traditionally warring factions whose actions and strategies need to be co-ordinated via the Council.

The Finnish Council can set the broad direction of budgets but implementation is up to the individual ministers and does not always follow the lines the Council suggests (Pelkonen, 2006). The Austrian Council had the task of allocating an additional appropriation of funds for R&D but its suggestion that it should assume wider budgetary responsibility has been firmly rejected by the Government and the rest of the governance system. The majority of the councils considered here do not allocate budgets. All, to varying degrees, act as sources of strategic intelligence, both commissioning reports and publishing their own, though in some cases advice to government may be confidential. However, their involvement with evaluation is limited. The Austrian Council has suggested that it should play a role in the evaluation of the innovation system but does not have the legitimacy to do so. It has since established a relationship with a national R&D evaluation network that allows it to overview the sum of national evaluative activity in research and innovation. The Swiss Council occasionally produces evaluations on request from the government. None of the Councils considered has the kind of systems-wide responsibility for evaluation proposed by the CNIC.

The councils in OECD Member countries almost always involve both industry and academia as advisors. Curiously, only the Finnish council involves the research institute sector, despite the inherent closeness of these institutes to innovation processes. The Councils considered in this Report tend not to suffer policy capture. They engage with a sufficiently wide set of stakeholders and provide a neutral forum for discussion, so that attempts by special interests to pursue their own objectives quickly become visible.

Most of the councils have a wider role in stakeholder consultation and communications. Some of the most effective councils use working processes that involve external people in project teams or sub-groups and go well beyond advising about problems to proposing solutions. The Dutch Platform is especially strong in this respect. It has very conspicuous communications activities that range from conferences to films and makes much more use of consultative meetings than the other councils.

Five of the eight councils considered have a more or less unique role as advisors on the whole of the innovation system. Three sit within the sphere either of the industry or education ministry and their ability to influence overall policy is correspondingly limited.

Lessons from OECD experience

Given that so many aspects of these councils' performance are conditioned by their different contexts, caution is needed in generating transferable lessons. Assessing the degree of policy influence of these councils in comparative terms is difficult and can at best be done subjectively. A key consideration is that they all provide advice in rather developed innovation systems, where many system components function quite well. Compared with developing or emerging countries, the need for advice from such councils is not always so great. Thus, for example, it may well be that the apparent decline in the importance of the Finnish Council is caused not by the structure or behaviour of the Council itself but by the Council's own success in strengthening the innovation system to a point where it needs comparatively minor adjustments rather than major changes.

Figure 2.1. Representation of influence of councils on overall innovation policy

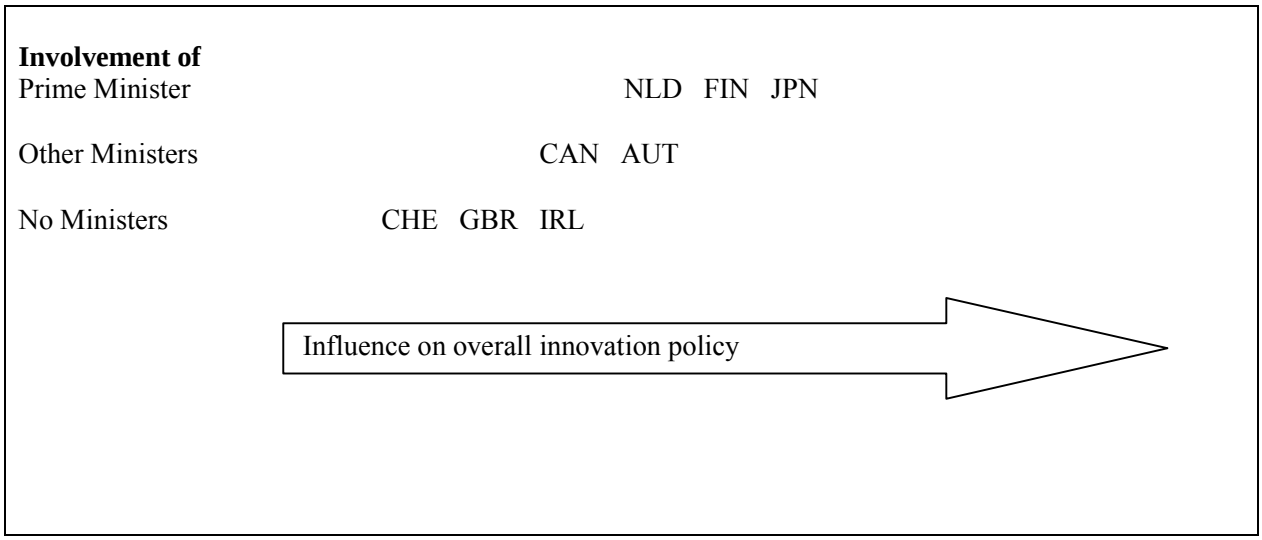


Figure 2.1 provides an impressionistic assessment of the relative degrees of influence of the councils considered over the design and implementation of coherent national policy for the innovation system (including of course research). It is based on the discussion in this chapter and on the more detailed information about the councils that is presented in the Annex. The assessment should of course be treated rather cautiously, but does suggest that the prime minister tends to be involved in the most influential councils. When only other ministers are involved, there is finally no "referee" in the system and no one who can impose the council's view on government as a whole.

A second driver of councils' influence appears to be the scope of their legitimate concerns. It appears that the ability of some of the councils to affect innovation policy as a whole is limited by the fact that their legitimacy is only partial. Thus, for example, it is difficult for the Austrian Council or the Irish ASC to have the last say on policies that affect research in higher education when there are parallel bodies responsible for that sphere. The Finnish, Japanese and UK councils have clear legitimacy across the whole innovation system; the two of these in which the prime minister is active have strong influence. The Dutch Innovation Platform contains the Prime Minister, Economic Affairs and Education ministers, and while there are other bodies that advise on education and research, they have not established the degree of legitimacy currently possessed by the Innovation Platform. The conclusion of this somewhat tentative analysis must therefore be that the combination of systems-wide legitimacy with the presence of the prime minister seems to be the winning one.

A third driver of influence appears to be the presence of ministers. At least, it can be said that the *absence* of ministers increases the communications gap between the council and the government, reducing the chances that advice will be ignored.

Of course, the role and structure of councils represents a *choice* by government. From the government perspective, the councils reviewed provide three possible choices:

- A *joint planning model* (Japan), where the government uses the Council as a virtual "horizontal ministry of innovation", much as engineering companies build project teams by bringing together people across different disciplines.

- A *co-ordination model* (Finland, Netherlands Innovation Platform, to some extent Austria), where the intention is that the council should communicate horizontally across ministry responsibilities so as to align policies in support of innovation, without this alignment always being binding.
- An *advice model* (Canada, Ireland, Netherlands AWT, Switzerland, UK), where the government is happy to be proactively or reactively advised on research and innovation policy but does not want to be restricted by that advice.

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. The CNIC is an example of a "co-ordination" council.

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. The CNIC should therefore be prepared to continue to modify its form and working processes in order to achieve the best possible fit with the needs of its context. It needs also to be somewhat flexible in its form if and when government changes. Unless the government "owns" it, the CNIC will be ignored.

The extent to which councils have a basis in legislation is driven by the legal traditions of the countries involved. The English-speaking countries in our sample have little tradition of legislating when a simple ministerial decision will do; other countries need a clearer basis in law in order to generate legitimacy. Chile is clearly in the second category, so the Council should seek legislation to ratify the presidential decree, otherwise its role can always be questioned.

All the councils generate reports of the advice they give to government, though this is not always in the public domain. All but the Finnish council in varying degrees commission and/or produce studies of bottlenecks in the innovation systems. They usually complement these with proposals for policies to solve the problems. These councils are therefore not only arenas for internal discussions among council members but also sources of strategic intelligence for the national research and innovation policymaking communities and discussion more generally. Wisely exploited, these publications can trigger wider debates and awareness of the importance of research and innovation – especially if coupled with Dutch-style information and consultation campaigns.

Based on international experience it appears important that co-ordination and advice councils do not get entangled in resource allocation or budgeting. By and large, they lack the power to make their decisions stick. It becomes hard for others to deal with them if they are simultaneously sources of money and advice. Since they have resources, they also become participants in the competition among actors – bringing them into conflict with their roles as neutral arenas or co-ordinators. In the Austrian case, for example, the Council was temporarily asked to distribute an additional appropriation for R&D but when it suggested that this role should be extended it was immediately seen by ministries and agencies alike as a threat, undermining its "arena" function.

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. The CNIC's strategy of complementing its strategies with the "flagship" clusters project appears wise; it needs an early demonstration of its usefulness.

The OECD countries' councils examined in this report all inhabit systems where there is considerable distributed strategic intelligence within the state's part of the innovation system. This means that a great deal of instrument and even policy design takes place in ministries, agencies and at other levels "below"

that of the respective advisory council. It has the advantage of exploiting the superior knowledge of needs and implementation found at lower levels of the system and demands good communication between the council and organisations working at "lower" levels. Making good use of the intelligence distributed across the system appears to depend to a fair extent on developing what might be called "social networking capital". For example, the Finnish system strongly depends upon constant informal communication between the agencies, ministries and the Council. It is tempting to suggest that, for similar reasons, the Austrian system works better than its fragmented and unclear governance structures and processes would suggest. Indeed, the Viennese research and innovation policy community is remarkable in the extent to which it participates in public debates and other events that encourage socialising so that – whatever the imperfections in formal communication may be – members of the policy community are intensely aware of what others plan and are doing.

While it is important to use distributed strategic intelligence, the fact that all the councils studied also generate their own intelligence underlines the importance of this function: not only in order to acquire the knowledge needed to build good strategy advice but also to create an evidence base on which consensus can be built.

Compared to the rather incremental progress sought by the OECD councils studied, the CNIC is aiming for radical changes in support of the goal of doubling income per head by 2021. This provides a way to reinforce the idea that (as in Finland) everyone is "in the same boat" and to show a common vision for improvement. The Council will need to consider what incentives can be offered to reduce the amount of fragmentation in the system, while at the same time empowering the cluster and regional levels.

Tentative implications for the Council

This account of international experience suggests a number of desiderata that could be used to assess the CNIC, which is a "co-ordination council" in the classification developed above.

- Membership by ministers, preferably including the president / prime minister, in order to generate close linkage with policy needs and to maximise the Council's influence over government policy.
- A form and processes which are robust against changes of government by being sufficiently flexible to accommodate some changes priorities while maintaining continuity of strategic intelligence and advice.
- "Ownership" of the Council by Government.
- Good personal relations with Government.
- A basis in parliamentary legislation – a necessity in Chilean administrative culture.

Moreover, that it:

- Includes a wide range of stakeholders, including policymakers, especially spanning the "industry" and "education" ministry spheres.
- Consults widely.
- Communicates widely – not just to the Government but also to other stakeholders and the general public.
- Generates its own strategic intelligence but also exploits and integrates the strategic intelligence available elsewhere in the system.

- Produces strategies that are accepted and implemented by Government.
- Makes its mark quickly, both as a "thought leader" in policy making and through successful intervention.
- Reduces systemic fragmentation.
- Reduces dynamic inconsistency.
- Proposes, in the Chilean context, step changes in policy.
- Avoids allocating ("core") budget resources.

CHAPTER 3 - SELECTIVITY AND CLUSTERS

In line with practice in many other countries, the CNIC has chosen to combine selective and generic approaches to research and innovation policy making. Indeed, it is difficult to think of any successful modern economy that does not have a history of selective as well as generic industrial and innovation policy. Given the risk of policy capture by special interests, there is understandable caution against selectivity in Chile. Both for this reason and because international experience shows the importance of an open and rational approach to "priority setting" in a broad sense, the Council needs to take care to use sound practices in devising selective interventions (as with generic ones), minimising the risk of a misallocation of resources. This section discusses the need for selectivity as well as some additional instruments that can be used selectively before focusing on clusters.

In order to provide a sound basis for selective policies and to minimise the risk of resource misallocation certain principles should be applied. These include the following:

- *Provide a well-founded rationale for policy intervention*. This involves an ex-ante evaluation of potential costs and benefits of policy measures.
- *Involve a broad set of actors or stakeholders in policy formulation* in order to gain and distribute a maximum amount of information.
- *Maintain high-powered incentives for innovation*. This goal is best achieved by fostering vigorous competition.
- *Avoid rent seeking and lock-in in constellations that produce inefficient outcomes*. The main problem may be less one of "picking winners" than avoiding being locked-in with failures (Rodrik, 2004). One option to minimise the risk of failure and lock-in in failure is to conduct policy experiments, *i.e*. to start with small-scale pilots to see if the measure works, and if so scale it up to become a full-fledged policy measure.
- *Keep the system as open as possible*. *E.g.*, make sufficient use of competitive tools of selecting projects. R&D consortia or public-private partnerships for research and innovation should be kept open to new participants.
- *Provide maximum transparency in order to avoid industrial policy initiatives to be captured by special interests and maintain high performance*. Ongoing monitoring and evaluations are important tools in providing the necessary degree of transparency and feedback to the policy cycle.

Selectivity

While it is attractive to present the choice between generic and "thematic" / sectoral focus in research and innovation funding as a dichotomy, this is in an important sense a false one. In the case of a generic subsidy for R&D and innovation, e.g. a tax incentive for R&D, it is likely that take-up is representative of existing capabilities. If an innovation system contains, say, a large R&D capacity in mining, the take-up of a generic subsidy will have a large mining component. In this sense, a generic subsidy amounts to a selective strategy that reflects the *status quo*. In practice, good selective strategies are generally based on an understanding of existing resources and inputs from the relevant stakeholders (whether via consultation

or self-organisation). In many cases, therefore, the difference between a "generic" and "selective" strategy is not so much in the choice of themes but in the amount of thinking and organisation that is applied to them. Increasingly, R&D funding instruments are in use, which focus on strengthening thematic / sectoral innovation systems, supply chains and knowledge value collectives. In addition to connecting the individual needs of participants to sources of more knowledge and faster innovation within the innovation system, these can therefore prompt the build-up of human capital able to outlive the successes and failures of individual institutions such as firms.

"*Selectivity*" has a chequered history that includes both successes and mistakes. Many economists prefer "neutral" instruments that do not differentiate between different segments of the economy. This is partly due to memories of the decline of old-style industry policies, where governments found themselves responding to the needs of powerful social groups (employers, trades unions) and increasingly locked into supporting declining industries such as ship-building and steel. It is partly because the neoclassical economic tradition is built on assumptions implying that markets produce optimal results – assumptions that have been challenged by a number of recent developments in economics, including, for example, in the economics of information.

"*Priority setting*" (in science and technology) similarly looks back at a varied history. Gassler *et al.* (2004) point out that that in the period after World War II, S&T priority setting was considered best left to the science and technology community. In the then prevailing "science-push" paradigm based on the linear model of innovation, there was no need for priority setting in the realm of scientific research. Unguided, curiosity driven, mostly basic research would lead to results which then would (occasionally) be taken up by society and industry. The only exception was the research carried out to pursue some kind of "public mission": defence, space and nuclear research being the most prominent examples. Priorities were defined top-down at the highest national level.

This model of priority setting changed in the 1960s and 1970s to include commercial and market-oriented R&D in single large-scale projects, mostly with very concrete and dedicated targets for the development of specific technologies. Some of these – especially in infrastructures, where the state played the role of lead customer but developments addressed internationally generic needs – were very successful. Others (for example, the UK-French Concorde supersonic aircraft project) were a spectacular technological success and equally spectacular commercial failure.

In the late 1970s and early 1980s, some countries even went a step further and ambitiously tried to identify very detailed lists of priorities for the whole of public S&T policies. Often the processes to identify and select "strategic technologies" were identical to the process known in industrial and defence policies: as top down either to protect specific sectors against competition, and (or) to help industries which were seen as being of "strategic importance". In general, the results of this approach to priority setting were not as successful or as effective as hoped. Governments seemed unable to predict developments in the market. Especially when the thematic area prioritised was outside the public domain, the success rate of programmes became smaller.

While in the 1990s, after some disillusion about priority setting following the experiences of the 1970s and 1980s, the main thrust of S&T policy was more towards "functional" priority setting and general improvement of the "systemic" performance of innovation systems, in recent years thematic priorities have received renewed interest. This interest is driven by increasing pressures on public budgets and by the internationalisation (including regional specificities such as the "Europeanisation") of research, which both require concentrating research efforts on a limited set of thematic areas. This is in line with what happens in the Netherlands within the framework of creating more focus and mass.

The literature indicates that five main lines of argument that have been used in the past to justify public intervention in support of mainly thematic priorities (Dachs *et al.* 2003):

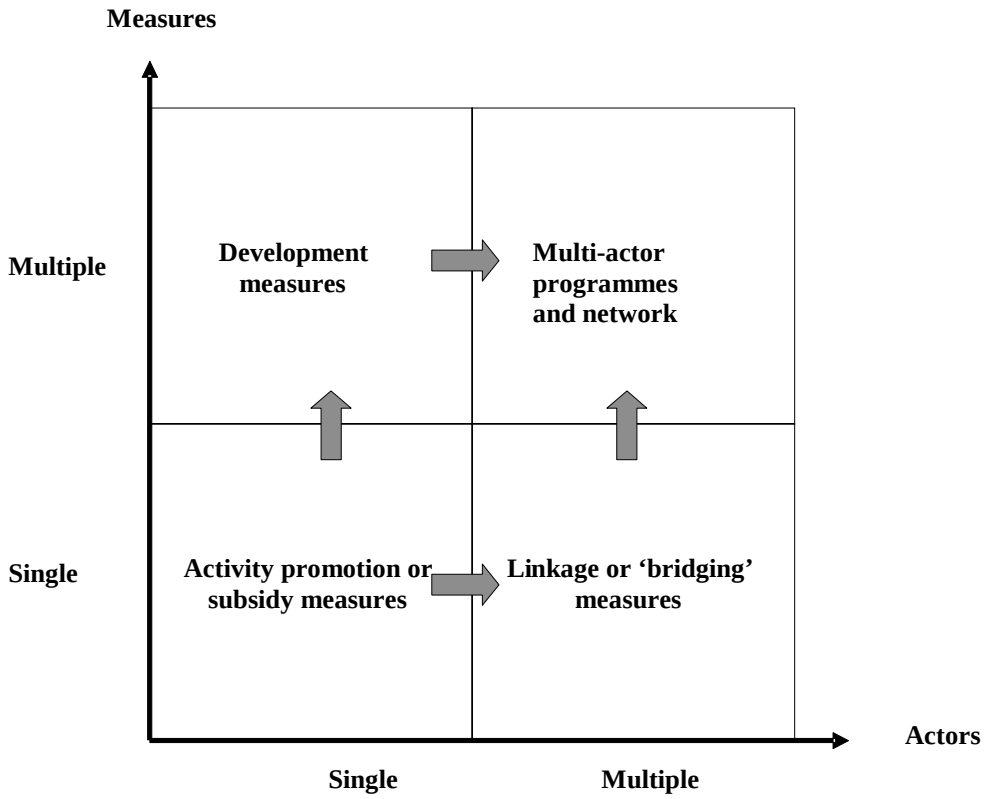
- React to the emergence of new scientific/technological paradigms ("science-push").
- Promote key sectors of strategic industrial importance ("industrial missions").
- Anticipate and react to new societal challenges ("policy-pull", "new missions").
- Ensure presence on emerging future markets ("anticipated demand-pull").
- Follow and adapt to international trends in science and technology ("fast second mover").

But this renewed interest in thematically oriented programmes has been accompanied by a marked change in the character of the technology programmes: the new forms of thematic priority setting (as well as the new forms of mission oriented programmes – Soete and Arundel, 1995) are – in most cases – not simply taking up where the old-style thematic programmes with their very narrow industry/discipline focus started from, but incorporate functional dimensions of the innovation system as well (*e.g.* by fostering collaboration, notably between industry and science). These dimensions include (Rammer *et al*., 2004, pp. 65-67)

- Support for industry-science co-operation.
- Integration of different technologies and research areas.
- (Regional) Cluster programmes.
- Special emphasis on and support for SMEs, new technology-based firms (NTBFs) and start-ups.
- Formulation of R&D programmes with an eye on innovation and diffusion.

While, therefore, traditional innovation policy instruments focused very much in the South-West quadrant of Figure 3.1**,** with policy "doing things to" individual actors, such as firms or university research groups, they have tended to migrate to the other quadrants. In some cases – notably in Ireland, with its focus on "company development", support systems have moved North to try to lead individual actors through multiple instruments. In many other systems, more of the effort has gone into the SE quadrant, with individual instruments being used to link different actors. Many EU Framework Programmes, for example, operate in this segment as do the Irish Innovation Partnerships. But increasingly, measures and instruments are operating in the NW quadrant, trying to act systemically with multiple actors and using multiple instruments. Interventions in industrial clusters, for example, have this character, as do competence centres.

Figure 3.1. Trends in innovation instruments



These interventions conform to our *systemic* understanding of research and innovation. In part this seems to represent an improvement in theory: a better way to describe what already exists. But there is also some evidence that research and innovation operate in ways that are *increasingly* systemic: that there is also a qualitative change in reality in progress. There is evidence for this, for example, through the increasing citation of academic research results in industrial patents.

Instruments

A growing range of instruments is available selectively to address industrial and technological development. These include

- Technology programmes.
- Competence centres.
- Innovation networks.
- Technology platforms.
- Cluster policies.

A common characteristic is that these tend to operate on areas of the economy that are somewhat established. By and large, they provide mechanisms through which policymakers can engage the self-organisation of research and innovation actors to define selective policies. These do not address situations where, for example, new branches need to be created. Those cases are considerably more difficult and may involve foresight as well as more traditional "science push" measures like generic science parks.

Europe's Nordic area has a strong tradition of *technology programmes*, which focus on building national capacity in industrially important technologies. TEKES (Finland), VINNOVA (Sweden) and the Innovation Division of the Research Council of Norway have operated very similar R&D programme planning and implementation mechanisms, largely according to the STU model. RCN's variant involves "user-directed R&D", where companies receive R&D subsidy funding that they can in part spend on work with or from institutions in the knowledge infrastructure. TEKES runs technology programmes in two parts – one, relatively open part mostly involving research in the knowledge infrastructure; the other closed, and involving R&D subsidies to companies, sometimes with and sometimes without knowledge infrastructure participation. Projects generally link industrial and academic R&D efforts, usually in binary relationships. The process of stakeholder involvement in planning and programme management is common to all, though there are variations in the amount of power exercised by the programme board over individual project decisions. Evaluation evidence concerning these programmes is broadly positive (Boekholt, Arnold and de Heide, 2007). *Competence centres* have some recognisably special features. Notably, they are:

- funded by three partners: industry, one or more public research institutions (University or non-university) and a state agency.
- interdisciplinary and problem-focused in the research they do, demanding "horizontal" networking across traditional university structures.
- intended to have an effect on university resource allocation and strategy, in addition to reinforcing university-industry links. To this end, they involve an unusually high degree of subsidy, often 60% or so.
- involving long-term contractual arrangements (7-14 years), requiring a much bigger commitment than traditional project-by-project funding of collaborative R&D.
- creating new on-campus structures, and therefore make new organisational and structural demands on the universities.

Moreover,

- their long-term presence on campus and their engagement with postgraduate education draws them into closer contact and co-operation with universities' "core business" of education and research than is often the case with linkage actions, which tend to focus more purely on research.
- by drawing industry personnel onto campus to join in research, they also extend academics' networks into the industrial research community.
- it is central to the idea of competence centres that they aim to do more fundamental types of research than is normally possible in industry, or even in conventional academic-industrial collaboration.

One example is the Swedish Competence Centres programme, which funded ten-year academic-industrial centres of excellence of high scientific quality in major Swedish universities. An impact study of the centres (Arnold, Clark and Bussillet, 2005) found that they generated:

- Knowledge – both practical/empirical knowledge, directly useful in design and development, and more fundamental understanding useful to Swedish industry in the longer term.
- Research-trained people, particularly adapted to working in industry.

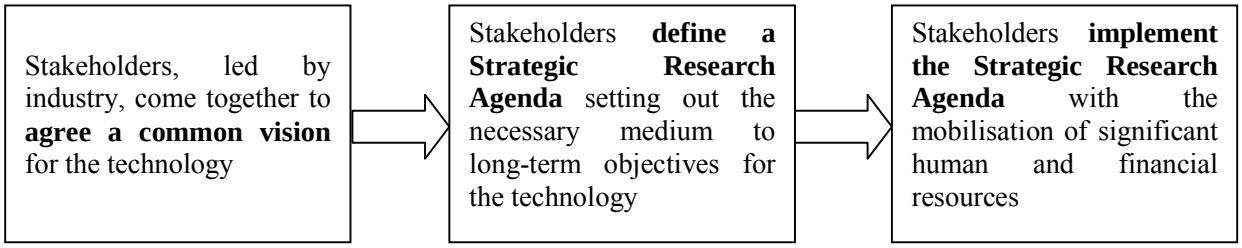
- Extended networks of people and organisations that work with a common set of knowledge in universities and in industry. We can also think of these as knowledge-bearing "spines" within Swedish innovation systems.
- Direct inputs into innovations, which generate money and jobs.
- Increased attractiveness of the Swedish innovation infrastructure, influencing the location of R&D and production for certain firms (especially large ones).

Similar programmes exist *inter alia* in the USA, Canada, Australia, Hungary, Austria and Norway.

Innovation networks are (generally regionally based) collectives of companies and organisations in the knowledge infrastructure, strongly focused on innovation. Usually they are smaller scale than cluster policy (see below). In Swedish policy, innovation networks were originally an outgrowth of technology programmes where, rather than funding binary industry-academic partnerships – the innovation agency began to fund larger constellations with several companies, one or two research institutes and a university in the VAMP programme (which focused on light materials and structures). VINNOVA generalised this successful approach into the AIS programme, which had no specific technological focus. Rather, it responded to proposals bottom up. An example of an AIS project is "Robot Valley", centred on Västerås (where ABB in Sweden has its headquarters). It comprised a network of the regional college, ABB Robotics and other companies aiming to increase the area's capacity to design, build and use robots. Denmark has run "centre contracts" (recently renamed "innovation contracts" for many years, in a version of innovation networking that is not necessarily regionally based. Centre contracts create a consortium of companies with a common problem, at least one university and at least one research institute. The University and institute solve the problem for the companies; the university published; and the institute acquires a new piece of intellectual capital that it can use to generate externalities by re-using to serve additional companies. The Danish programme was positively evaluated (Kristiansen *et al.*, 1997).

The most recent instrument we describe is technology platforms, which were innovated in the last few years by the European Commission. The Technology Platforms allow a wide range of stakeholders – primarily led by European industry – to work together to define common needs and to assemble a portfolio of funding, based on those needs. The results differ among platforms, but clearly allow configurations to emerge that could not easily have been foreseen or designed in the form of a programme. The Technology Platforms have been imitated at national level in some countries – sometimes as stand-alone efforts; sometimes as national adjuncts to the European platforms. Their key characteristic is that they are largely self-organised. They define their own strategies and seek their own money, usually from a mixture of state and industrial sources. The functioning of such Platforms is illustrated in Figure 3.1.

Figure 3.2. Functioning of Technology Platforms



Cluster policy

Cluster policy has its roots in industrial economics going back at least to Marshall's description of industrial districts but was given a boost by Michael Porter's book *The Competitive Advantage of Nations* (1990). Porter's original concept defined clusters as geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions .in particular fields that compete and also co-operate (Porter, 1998). Table 3.1 summarises wider theoretical rationales for cluster policies.

In practice, cluster policy spans quite a variety of different forms and ideas about clusters (Raines, 2001), ranging from micro-networks of firms to macro-level sectors of industry. Usually, though not always, there is a strong spatial component to the definition of clusters, recognising the centrality of the dynamics of industrial districts. However, in general, clusters are now seen not only as having industrial but also infrastructural, governmental and governance aspects (Cooke and Morgan, 1998; Asheim, 1999). Nauwelærs (2001) points out that cluster policy has been constructed through an "innovative combination of existing policy instruments from traditional policy fields" and argues that in merging several different policy traditions, cluster policy has drawn attention to the need for a more comprehensive, integrated approach to local economic development and the growing importance of localised policy design and delivery.

A recent overview by the European Trend Chart on Innovation showed that a vast majority of EU25 countries have implemented cluster policies, at regional or national level or a combination of both. Reviewing the Trend Chart countries one can see that "stand-alone" or specific cluster policies are rare (at least at the national level) and are often closely linked to research policy, innovation policy, industrial policy, and regional development policy. When policies aim to strengthen existing 'traditional' clusters, they would often be positioned in industrial policy or regional regeneration strategies. When policies aim at encouraging the emergence of new clusters in high growth industries, they are mostly linked to science and technology policies.

Table 3.1. Theoretical basis of cluster policies

Concept	Benefit
Marshallian externalities	
Labour market pooling	Labour cost savings due to access to specialised skills, especially in an environment where quick turnaround is important
Greater variety of specialised intermediate goods and services	Access to a local supplier base that has more product variety and a high degree of specialisation
(Tacit) knowledge spillovers	Access to tacit knowledge in geographic proximity by means of both formal processes as well as through such informal channels as knowledge leakages made possible by casual inter-firm interactions
Porter's market conditions	
Demanding customers	Motivational effects due to demands of highly competitive local customers that improve quality, cost, etc.
Rivalry	Motivational effects related to social/peer pressure
Complementarities	Better sales opportunities of firms due to search cost savings for the buyers of complementary products offered in proximity and privileged opportunities for co-operation (sales, marketing, etc.) between nearby suppliers of complementary products.
Cost advantages	
Transportation	Transportation cost savings due to geographic proximity, especially in the case of just in time delivery contracts
Trust	Transaction cost savings due to an environment that encourages trust

Source: adapted from Lulinski (2003).

In practice there are at least four different cluster models (Boekholt and Thuriaux, 1999):

- National advantage model, where "macro-clusters" (more or less at national level) are the objects of policy.
- SME/networking model, at the opposite end of the scale, where the cluster is effectively defined as a network of SMEs.
- Regional cluster development model, where the spatial element is a stronger defining characteristic and where, necessarily, the regional authorities and stakeholders are likely to be more involved.
- Research-industry relations model (for example the German *Kompetenzzentren*), where clusters are centred on academic institutions and largely defined as one or more sets of related links to an academic institution.

The Cluster Policies Whitebook (Andersson *et al*., 2004) states that governments and other public authorities are known to be responsible for most cluster initiatives. "… even initiatives started or managed by private sector actors are in many cases dependent on some form of public funding …, indicating the significance of "cluster policy" for the outcome of cluster initiatives. However, the outcomes of clustering tend to be different depending on whether public or private actors are in charge. Studies of cluster processes have concluded that top-down policies often fail. At the core of cluster processes lies the interaction between the individual firms and organisations".

This finding would support the notion that if governments actively engage in cluster type policies, the firms and other stakeholder organisations should be in the driving seat when it comes to developing activities. The White Paper discusses the rationale for policy makers to engage in cluster policy, which include addressing "systemic failures", the increased global pressure on firms to innovate and the market failure which prevent firms to form inter-linkages and under-investment in capacity-building for collaboration.

The White Paper also considers the options for evaluations and other studies into the effects of cluster policy. "Assessments of clustering, and the associated economic importance of collaboration and partnership, do not always lend themselves to meaningful quantitative estimates of socio-economic impacts. Benefits are often indirect and diffused among stakeholders. The time horizon renders difficulties since some benefits materialise only in the long term. Cluster policies to some extent attempt to move away from the sub-optimisation and lack of relevance in traditional policy approaches. Experimentation, customisation and adjustment of traditional measures are part of the goal." (Andersson *et al*., 2004, page 117).

The report continues to state that the task is partly to measure the specific contribution of collaborative action as opposed to the outcome that would have been observed in the absence of a clustering initiative, *i.e.* to measure "additionality".

Few empirical studies have been conducted to assess the effectiveness of cluster-type policies over the years. An extensive and worldwide survey of cluster initiatives has been conducted by Sölvell, Linquist and Ketels published in the Cluster Initiative Green Book (2003). The conclusion was that the data (of the 238 clusters that responded) showed that 80% of the respondents agree that the cluster initiative they were involved in improved the competitiveness of their cluster. The authors, however, acknowledge that there could be a bias towards successful clusters in the survey. Still, the large number of respondents indicating success is seen as impressive. The cluster initiatives they cover include a large variety of very small scale to more extensive cluster initiatives which implies that comparisons with programmatic approaches are difficult to make. Some of the report's findings on success factors are:

- Key factors include a high level of company trust in government initiatives and having influential government decision makers.
- Cluster initiatives that build clear, explicit frameworks based on the clusters' own strengths and devote time to sharing this framework with all parties are clearly more successful in promoting cluster competitiveness.
- Cluster initiatives with only domestic firms perform less well than those with international outlook.

A recent OECD study showed that there are good theoretical and practical justifications for the international resurgence of interest in cluster policy in recent years, and that such policy demands a fair degree of integration of regional, sectoral, science and technology and education policies. It generated the following lessons for practice:

- Identify explicitly what the national level's interests are, what the barriers to achieving those goals are, and how a cluster approach can help overcome these problems.
- Weigh the relative merits of active intervention from the national government versus framework conditions and facilitation.
- Consider that cluster-type policies can be valuable as a practical tool, not only to respond to conceptual models.
- Be realistic with respect to clarity of targets, funding and duration as compared to programme goals.
- Ensure that programmes have a range of instruments for adaptation across the targets (in terms of cluster types, region types, *etc.*).
- Determine a cross-ministerial strategy for national level intervention.
- Work in consort with regional levels in programme development for capacity building, coherence and complementarity.
- Structure the programme to minimise the associated risks, such as picking winners and lock-in.
- Ensure sufficient private sector engagement, as their motivation ensures longevity of partnerships and their skills reactivity to market changes.
- Set outcome targets, even if it is difficult to evaluate the causal relationship of public policy on private action (OECD, 2007b).

As the experience in a number of countries shows there has been a tendency towards an inflationary use of the "cluster" terminology. Yet the cluster approach remains not only an attractive framework of analysis but also for providing guidance for policies. Policy makers today can draw on extensive international experience with cluster policies – such as the sources quoted above – thus being able to distinguish clearly between good practice policies and mere "cluster rhetoric".

The Chilean Innovation Council has used a systematic, top-down screening strategy to provide an analytical basis for choosing clusters which to foster, based on their importance to the economy and the prospects in their making a greater contribution in future. To avoid the risk of capture and to put its activities on sound foundations, it used an external consultancy – Boston Consulting Group (BCG) – to conduct the analysis. The overall prioritisation exercise, together with the more detailed analyses of potential in eight clusters, have been documented in detail, with three more to be examined in 2008. Based

on these analyses, the Council has been able transparently and publicly to prioritise five clusters – one of which (food) is rather broader than those proposed by BCG. The lessons from OECD experience (see above) about national interest, types of intervention, practicality, having a range of instruments and ensuring private sector engagement are clearly reflected in the Council's practice. The other issues listed by OECD relate more to implementation steps downstream of the Council's work. A crucial element in the Council's approach has been to devolve the cluster management function to the clusters themselves, rather than itself trying to implement the cluster policy. There is a delivery office (Programme Management Office) attached to the Industry Minister to take care of the implementation in the period between the decision to invest in the clusters and the point where cluster managements are in place.

Within two weeks of the final clusters report being presented, a new tourism law was presented to the Parliament, incorporating the initiatives proposed in the study. Co-financed projects were launched for foreign market research and promotion and a budget of some USD 100 million from the FIC was included in the 2008 budget law.

Practical implementation of the cluster policy has proceeded; at the beginning of 2008 cluster management committees were in place for the Mining and Food clusters and structures for clusters in Offshoring, Aquaculture and Tourism were to follow. CONICYT and CORFO have announced competitions for R&D funding in the mining sector, to support that cluster.

Choice of selective instruments

A common theme among clusters and the other selective policy instruments described in this Chapter is that policy makers have a choice about the extent to which they select and implement them top-down or bottom-up. Increasingly, the instruments described above are being used bottom-up, notably via competitions.

The Council's clusters have been chosen via a top-down process that needed to be visibly fair and transparent. At the present stage, where there is not yet widespread experience of these types of measures in Chile, there is a further argument for selecting top-down: namely, that the ability to design and compete for selective support is likely to be sufficiently limited that it obscures the inherent merit of alterative cases. (In this vein, there is experience in Europe of new member state regions being so unused to competing for resources in this way that poor presentation of inherently strong arguments leads to allocation of funds to weak but well-presented projects.)

As experience and ability to compete builds up, however, there is a strong case for awarding selective grants based on competitions. This reduces the requirement for perfect information and perfect planning, which is inherent to a top-down process. Rather, the power of self-organisation can be used so that potential beneficiaries demonstrate to the funding authorities what the opportunities are. The ability to create a consortium to enter a competence centre or a cluster competition is itself an indicator of stakeholders' commitment to the project. The German BioRegio programme is well known for the fact that several proposals that failed to secure funding nonetheless resulted in more local initiatives. For example, the city of Berlin stepped in to fund the proposed Berlin centre, when that failed to win national funding.

A cautionary note is however needed on timing. The Swedish competence centres programme launched 29 centres selected in a single call for proposals in the mid-1990s. As a result, it had to live for the 10-year funding term with a "snap shot" of what seemed interesting and exciting in research-intensive industry and academia from 1995. It would have been better to roll the programme out over a number of years as, for example, was done with Austria's Kplus programme (OECD, 2004).

Given the desirability of moving from top-down to more competitive allocation of selective funds over time, as well as the more general issue of increasing the capacity for strategic intelligence and planning among potential beneficiaries such as regions, the Council could usefully consider what resources (such as information and training) it could provide. These should also feed back to the Council in the form of better-considered inputs and advice from the actors concerned.

The cluster programme is a major effort that will take a number of years to implement, especially in so far as it calls for changes in education and training, research and governance capabilities at regional level. The CNIC should therefore not necessarily rush into using more new instruments but it could selectively consider adopting some new instruments as these become necessary:

- Finnish-style technology programmes, where is it necessary to raise the R&D capabilities of a branch of industry of a national-level supply chain?
- Competence centres in the special cases where significant industrial absorptive capacity can be linked with the knowledge infrastructure to generate long-lasting strategic partnerships and more strongly research-based innovation and/or there is a need to reorient university groups towards longer-term industrial needs and industrially interesting research problems.
- Innovation networks for smaller, more localised and shorter-term innovation needs.
- Technology platforms where there should be a high degree of industrial self-organisation and where there is not necessarily a need to involve the knowledge infrastructure in technological development.

CHAPTER 4 - THE COUNCIL'S PERFORMANCE TO DATE

This Chapter broadly summarises the National Innovation Council's achievements to date, assessing the Council against:

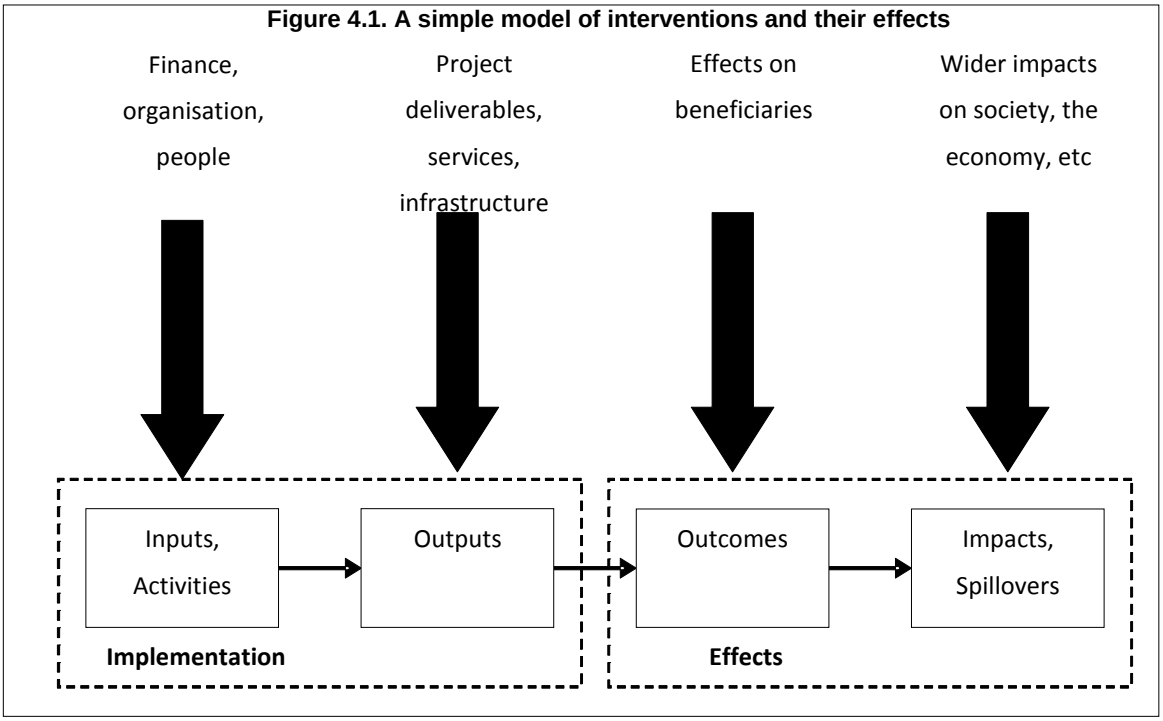
- a logical description of the way the CNIC is intended to function (expressed as a "logic model");
- the challenges for the innovation system presented in the recent OECD innovation systems review;
- the recommendations of the OECD Review of Chile's Innovation Policy about governance for the future of the Council, and
- findings from the emerging literature on research and innovation governance and from international experience of similar councils.

It also considers the CNIC's flagship cluster programme discussed in Chapter 3 in the context of international experience of cluster development.

Assessing the Council according to its intervention logic

Like any other government intervention, the process through which the CNIC is expected to achieve its goals can be described as a chain of causal steps leading from the intervention to its eventual effects. Figure 4.1 illustrates the principle. Inherently, a state intervention provides inputs and involves activities, which are expected to result in outputs. These in turn are expected to cause wider outcomes and eventually to lead to social and economic impacts, as the arrows from left to right in the illustration suggest.

Figure 4.1. A simple model of interventions and their effects

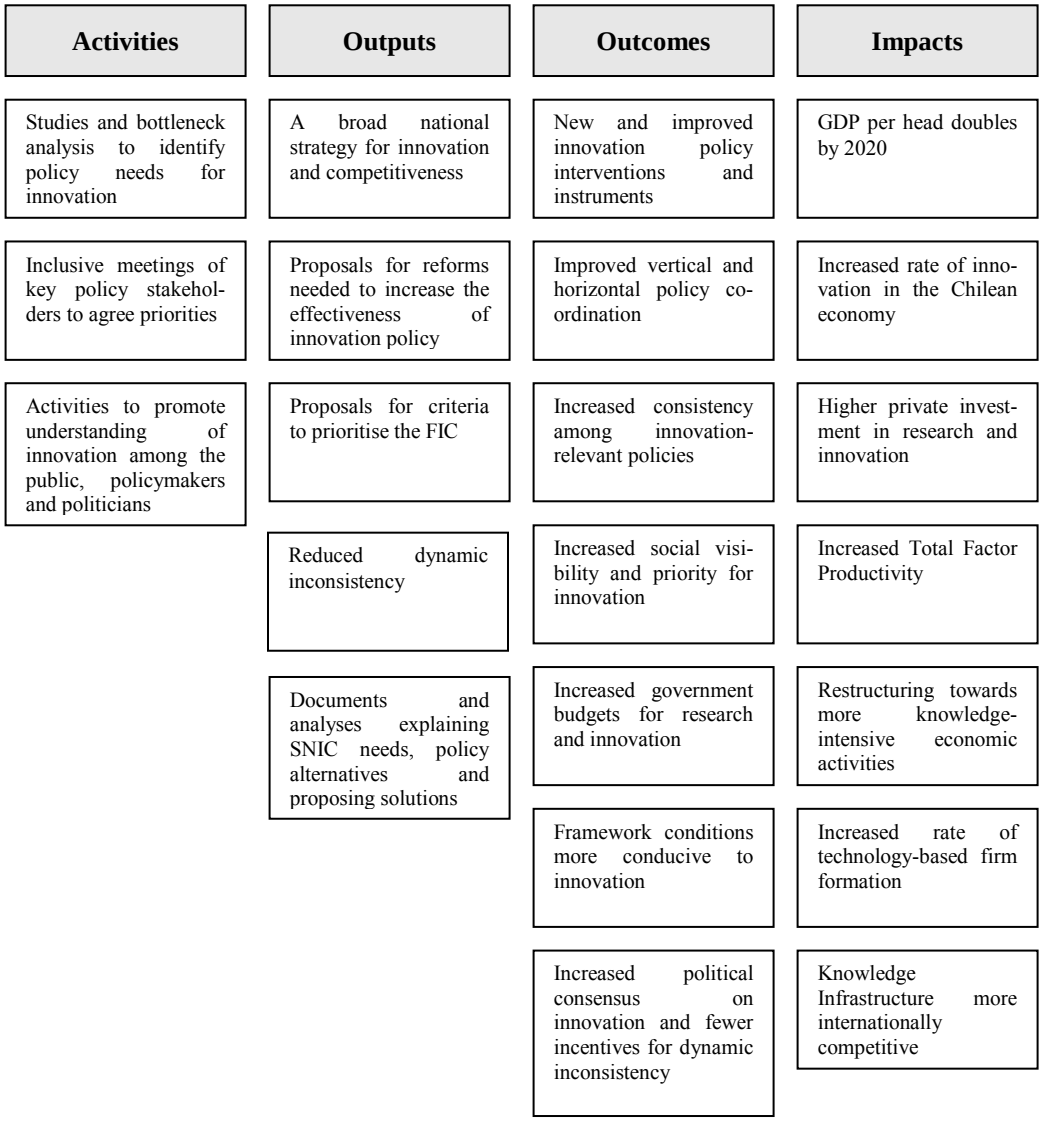


Source : Technopolis.

Figure 4.2uses this idea in a specific way to show the intervention logic of the Council. Broadly, it says that the CNIC should function as an arena for agreeing on policy priorities in relation to research and innovation and that it should document these in an open and accessible way so that they can both be used by policy makers to set policy and serve to explain to a wider audience why innovation is important and what should be done to promote it. The clarity and consensus introduced into innovation and competitiveness policy as a result of this should lead to new and improved policies and measures for promoting research and innovation that are co-ordinated and consistent across government. They should also be reflected in growing consensus at the political level on the need to take long-term action to improve research and innovation performance. This political consensus is needed in order to create incentives (and reduce disincentives) for long-term policies that may not have a political payoff within the current electoral period. These policy changes (outcomes) are in turn expected to lead to improved research, innovation and competitiveness performance along a range of dimensions that ultimately support the overall objective of doubling per capita GDP by 2020.

The Council's remit is effectively to do activities and produce outputs. Implementation is now the overall responsibility of the Ministerial Committee for Innovation (CMI), which therefore needs – together with implementing agencies such as CORFO and CONICYT – to take responsibility for ensuring that CNIC outputs trigger the generation of national outcomes and impacts.

Figure 4.2. CNIC intervention logic



Inputs, activities

The first, important achievement of the Council is to establish itself as a credible analyst and advisor to government. It has brought together around a table many of the actors needed to generate consensus and a common, holistic innovation strategy for Chile and conducted a large amount of analysis of the national innovation system in order to generate successive strategies for strengthening that system. It has consulted relevant stakeholder groups in a series of workshops. There appear to have been few activities aiming to communicate the importance of innovation to society, especially at the level of politicians and other opinion-formers, although some of the FIC resources have been allocated to increasing business' awareness of innovation.

Outputs

The CNIC has delivered the analyses, strategies and recommendations for how to use FIC resources that were required of it, both at the interim Council stage and in the strategy documents of 2007 and 2008 (which are distinguished among national strategy documents in being very explicitly evidence-based, with substantial use of statistics to demonstrate policy needs and achievements). These documents are coherent, well argued and set out a very wide agenda for change. They have played important roles in defining a national agenda for innovation. The formation of the Council has reduced the incentives for "dynamic inconsistency", where political incentives are inconsistent with the need to make policy for the longer term. It has achieved this by increasing the status associated with making and implementing such longer-term policies.

The potential for cluster initiatives to strengthen sectoral innovation systems has been investigated and validated by a neutral external party (Boston Consulting Group – BCG) and a large-scale programme of cluster support has been launched, funded by the 2008 FIC budget.

The Council triggered the formation of the Ministerial Committee for Innovation which is intended to be the decision-making counterpart of the Council. This is a crucial step because without such a counterpart body there is no practical interface between the Council's advice and the government. Involving the ministers is necessary in order to get the authority required to influence budgets. In addition, the creation of the Ministerial Committee is of key importance for developing a coherent whole-of-government approach to innovation.

The Council has established itself as a creator and maintainer of "strategic intelligence" about the innovation system and its performance – not only through its own strategic work but also by commissioning other studies and working to put in place the necessary tools of policy learning, such as evaluation systems. This is an important contribution to de-fragmenting the national debate about research and innovation policy and to building the Council's credibility as an *arena* where policy can be considered, based on evidence about innovation systems performance. Providing and publishing an evidence base is also a useful way to prevent policy "capture" by special interest groups.

Outcomes

The Council contributed to the allocation of FIC financial resources. In 2007 this (USD 52.3 million) led to:

- "Public interest innovation" expenditure on strengthening the institutional framework of the public innovation system, notably through competitions organised by Innova Chile and road mapping of sectors with high economic potential (16%).
- Education, including postgraduate training, accreditation and scholarships for professors and students in pedagogy, to strengthen the teaching base in future allowing CONICYT has increased the number of postgraduate scholarships it offers (17%).
- Science and technology funding for both industry-orientated research university sectors of excellence, in line with the thinking of the Council, including CONICYT's *financiamento basal* funding scheme that supports inter-university networks of research excellence (36%).
- Business innovation schemes, including both R&D support and seed and pre-seed capital funds (5%).

- Internationalisation projects involving market research, promoting Chile's "brand image" and creating sales platforms in interesting markets (5%).
- Programmes for raising awareness of innovation and research (5%).
- Other expenses, especially for strategic intelligence for the CNIC itself (2%), including operating the 2007 Innovation Survey.

The Council also prompted the creation of a number of technology diffusion measures and led the Ministry of Economy to introduce performance contracts in the relation with its agencies. The Education Ministry aims to do the same but has so far experienced greater difficulties in implementation.

Establishing a cluster programme is a major outcome. The Council's proposals for the FIC in 2008 partly extend the 2007 activities and partly (about one third) orient resources selectively towards the prioritised clusters. The need to do both things leads to a complex matrix of proposals (CNIC, 2008) and the Council points out the need therefore carefully to track the money in order later to be able to evaluate the additionality created by the FIC. Based on a compromise with the regions, one quarter of the FIC is reserved for use by the regional authorities, providing a way to finance a bottom-up and local component of the cluster programme.

In its recommendations for the FIC in 2008, the Council also set out a number of organisational and institutional changes needed, including the creation of implementation capacity under the CMI, strengthening the Council's own capacity and the creation of a position in the Ministry of Education that would co-ordinate both higher education and life-long learning. It goes on to make a number of rather specific recommendations for organisation and institutional changes that will tend to simplify the research and innovation support system.

A key outcome has been the incorporation of the principle of selectivity into the government budget, via the cluster programme in 2007, which goes beyond simply identifying areas of strength and funding them (though this is of course important) to the idea of trying to build new positions of strength, such as in offshoring and financial services. The work of the Council means that selectivity is now more firmly established in the budget process than before, and this is a key precondition for the success of innovation policy in a small country. The use of a transparent, externally validated process (via BCG) to identify where such investments should be made has been an important step towards a sound application of the principle of selectivity, taking precautions to prevent rent-seeking behaviour of incumbents.

The cluster policy builds the earlier achievements of Fundacíon Chile (see Box 1.1.) – and indeed has good reasons to do so. As a result of the CNIC's work, Chile is moving towards the kind of two-tier cluster policy operated, for example, in the Netherlands, where "key areas" are defined at national level to support macro-clusters, while more local, regionally anchored cluster initiatives – the so-called "peaks in the delta" – operate at a lower level. In this way, nationally- and regionally-driven policies can be mutually supporting.

The focus on CORFO and CONICYT as the two pillars of the support system and the proposed simplifications of programmes are important steps towards improved policy co-ordination. The Council itself is also an instrument for handling dynamic inconsistency, among others because its mandate is longer than that of a government. (Of course, the acid test is whether it survives a change of government – though the fact that it was initiated during one presidency and established under a second is a hopeful sign). More durably tackling dynamic inconsistency would mean that the Council would have to establish research and innovation as subjects where there is broad political agreement so that political incentives shift towards longer-term behaviour. At this stage, it is clearly too early for the Council to have achieved this but it should continue efforts in this direction.

The Council's performance in the light of international experience

Earlier Chapters of this report discussed international experience of research and innovation governance, high-level advisory councils similar to the CNIC and suggestions of the OECD Review of Chile's Innovation Policy. The lessons from these discussions are synthesised here, as a further basis for assessing the CNIC's performance so far and to support recommendations.

Based on international experience, it is possible to state a number of desiderata for councils such as the CNIC – always recognising that these are subject to needs and circumstances in the local context.

- An innovation (policy) council should serve as a publicly open arena in which stakeholders and decision-makers debate and influence the directions of long-term research and innovation policy. This arena role should be complemented by actively consulting stakeholders
- Its composition and status should be such that it is socially and politically legitimate and therefore largely robust against changes in government. It should include scientific and technological expertise
- The council may sometimes need to act as referee and take decisions with which not everyone agrees, but an important goal is to create consensus about policy, so that it is natural for stakeholders to do things that are consistent with the policy
- Part of the council's function is to create and collate the "strategic intelligence" it needs in order to analyse deficiencies in the innovation system and propose improvements. This should be part of a wider pattern of distributed strategic intelligence, in which others also gather and analyse data and exploit them in support of policy analysis and deployment. The information produced and exchanged should be open so that it can be debated
- The council should produce a long-term strategy for the innovation system that goes beyond treating systemic and market failures to be selective, is holistic, suggests an appropriate policy mix and serves to reduce dynamic inconsistency.
- A key role of the council is co-ordination: vertically, horizontally and over time. In many countries, co-ordination also needs to have a regional dimension. Co-ordination serves to reduce inconsistencies and goal conflicts among policies and actors, make the division of labour in the support system efficient and reduce fragmentation of effort while empowering the actors involved to do their jobs effectively.
- The council needs to maintain a high profile with the public and at the level of opinion-formers, promoting the importance of research and innovation and demonstrating its own impact.
- It should be sufficiently independent of the system that it can act as a change agent. This means it should have no agendas or operational functions other than its brief to promote innovation and it should not have an interest in acquiring or spending significant resources of its own
- The council should have a clear interface to government, at least at the level of ministers, so that someone is responsible for accepting (or rejecting) and implementing its advice. This often means that some ministers should be members of the council.

Arena

The CNIC has established itself as a credible arena, with the ear of the President and involving people from relevant stakeholder groups. Its recommendations and even the minutes of its meetings are public. It has focused much of its effort so far on producing its strategy and developing the cluster programme. These have to some degree involved consulting stakeholders, but the Council's reputation and the quality of its work would probably benefit from more active and visible consultation as well as promotion of its work.

Legitimacy

The CNIC's membership covers the areas of society that need to be involved in order for the Council to be seen as legitimate. It has demonstrated that, with minor changes in composition, it can successfully survive changes in Government, given that ministers of the new Government are automatically present in the Council. It includes technological expertise from both academic and industrial sectors in the policymaking process as well as engaging relevant stakeholders in the formation of innovation policy, currently

- A chair with policy experience.
- Five key ministers.
- Two university people involved in funding education.
- One person each from the employers' federation and the labour unions.
- Two university people who run technology-based firms.
- One university person engaged in innovation support in industry.
- Two people from leading companies in key clusters (aquaculture and minerals).
- One university pure scientist.
- One university innovation policy specialist.

The heads of CORFO and CONICYT and CNIC's own secretary-general participate in meetings by invitation but do not vote.

The size of the Council was seen by most interview partners as too big. This made it a long-winded process to reach agreement in the Council's meetings. It encouraged shirking, with certain members often not turning up to meetings.

The science and higher education communities does not seem to have yet developed sufficient trust in the ability of the Council to balance fairly the different views and interests of the various stakeholders– even though university people have a very important share (7) in the composition of the current CNIC. Given that significant university reforms are needed in order effectively to pursue the Council's innovation agenda, it would probably be useful to engage that sector more actively in the Council's work, while maintaining the principle that that Council members sit as individuals and not as representatives of specific institutions.

Chile has a Spanish-inspired culture of legalism. The fact that the Council's creation rests on a presidential decree that has not been ratified by the parliament tends to undermine its authority and credibility. It would have clearer legitimacy, more strongly tying it to the national agenda, if its enabling legislation were ratified by parliament.

Consensus

Winning the hearts and minds of relevant stakeholders as well as others whose opposition could undermine progress is a key requirement for the CNIC to succeed, since it is trying to influence the performance of a large and complex system, which it cannot directly control and which cannot efficiently be centrally planned.

While there has clearly been progress towards consensus on policy needs and challenges, at this early stage in the Council's life it is not clear that there is full agreement – especially about issues of implementation. Undertaking action to increase the degree of consensus around the Council's agenda should therefore be a high priority.

Several interview partners pointed out that Chilean politics and business exhibit low levels of trust – again a stark contrast, e.g. to the Finnish situation, on which the Innovation Council was modelled. Within the Finnish public services, ministries and agencies tend to be in almost daily touch and there are multiple *fora* in which industry and government debate policy, including but not limited to the Finnish Science and Technology Policy Council. This constant communication builds trust and underpins the consensus that is vital to the Finnish council's operation. The Council will need to raise the levels of trust and consensus around its activities and this will clearly take time. The consensus needed to make policy implementation uncontroversial is a requirement for the Council to operate successfully. Consensus arises from trust and cannot be created by *fiat*.

Strategic intelligence

Probably the major achievement of the Council to date is creating a national arena where evidence-based research and innovation policy can be discussed on the basis of good strategic intelligence. The Council has created a platform where relevant studies are commissioned and has made these (and other studies of interest) available via its web site. The Council is in the process of extending its activities into the sphere of evaluation and monitoring, so that it will play a national role in monitoring and identifying bottlenecks in the innovation system at meso and macro levels.

The next challenge in strategic intelligence is to find ways to benefit from the work conducted in other parts of the system (notably the agencies) and to include these levels of intelligence in the common "library" of policy-relevant knowledge. Empowering the regions to make a strong contribution to innovation policy is necessary for the success of the cluster programme as well as in economic development more generally. It is therefore important to have a regional dimension to national sources of strategic intelligence, to encourage the development of strategic intelligence at a regional level and to maintain open communication channels to those working at regional level.

Long-term strategy

The Council has now delivered its overall strategy and will have to move into a mode of updating and refreshing it. Monitoring and bottleneck analysis will be necessary during the next few years as the situation changes.

The CNIC's strategy tackles many of the governance issues raised by the OECD Review of Chile's Innovation Policy. The cluster programme is closing some of the gaps in policies relating to networking and non-traditional (in Chile) beneficiaries of support such as SMEs. The comparatively low level of trust within the Chilean business community will also be addressed in this way. This is important if one of the central premises of the innovation systems approach – namely that innovators do not innovate alone – is correct. The Chilean system tends to conflate innovation with research and historically that has meant dominance by the university sector. CNIC's strategy specifically aims to change this emphasis towards

more R&D and other innovation activities taking place within firms, tuning CONICYT funding towards a higher component of industry-relevant research and encouraging partnerships between firms and the various parts of the knowledge infrastructure. Through the cluster programme, it has already established the principle of selective programming. Its principles of transparency of analysis reduce the risks of "capture" by vested interests and its growing role in creating and using strategic intelligence means that there will be better knowledge about the progress of selective policies, so that they can be adjusted if and when necessary. Overall, the strategy permits a more balanced policy mix than the previous situation, which was overly focused on research and on "neutral" measures.

Co-ordination

A key value of the innovation strategy is that it creates a framework for co-ordination and strengthens the governance of the innovation support system. It establishes the principle that CORFO and CONICYT are the main vehicles for policy implementation and delegates many implementation tasks to them as well as reinforcing the division of labour between them and others, starting a process of simplification of Chile's fragmented support system that should increasingly tackle the problem of fragmented instrument operating below critical mass that the - OECD Review described. Empowering the agencies to act also entails a greater need for a system of monitoring and evaluation, which the CNIC is working to develop.

The OECD Review pointed out the high degree of political centralisation in Chile and this is to some degree also reflected in the innovation strategy, which takes an essentially national view that needs now to acquire a stronger regional dimension – not least, in order to implement the cluster programme. It is desirable that there is co-ordination and some degree of consistency between national and regional actions and there are opportunities for the Council to become more active in respect to the regions.

Profile

The Council's work has so far focused on producing its strategies and launching the cluster programme. Interviews suggest that the fact that it has "only" produced reports to date has caused some impatience among policymakers and in the press. In 2007, some of the FIC was devoted to promoting innovation within the business community. The CNIC could usefully complement this by addressing the political level and other opinion formers, helping to generate a wider consensus on the importance of innovation and therefore a willingness to develop policy and budgets for innovation. The clusters initiative is beginning to function as the Council's "flagship" activity but it would have been useful for the Council's image if something large and visible could have been launched sooner.

While the Council has invested in developing a logo and visual image, it has yet to develop a communications strategy. Such a strategy would reinforce its message and identify to whom and how that message should be more effectively delivered. The CNIC's early focus on strategy documents means that it needs visibly to demonstrate that its work also leads to action, so as to ensure it is valued enough by opinion makers and the public to be continued into the future. Much of the real value of the Council is in the analysis and intelligence it provides. A communications strategy should not displace this but complement it by targeting its use more precisely.

Independence

While ministers are members ex officio, ordinary members of the Council sit on the CNIC in a personal capacity. They are not there formally to represent any organisation or sector of society. This is a normal principle for such councils internationally and is intended to provide the advice of the councils with a degree of independence. It is important that this principle should be maintained.

Few innovation advisory councils internationally play a role in (directly) allocating funds. Those that do, tend only to address short-term resources, such as a temporary boost to the national R&D budget, and not to get involved with "normal" budgets. This is also true of the CNIC, which makes proposals to Government about how to allocate FIC financial resources. There was popular misunderstanding of this role in 2006, when the press got hold of the idea that the CNIC had money to give away.

The danger of controlling some budget is that it tends to make the CNIC into an actor within the system, and therefore implicitly in competition with those whom it tries to co-ordinate. At present, when the FIC is new and is perceived as "additional money" this is not a big problem; but as the FIC is increasingly perceived as an ordinary part of the funding system, the competition issue is likely to become more important. Indeed, the separation between FIC and other funding is somewhat artificial. It was sometimes argued that FIC funds were displacing existing funding in certain areas. The fact that money is fungible means that once the Council recommends how to use the FIC it also risks having to advise in detail on the use of other resources over which it has no legitimate control. Further, the Council's responsibility to prioritise the FIC resources provides an implicit limitation on the scope of its advice. The CNIC needs to be able to advise on the whole of the innovation system, and not to focus on the proportion of it that can be affected by FIC resources.

While the Council's role is to act as a change agent at national level, it is – in the absence of enabling legislation – administratively tied to the Ministry of Economy, which also chairs the Ministerial Committee to which the CNIC is supposed to relate. Having its own budget could increase the Council's legitimacy and actual role.[13]

Interface to government

If the Council is an "emitter" then the Ministerial Committee for Innovation is intended to be its counterpart "receptor" for advice about research and innovation policy. Interview partners pointed out that debates resolved in the Council would be re-opened or passed over by the ministers, despite the fact that the key ministers are themselves also members of the Council. The Finnish Council is also not immune to this phenomenon (Pelkonen, 2006). A key success factor in the Finnish context is the presence of the Prime Minister and the fact that she is a powerful figure in the government. This connection to the ultimate source of authority in the government is so far missing in the Chilean system, where the President is a much more politically powerful figure than the Finnish president. The experience of other countries, e.g. Hungary (OECD, 2008), however, shows that the Prime Minister chairing the Council is not a sufficient, and may not even be a necessary condition for success.

While the Council formally advises the President of the Republic, the President neither makes the budget nor takes detailed decisions about resource allocation. It was therefore important to create the CMI as a counterpart to the CNIC, so that advice can be turned into decisions about policy that can be implemented. The CMI is now putting in place implementation mechanisms of its own, thereby running the risk of increasing the systemic fragmentation that the Council is supposed to reduce – a tendency that will need to be monitored.

In Chile as in most countries, the Government's annual budget is produced through a process of bilateral negotiations between spending ministries and (the budget branch of) the Ministry of Finance. No matter how holistic an approach the Council might take in its recommendations, they risk being cut into pieces in bilateral budgetary negotiations. A consequence of this was that – despite the Council's

[13] OECD countries have implemented different solutions. Finland, for example, has chosen to base its Council's secretariat on resources drawn from both the industry and education ministries, as a way to reduce potential friction, as well as to increase the Council's legitimacy.

recommendation that the science budget be increased – in 2007, CONICYT's budget was actually reduced in response to the fact that a loan from the World Bank reached the end of the period during which it had been agreed that Chile would be drawing down funds. The Council therefore lost considerable credibility with an academic community that already felt under-represented in the Council itself.

As the budgetary process currently works, there is simply no mechanism that can take a holistic view of a horizontal issue such as innovation. If the Council is to be effective as a change agent in the innovation system as a whole, its advice must increasingly affect not only the FIC but also the other budgets devoted to innovation. The CMI will need to innovate a way to present and negotiate as a whole with the Ministry of Finance about the budget of a "virtual ministry of innovation".

The Clusters Programme

The clusters programme has been the subject of a great deal of analytical effort and is at the point where implementation is beginning. Little can therefore be said about its process or outputs, let alone its wider effects. However, it is possible to distil some lessons from international experience with cluster development to suggest some pointers for the programme.

A defining characteristic of a cluster is the network of linkages among its members. Historically, this meant that clusters have a strongly spatial dimension (industrial districts) but changes in transport and communications technologies have successively relaxed this constraint. It therefore makes policy sense to operate both at the (national/international) level of macro clusters and at the level of more spatially determined (regional) micro clusters. Hence there needs to be articulation between the national implementation office and the regional activities, recognising that in many cases the regional level is already active and that there are numbers of existing cluster networks that can be brought together by the national level.

The experience of clusters, and networks more generally, strongly suggests that they are successful when the business interests of their members drive them and that attempts to create networks and clusters "top down" are less likely to succeed. It follows that the clusters programme needs to ensure there is cluster development capability at the regional level and that this is either contained within, or placed at the disposal of, the regional business communities (both business and others, such as regional education and research organisations) involved. The role of the national level must be *enabling***,** i.e. creating and offering opportunities rather than trying to be overly directive. It can usefully generate clear frameworks for the respective clusters, in particular clarifying what government can do to support them. A useful start towards such frameworks has already been made through initial road maps for the clusters. The continuation could involve further study of cluster-specific bottlenecks, cluster foresights and the building of platforms for international marketing (including for attracting FDI), national-level planning and provision of cluster-specific education, research and other infrastructures and national competitions for allocating resources to specific regional micro clusters. In many cases, the national level can add value through horizontal co-ordination (across different ministries' spheres of responsibility) and vertical co-ordination (for example, balancing the provision of training among regions to develop a nationally balanced pattern of regional provision).

It is important that the CNIC does not disengage from the clusters, as they move into implementation. Having identified leading clusters for development the Council has also tapped crucial sources of intelligence about problems and opportunities in the innovation system. It needs therefore to monitor and evaluate the progress of the clusters – not only in the summative sense of trying to discover the impacts of the cluster programme but especially in the formative sense of learning from them how not only to improve the performance of the clusters and cluster management but also deriving more general lessons about development needs and opportunities.

The Council's performance in the light of the findings of the OECD Review

In terms of the definition and operation of the CNIC, the OECD Review of Chile's Innovation Policy suggested that the Council could be the catalyst of an accelerated maturation of Chile's innovation system, provided that it is properly composed, institutionally positioned and equipped. The Review (OECD, 2007a) noted that OECD countries' experience in this field suggests that:

- Its composition, in terms of numbers and institutional affiliation of members, should balance representativity and efficacy, in order to avoid capture by vested interests and ensure productive deliberations. While it should include representatives of all communities (government, industry, the financial sector, academia and technological institutes), at least one third of the members should not have any responsibility for the management of innovation policy. Among the "independent" members, at least one should have an international background (a foreign citizen or Chilean expatriate with a proven record in science, technology or innovation. A person of this profile could strengthen the international perspective and provide first-hand experience with international good practice.
- Its institutional positioning should maximise its policy impact and guarantee its reputation as an impartial body that acts in the public interest.
- Its mandate and mode of operation should safeguard against the "talking-shop" syndrome and encourage evidence-based approaches to policy assessment and advice.
- It should be backed by a well-resourced and strong executive secretariat, steered through a reduced-scale executive board, which should have the skills and financial means to carry out or commission independent studies and evaluation, and ensure permanent monitoring.
- Provided that it meets all of the conditions for efficient operation, it might be entrusted with the task of strategically orienting the flow of new public resources for innovation through a mechanism that would translate its priorities into funding priorities for the Innovation for Competitiveness Fund (FIC).
- Its role in evaluation should be two-fold: i) to set quality standards and a framework for the evaluation of individual institutions, programmes and measures; and ii) to carry out thematic evaluations from a systemic perspective.

These conditions appear mostly to be satisfied. The composition of the CNIC does not yet include a foreigner, but adding a foreign voice is on the Council's agenda. The independent position of the Council today underpins its advice-giving role, though – as suggested above – engaging the education ministry in the secretariat could be a useful way to extend the Council's legitimacy and influence over the higher education system. Its role in gathering and using strategic intelligence encourages an evidence-based approach to policy that is clear in its strategic documents and that should further be reinforced by its introduction of a systematic evaluation scheme. The Council, supported by its Executive Secretariat, is equipped to provide wider innovation policy advice than only to allocate FIC resources. Its role in evaluation is under development (see Chapter 5).

The main purpose of the OECD Review was to diagnose the strengths and weaknesses of the innovation system as a whole. The remaining basis for assessing the CNIC's performance is to consider whether the Council is in fact addressing the problems identified by the OECD.

Table 4.1 shows that most of the issues identified are in some way being tackled. The cultural challenges identified are not trivial and will take years to address fully. A possible omission from the policy repertoire of the Council is schemes that directly aim to increase companies' absorptive capacity,

for example by placing and subsidising technical or research personnel in smaller companies. Such schemes are operated in many OECD countries and typically there is a very high retention rate at the end of the subsidy period. However, these schemes crucially depend upon a supply of technically qualified young people, an area of shortage in Chile. Injecting relevant human capital into industry is the key to establishing the kinds of linkages with the universities and multinational enterprises addressed in the OECD Review.

Table 4.1. Weaknesses in the Chilean innovation system

OECD Diagnosis	CNIC Actions / Recommendations
A culture, typical of many resource-based economies, of viewing technology as a set of "black boxes" that can be bought or sold, as opposed to placing innovation and technological capabilities in the centre of entrepreneurship.	Business innovation schemes; Innovation awareness programme among businesses
Lack of "innovation culture" within much of the business sector	Innovation awareness programme among businesses
Low business expenditure on R&D	Innovation awareness programme among businesses; Business innovation schemes
Low trust among business enterprises	Cluster programme
Shortage of specialised human resources, especially postgraduate technologists and innovation managers	Education funding
Many research institutes do poor-quality and irrelevant research	Identified as an issue. Next step is to launch a study to set the strategic direction for the institutes
Underdeveloped supporting financial market mechanisms (risk and equity capital)	Seed and seed capital funds
Insufficient networking and clustering of firms	Cluster programme
Weak university-industry links (as in other countries)	Funding industry-relevant research in universities
Unexploited opportunities to exploit the presence of R&D-performing foreign multinational enterprises	Potentially via cluster programme
Under-exploitation of the core of competent companies in the economy	Potentially via cluster programme
Opportunities to extend into new niches based on existing resources and competences (such as high value tourism) not adequately exploited	Cluster programme

Source: OECD (2007a).

A second omission is to build up technical capabilities in industry with the help of the institutes and technology centres – though again this may need to be a second step if the quality and relevance of the institutes' work is poor, as the OECD Review and the CNIC itself suggest.

CHAPTER 5 - OUTLINE EVALUATION SYSTEM

Introduction

This Chapter responds to the CNIC's desire for a discussion of how to evaluate the other policy actors and actions within the Chilean innovation system and how it might itself be evaluated. This outline intends to provide a discussion of what can be learned from international practice about how these evaluations should be tackled, to provide a *sketch* of features of the relevant evaluation system and to consider factors relevant to its successful implementation. It is not the intention here to provide a detailed design of such a system.

The Chapter deals in turn with:

- CNIC's evaluation ambitions for its evaluation of itself and a wider framework of evaluation.
- Trends and international practice in using common evaluation frameworks.
- Some lessons from international practice in organising evaluations.
- Designing an architecture for evaluating the impact of Chilean innovation policies.
- Evaluating the CNIC itself.
- Conclusions about setting up the evaluation system.

The Council's evaluation ambitions

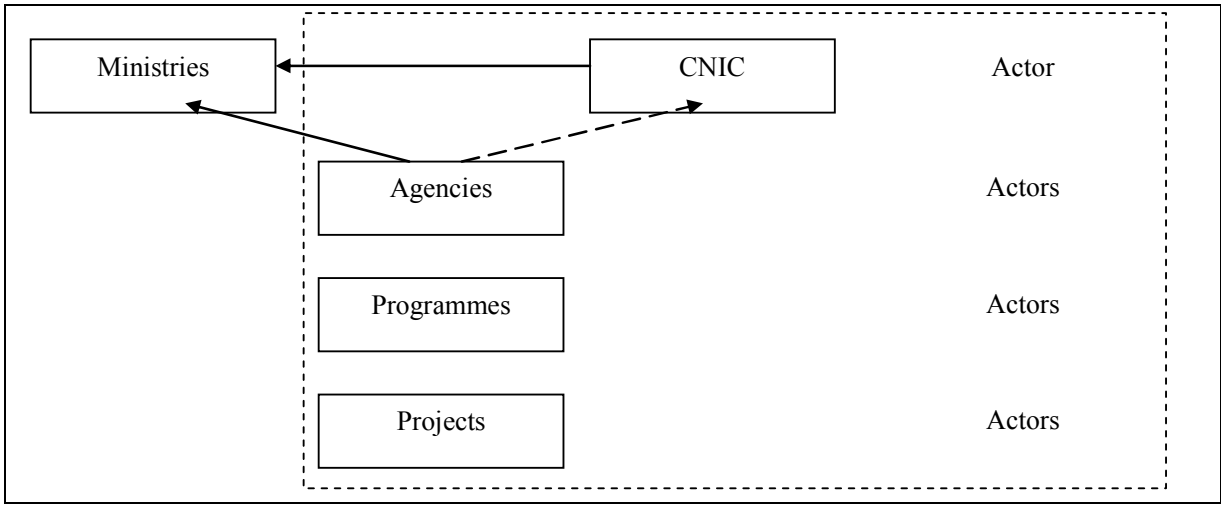
CNIC's intention to be *the* national innovation and research policy forum in Chile naturally entails the production of strategic intelligence at the national level, as it has so far done in producing its strategy documents (CNIC, 2007 and 2008). There are opportunities further to develop this role, for example in exploiting the national Innovation Survey of companies and in promoting foresight and road mapping for Chile at the national level.

Focusing the analytic and strategic role at the national level is normal among such high-level innovation councils internationally because they typically address a systems failure, namely, the difficulty of obtaining and considering understanding about the national (trans-ministry, trans-regional) level for which individual policy actors (ministries, agencies, regional governments) are not responsible.

CNIC has a further ambition to *evaluate* not only itself but also the hierarchy of policy actors and policy actions in the Chilean innovation system as a whole. Both these aspects are not standard international practice. It was not possible to identify any case where an equivalent national research and innovation policy council has been evaluated, so there is a need to suggest how to do this from first principles. Equally, while there have been quite a number of reforms in recent years that bring evaluation into more common practice, no case could be found where anyone has designed a meta-system of evaluation of the kind CNIC desires. That, too, must therefore be designed from scratch.

CNIC's role means that it recommends national strategy to the president and the ministries, which then play a role in implementing the strategy themselves, as well as delegating aspects of the implementation to their agencies, which in turn delegate to programme managers and project leaders. It would appear rational for CNIC to organise a national evaluation system of all these actors and actions 'downstream' of its strategy. However, strictly speaking this implies CNIC would evaluate ministries, which is obviously problematic in two senses. First, ministers are not only members of CNIC but also its principals: they decide whether and how to make use of CNIC's advice. Second, evaluating ministries also means evaluating the political level (since ministries in effect operate as the servants of their ministers). Neither of these would be appropriate. The evaluation structure established by the CNIC should therefore have the scope shown in the shaded portion of Figure 5.1.

Figure 5.1. Desirable coverage of a national innovation evaluation system



This means that the ministries will retain formal control over the evaluation of their agencies (since they are responsible for them) while there should be an information channel to CNIC, allowing it to evaluate the implementation of its national strategies. If CNIC Itself is to be evaluated, that should be under the authority of the ministers.

International developments in using common evaluation frameworks

International developments in the use of evaluation in relation to research and innovation policies in recent years largely conform to a pattern of practices being improved through a range of formal and informal requirements and the gradual spread of 'evaluation culture'. This is most visible through the increasing use of explicit planning and evaluation frameworks. However, these tend to specify how to plan and evaluate specific interventions; they do not offer guidance of how to build the kind of *hierarchy* of evaluation desired by CNIC.

The growing international interest in evaluation stems primarily from the spread of the so-called New Public Management (with the OECD's PUMA work on public management acting as an important vector). A key idea in the New Public Management is that of 'performance contracts' providing a series of links between principals and agents within the state system and which may be seen as extending back to the electorate (Figure 5.2). Most systems that use performance contracts (sometimes taking the form of 'Service Level Agreements') establish them between ministries and agencies and between agencies and (usually non-government) external organisations to which they entrust tasks such as programme management or project performance (as, for example, in the contract between a research council and a

professor). New Zealand takes the principle further, establishing explicit contracts between the Prime Minister and the other Ministers and between the Ministers and their Ministries.

This hierarchy implies a process in which broad policy decisions made at high levels are broken down into constituent actions and sub-actions. Most OECD countries have a rather implicit framework for planning and evaluation (though as we show below this is becoming more explicit). They tend to distribute strategic intelligence across different levels of the hierarchy shown in Figure 5.2 because much more information and understanding is used across the entire system in order to implement policy than can be assembled centrally, for example in the ministries. Typically there are multiple levels of analysis and planning and some interaction between planning cycles at different levels (Figure 5.3). Thus, while **in** *principle* the hierarchy works top down, in practice there has to be communication upwards as well as downwards about problems and objectives, resources and results. Intelligence needs to be *distributed* in order to be effective.

Box. 5.1. Strategic intelligence

In the context of R&D policy and R&D evaluation, the term *strategic intelligence* means the combined use of such tools as evaluation, benchmarking studies, technology foresight exercises, technology assessment and other analytical tools. The term was coined as increasing attention was being paid to the way in which evaluation and similar techniques can inform policy and programmes.

Source: Kuhlmann (2001), Management of Innovation Systems: The Role of Distributed Intelligence, Mauklu, Antwerpen-Apeldoorn.

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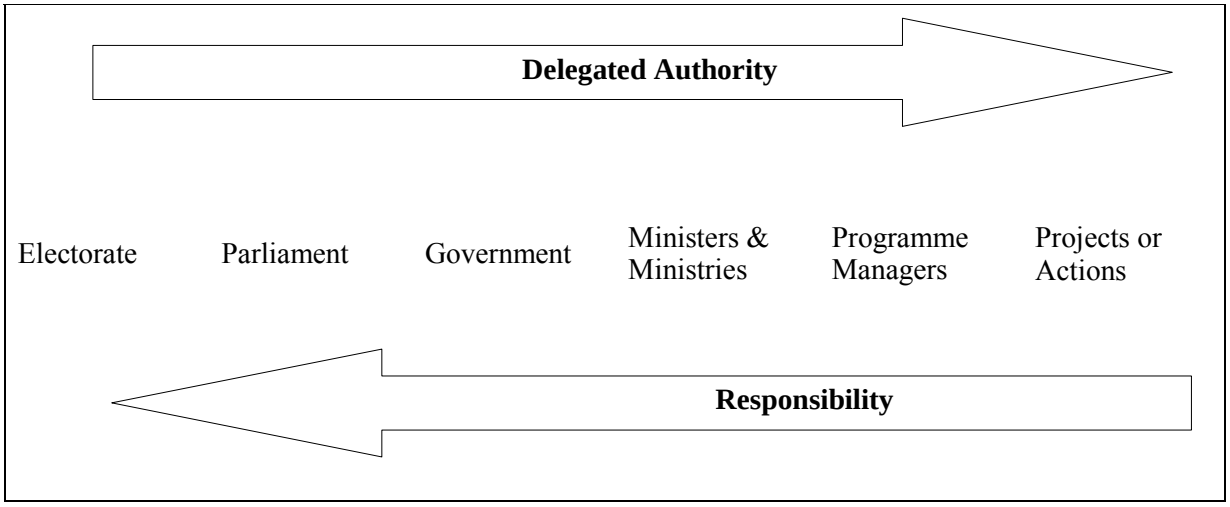
Figure 5.2. Legitimacy and responsibility of research and innovation programmes in the new public management

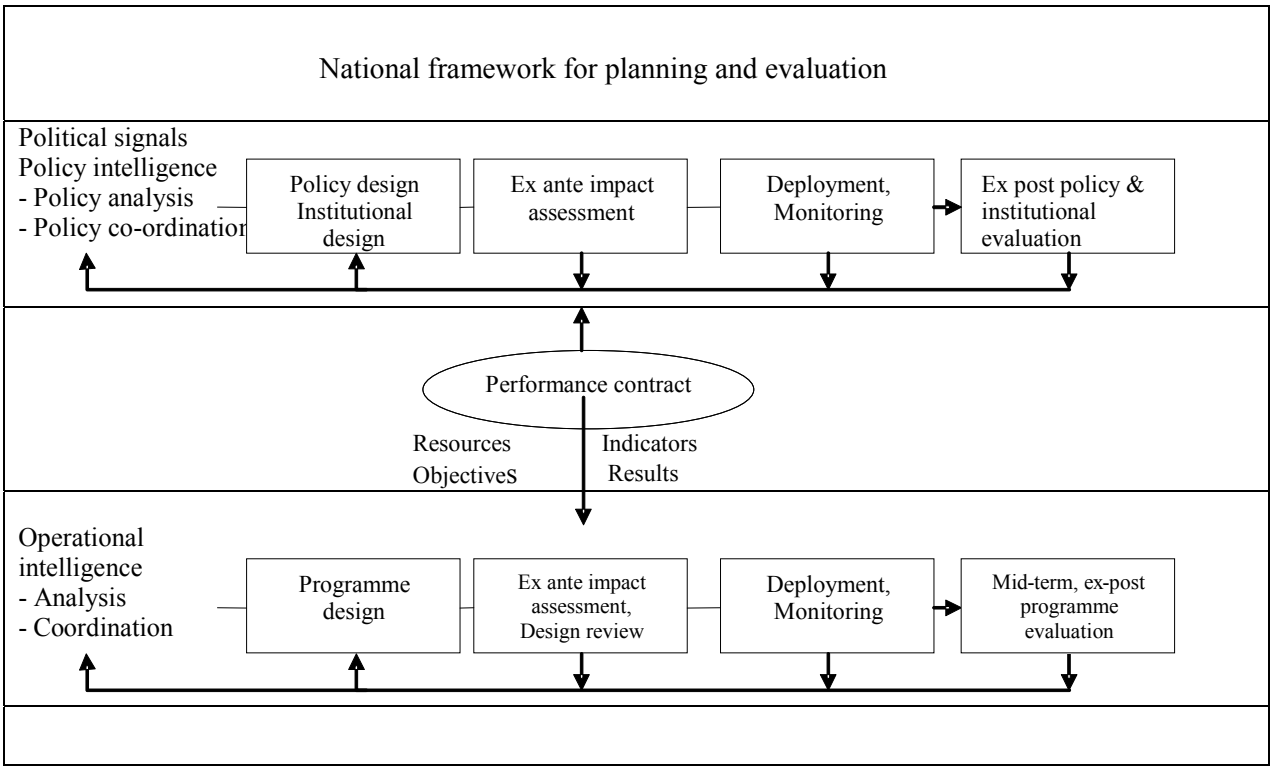


Source : Arnold, Boekholt and Keen (1994).

The purpose of the hierarchy is nonetheless to organise the design and implementation of policy and it is the reporting lines associated with policymaking that hold the hierarchy together. Normally, evaluation is added on to this hierarchy and becomes *a)* part of the internal management information system at that level and *b)* an input to the way that level reports upwards. There is no overall evaluation architecture

because evaluation is designed in a fragmented way in order to support the needs of different levels of the policymaking 'line management'. In order to create such a national evaluation architecture, CNIC needs to find a way to co-design that architecture with the various levels of 'line management' so that the result serves both their own needs and the overall needs. It has to create a 'win-win' situation in which all sides benefit if all the relevant parts of the hierarchy are to co-operate and allow a national architecture to be built.

Figure 5.3. A generic 'landscape' of national planning and evaluation



United States

The planning and evaluation framework implied by the US Government Performance and Results Act (GPRA) of 1993 has been enormously influential outside as well as inside the United States. It was modelled on similar legislation already in place in individual states, and in several other countries. The GPRA focuses at the level of agencies. It requires every agency to

- Make a strategic plan every three years, in which they define their missions, establish results-oriented goals and identify the strategies that will be needed to achieve those goals.
- Translate the three-year plan into specific annual performance plans with quantified targets and performance indicators.
- Report every year on the extent to which the targets were met and explain what corrective actions are being taken where performance is below plan.

These measures are not only intended to increase transparency and accountability but in principle also to allow the Office of Management and Budget (OMB) and others to co-ordinate policy across departments of state and to increase public confidence in the federal government, in a culture that is often hostile to government.

The General Audit Office (GAO, 2004a) has surveyed people in government implementing the GPRA to try to understand its effects. It found that the Act had been effective in refocusing federal government away from doing programme activities and towards the results to be achieved. It had increased the numbers of performance indicators in use. Goals were more quantified and results-oriented and agencies were providing more information about how goals and strategies addressed performance and accountability challenges. "However, certain serious weaknesses persist, such as lack of detail on how annual performance goals relate to strategic goals and how agencies are co-ordinating with other entities to address common challenges and achieve common objectives." Other difficulties included:

- Problems in embedding a 'GPRA culture' in agencies, via training, obtaining top management commitment and allocating appropriate human resources.
- Lack of programme evaluation capacity.
- Lack of feedback from performance to civil service pay, so that a poor performance report had no real consequences for those involved.
- Failure to tackle cross-cutting issues: in planning – or, in the terms used here, failures in horizontal co-ordination.
- Disconnection between the three-year planning cycle mandated by the GPRA and the four-year US political cycle, so that strategies may be radically rewritten during their lives in order to cope with changing political priorities.

Perhaps the most fundamental problem identified by the GAO report is that, while the government has a budget, it does not have an overall strategy. In fact, the GPRA processes tended to expose internal inconsistencies in government policy. The evidence so far does not indicate that GPRA performance measurement is having a significant impact on resource allocation by legislatures.

In 2000, the Bush Administration introduced the President's Management Agenda. It noted that, after eight years of GPRA implementation, "progress towards the use of performance information for programme management has been discouraging." The President's Management Agenda introduced a Programme Assessment Rating Tool (PART), developed by OMB. The PART was developed to assess and improve programme performance so that the Federal government can achieve better results. A PART review is supposed to help identify a programme's strengths and weaknesses to inform funding and management decisions aimed at making the programme more effective.[14] Departments and agencies have to report how their programmes perform and reports are made public on the website of the Federal government. Using the tool, the OMB should assess a fifth of the federal government's programmes each year. Presentations during the American Evaluation Association's conference in Toronto 2005 demonstrated that many evaluation officers from various US departments and RTDI organisations found the application of PART difficult as guidelines are open to different interpretations while consequences can be severe.[15]

14. See http://www.whitehouse.gov/omb/part/index.html.

15. See: http://eval.org/eval2005/.

At Federal level, a report (GAO, 2004b) on GPRA and PART implementation identifies lack of use of the indicators as a de-motivating factor for many agencies. There is no clear relationship between PART scores and funding, since funding is driven by politics and policy objectives. Aggregate PART scores mix up ratings of the *purposes* of initiatives, how well they are *managed* and whether they get *results*. They do not help much in thinking through whether an important programme that is failing to achieve good results should be given less money because it is doing badly or should be given more money so that it can be improved. According to the GAO, mechanistic application of OMB review and PART to everything meant that unimportant priorities were analysed and scarce analytic resources therefore were misused. Programmes analysed using PART were often disconnected from the higher-level strategies set out under the GPRA process.

The GAO has also found that, despite efforts by OMB throughout the development and implementation of PART, assessments still ended up requiring a large amount of judgment and interpretation by OMB budget officers. Their report concludes, "By using the PART process to review and sometimes replace GPRA goals and measures, OMB is substituting its judgment for a wide range of stakeholder interests." This leads to inconsistencies in the implementation of PART and therefore an inherent unfairness in PART scores across programmes and budget officers. GAO found that design flaws in the tool made these problems worse.

These problems do not mean that the GPRA as a whole is not having an impact, and the main lesson to draw from PART experience is perhaps the danger of mechanistic implementation of a centralised system. Many observers note that strategic planning and performance assessment is forcing agencies to think through their missions more carefully and make sure what they are doing on a day-to-day basis supports those missions. Likewise, development of indicator systems, rather than the actual levels of the indicators themselves, may have the strongest impact on agency operations.

OMB always seeks opportunities to improve the PART system. To enhance the accountability of the PART scoring system and to provide more transparent information to the public OMB developed together with Federal agencies a new webpage. ExpectMore.gov was launched in 2006 and it provides information on the performance of more than a thousand Federal programmes.

In November 2007 a new executive order[16] came into force that established the Performance Improvement Council. Senior officers – so called performance improvement officers – will represent each agency on the council, while the OMB deputy director acts as chair. The council has to establish performance standards and evaluation criteria to enhance the information exchange among agencies, and to co-ordinate and monitor performance assessments. According to a memorandum for the heads of departments and agencies dated in December 2007, the performance improvement officers will be responsible for the co-ordination of agencies' performance management activities, including developing and improving strategic plans, ensuring program goals are aggressive and accurately measured. The council's inaugural meeting was held in January 2008 so it is too early to observe any results of its work.

However, while the US reforms were aimed at improving planning and evaluation practices at specific points in the government system, they are not aimed at creating the kind of unified system evaluation system desired by CNIC.

United Kingdom

In line with the government's commitment to continuous improvement in the field of effectiveness of public services, HM Treasury has published some evaluation guidelines during the recent years. These

16. November 13, 2007 Executive Order 13450: Improving Government Program Performance.

evaluation principles are expressed in the form of comprehensive guidance books. The *Green Book: Appraisal and Evaluation in Central Government* was published first in 1997. It describes the economic assessment of spending and investment and includes the preparation of business cases for the public sector. Furthermore a set of publications emphasised the important role of proper evaluations with high quality in policymaking process. The so-called *Magenta Book: Guidance Notes for Policy Evaluation and Analysis* has been developed by the Government Social Research Unit in 2003 providing guidance on the effective usage of evaluation tools.

Since 1998 UK has been operating a new planning and control system for public expenditure, intended to increase accountability. The system involves Comprehensive Spending Reviews (CSR), which set spending plans on a three-yearly basis, and Public Service Agreements (PSA) to set performance targets. The intention has been that CSRs and PSAs should help ensure that resources have been translated into higher standards and improvements in outcomes. Further development has been done recently to establish a new performance management framework based on a set of 30 new PSAs setting the Government's highest priority outcomes for the period of the 2007 CSR. This involves a radically reduced set of PSA indicators and rationalised use of targets. The new PSAs are outcome-based, measurable and supported by delivery agreements. Single Delivery Agreements for each PSA have been developed and published to strengthen accountability. New Cabinet Committees have been announced, which are intended to play key role in driving performance on cross-government PSAs by regularly monitoring progress.

Unlike the United States the United Kingdom typically does not use legislation to achieve changes in practice within the state. As a result, the rate of change can be slower. Nonetheless, the UK has build up an 'evaluation culture' as a function of a planning tradition launched in the 1980s by the UK Department of Trade and Industry in response to Prime Minister Thatcher's questioning of the usefulness of having a state role in industry and innovation. This simple programme planning methodology (ROAME-F[17]) required that all new programme proposals should be able to explain their:

- ***R**ationale* - the broad reasons for intervention in terms of the benefits to be gained and the reasons why the activity cannot be left entirely to market forces.

- ***O**bjectives* - to clarify the goals and provide the benchmark and indicators against which ultimate evaluation will be carried out.

- ***A**ppraisal* – namely the way in which the component projects which form the programme will be selected and the criteria, which will be adopted for this purpose. These must be consistent with the overall rationale and objectives of the programme.

- ***M**onitoring* arrangements for overseeing the progress of the activity, particularly in relation to individual projects. It will usually also include arrangements for tracking and reviewing the progress of the programme as a whole. If serious problems emerge these may call for reference back to central management or ministers. They may wish to review the appropriateness of the original strategy in the light of changed circumstances.

- ***E**valuation* plan - making preliminary proposals for ultimate evaluation of the programme.

The use of this discipline gradually spread across departments of state. ROAME statements successively became more sophisticated and their use was recommended in departmental handbooks and evaluation manuals, but ROAME was never enshrined in law. The UK Department of Trade and Industry

17. During the revision of the methodology "F" as feedback was added to the scheme ROAME.

(DTI) extended the ROAME approach to include more explicit modelling of the intervention logic (Malik and Cunningham, 2004). More recently, 'business case' documents have begun partly to take the place of "ROAME" statements. They continue to set out the evidence based rationale and objectives for a new product, and on its delivery but they also include a number of new features such as option appraisal, cost benefit analysis and balanced scorecard.

As the recent UK extensions to programme-planning models recognise, and as Canadian practice in particular has long recognised, explicitly modelling the logic that is expected to connect an intervention to its intended effects is a good way to quality-assure the design. Indeed, The DTI historically argued that investing in a quality-assured programme design both produced more effective programmes and reduced the need to do evaluation. As in the United States, however, the UK practice does not extend beyond considering interventions and actors one at a time; it does not aim to use evaluation to build an integrated national picture.

The Netherlands

The Netherlands Ministry of Finance launched an ambitious project several years ago to establish a clear link in the government's accounts between goals, performance and resources. This approach was implemented and made mandatory for all Ministries under the name *From Policy Budgets to Policy Accountability* (VBTB). VBTB aimed to link together objectives, activities and the allocation of resources, *i.e.* what do we want to achieve, how will we go about it, and how much can we spend?[18] This new style of making budgets also left its mark on policy processes, highlighting the importance of measurability of policy objectives, the use of performance indicators and systematic monitoring and evaluation.

Since January 2002, policy design and policy evaluation have also been subject to the ministerial decree on performance measurement and evaluation (*Regeling Prestatiegegevens en Evaluatieonderzoek* – RPE), which poses a number of requirements on policy preparation (ex ante evaluation), monitoring and ex post evaluation. The requirements cover:

- The use of evaluation instruments.
- The obligation to consider an ex ante evaluation when starting to think about a new instrument.
- The frequency and extent of ex post policy evaluations (every instrument has to be evaluated every five years.
- The quality of the evaluation instruments.
- Informing the minister, head of the department and parliament about the outcomes of an evaluation.
- The distribution of responsibilities within the department with regard to the implementation of the decree (RPE).

Based on the RPE, the Ministry of Economic Affairs (EZ, which is responsible for RTDI policy) has developed a guideline for the (ex ante) evaluation of instruments. Since 2002, EZ uses a systematic ex ante evaluation approach to assess how (new) instruments fit with policy objectives and how they affect the identified problems. It is customary to start each new programme with a baseline study, a monitoring and

18. In annual reports the ministries report on their policies and the results achieved. These annual reports are debated in Parliament at the third Wednesday in May.

evaluation plan with specified input, output and outcome indicators for each programme. Ex post evaluations of earlier instruments are also used to inform policy design.

The VBRB process has recently been evaluated and the report recommended having better evaluations that give more insight in efficiency of public policy. This should be articulated via better formulated ex ante and ex post evaluations. The previously defined five years rule will be applied less strictly; the timing of the evaluations should be in line with the policy cycle instead. There is a distinction between policy monitoring and policy evaluation. Monitoring addresses operational targets while evaluations assess policy, regulation or instruments. Ex ante evaluations have to be used further in the future to assess questions of a planned new policy action and ex post evaluation should be used at the level of general or operational policy objectives. VBRB evaluation was followed up in a revised RPE in 2006. It puts emphasis on the independence of the evaluations, stresses that information from ex-post evaluation studies should be used as much as possible in policymaking and points out the need of periodic policy evaluation. Recently there has been a shift of attention toward ex ante evaluation and monitoring instead of ex post evaluation.

Evaluations of the major RTDI programmes are discussed in Parliament. This has had a positive influence on the evaluation culture in the Ministry, the Agencies implementing the policies and the beneficiaries of public RTDI funding. As with the USA and UK, however, there is not attempt to build an overall systems picture.

Canada

Canada has for many years had a strong culture of accountability in public policy. In 2006, the government introduced the new *Federal Accountability Act and Action Plan* to make government more accountable, increase transparency and oversight in government operations. This recent Act is a continuation of a long tradition of introducing new public management aspects in Canadian policy. The Federal Accountability Act requires all transfer payment programmes to be evaluated during the course of a five-year cycle.

As part of the implementation of the action plan, the Treasury Board commissioned an independent blue ribbon panel.[19] The panel had to assess the efficiency of grant and contribution programmes. In their final report the panel made suggestions about how to improve the accountability of the programmes including proposals on better services, usage of definitions, information sharing, funding principles, evaluation, audit and reporting requirements.

Evaluation was officially introduced into the federal government in the late 70's to help improve management practices and controls. The 1977 Evaluation Policy mandated that evaluation be a component of the management of each department and organisation.

In 2001 the Treasury Board set Evaluation Policy and Standards for the Government of Canada, which are still in place today. The policy separated the evaluation and internal audit functions as well as extending the scope of evaluation to include programmes, policies and measures. A Centre of Excellence for Evaluation was established to assist with the implementation of this new policy. The policy focused on results-based management and aimed to embed evaluation in the life cycle management of policies, programs and measures. The Treasury Board policy also required that Departments employ qualified staff for evaluation with a Departmental head for evaluation who "must provide leadership and direction to the practice of evaluation in the department" (Treasury Board Canada, 2001). Therefore it has become normal practice in Canada to employ common evaluation tools (such as *logic models* – see below) in an early stage

19. Further information on the website of the independent blue ribbon panel: www.brp-gde.ca/en/.

of policy development. Currently there is a need to renew the evaluation policy of Canada in line with the Federal Accountability Act and for refocusing the evaluations on value for money.

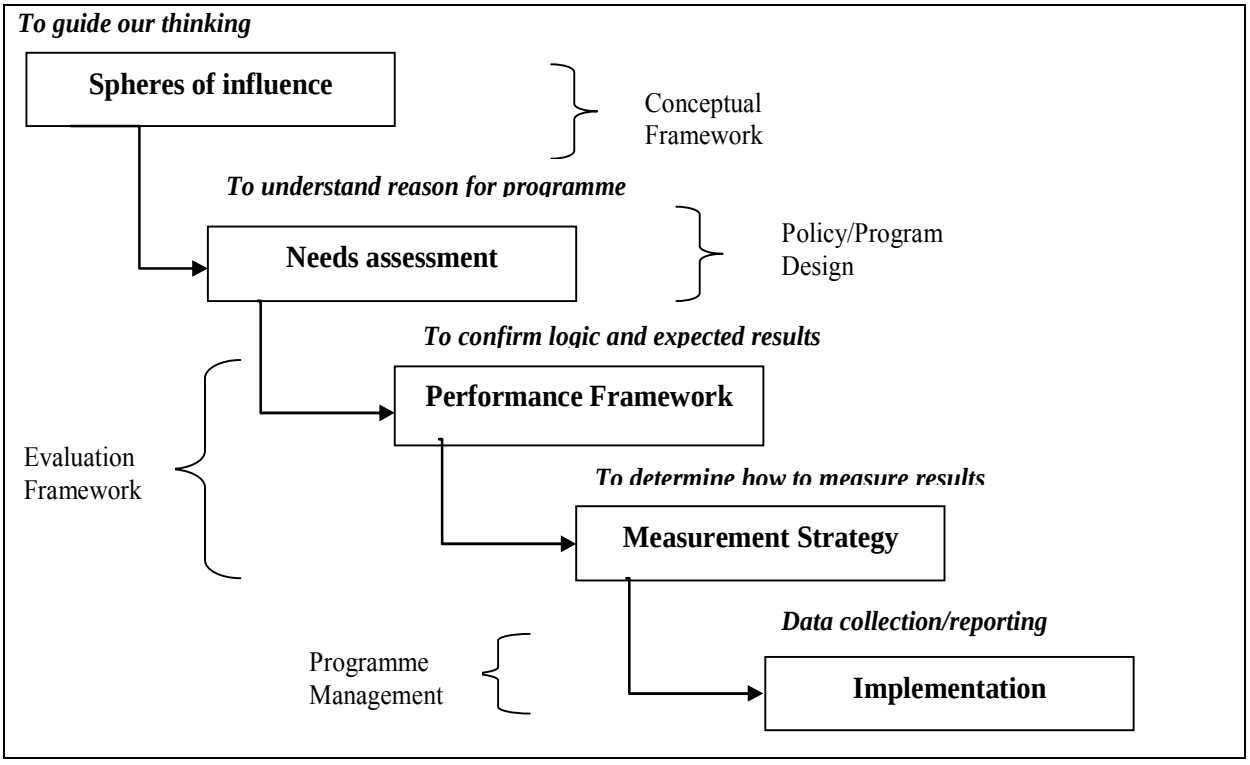
Before launching new instruments, Industry Canada – one of the key departments involved in research and innovation policy – goes through several steps to prepare the instruments, including a process to assess the likely effects of the programme (Figure 5.4).

These start by defining the *spheres of influence* of a certain problem area. Such as, in what context is this issue (*e.g.* lack of start-up companies) situated, and what are the key determinants of influencing the situation (markets, regulation, other policy instruments)? This is to create a basic theoretical understanding of the problem that the new instrument aims to address. This is followed by a **needs assessment**, involving stakeholders and asking for their opinion about the main bottlenecks and required government action.

A central element in this policy process is the design of an *Evaluation Framework* for every policy instrument. In general terms an evaluation framework describes a programme in terms of its objectives, outlines what an evaluation should entail or examine, describes the kind of information and data that are to be collected, and proposes some measures to assess performance relative to the programme's intentions. Before any budget allocation is made, the department has to present the Treasury with the Evaluation Framework, which is usually prepared by outside consultants and takes 2-3 months of work.

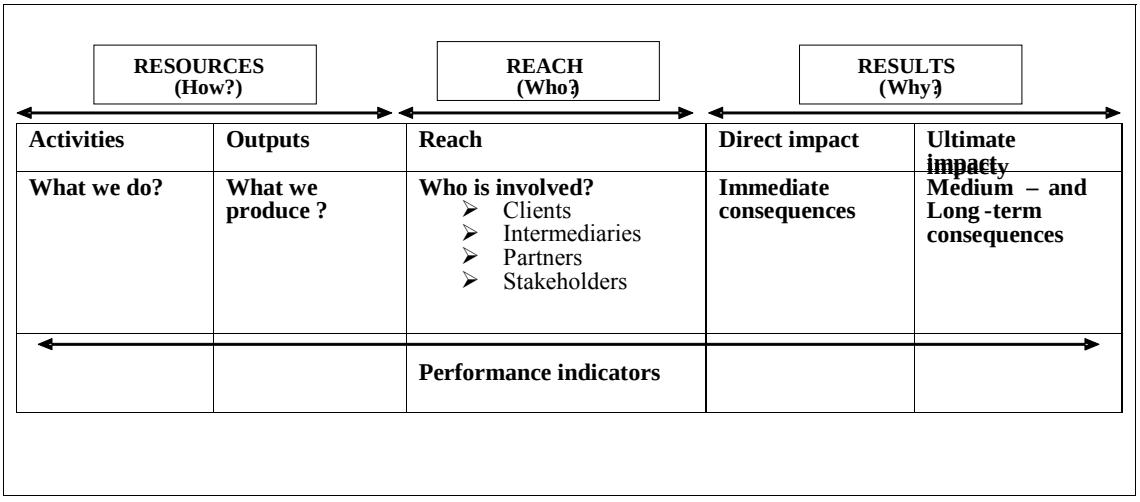
The Evaluation Framework's core is the definition of the *Performance Framework*, which describes the programme's purpose, activities and expected results. Figure 5.5 gives an overview of the elements that the programme managers have to define before the start of the programme.

Figure 5.4. Steps in the Canadian policy planning process



Source : Industry Canada, cited from Boekholt et al. (2001).

Figure 5.5. The performance framework



Source : Industry Canada, cited from *Boekholt et a*l. (2001).

The expected results are defined in measurable terms and the data collection strategy is attached to those indicators. The Evaluation Framework is used on the single programme level but never at the intermediate level of programme portfolios or at the level of the national system.

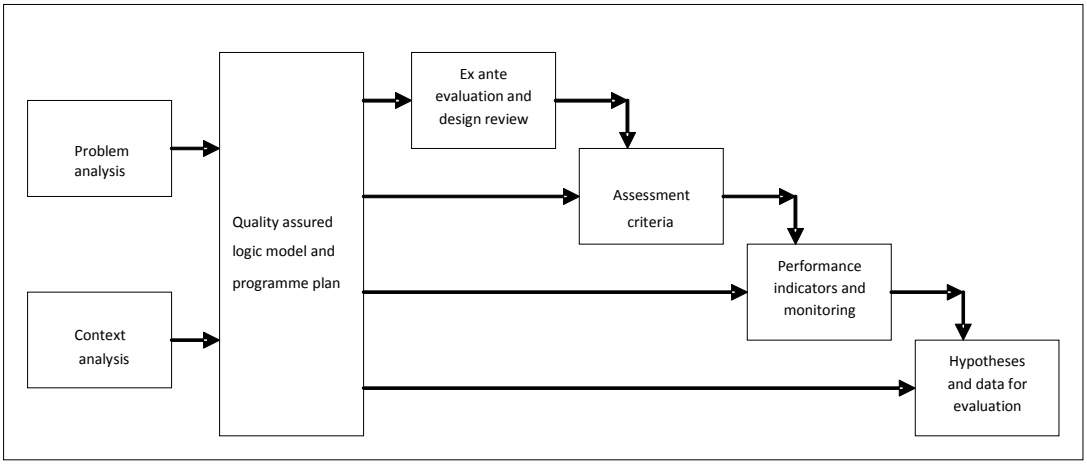
Lessons from international experience

More explicit planning and evaluation frameworks clearly generate an 'evaluation culture' in which it becomes natural to make use of systematised experience in order to guide policy and its implementation and tend to improve the quality of government – though they can also produce a risk that evaluation and planning become overly mechanistic. However, practice is typically that such frameworks influence processes at individual points within the system of actors and actions and do not in themselves lead these to become more 'joined up'. None of the countries examined here tries to use a unified national evaluation system as a way to understand the overall progress of the innovation system – nor has it been possible to identify other countries that do so. There is a need for some external actor (like the CNIC) to integrate the information produced and to perceive patterns not visible at the actor or activity level.

The evaluation frameworks do, however, impose some commonality of approach on planning and therefore aim to provide the kind of explicit and to some degree standardised planning approach that would be needed in order to build the national evaluation system CNIC desires. The frameworks illustrate a further important point: the importance of explicit intervention design. Improved design and improved evaluation go hand in hand and both benefit from a more systematic approach than has typically been used in the past. Programme design should incorporate explicit links to higher-level policy. As a result of this, programmes and programme portfolios should have an explicit 'middle' logic, connecting individual activities and programmes with higher-level goals. Assessment criteria to be used in project selection should be firmly and explicitly anchored in the programme logic. Performance indicators need to be quality assured and to derive from the programme logic.

There is thus a need for logical consistency across the programme cycle, to maximise the chances that interventions reach their objectives. Figure 5.6 shows the interrelationships involved, drawing from and synthesising existing models and practice. Clearly, this type of consistency requires an articulated programme design and development model.

Figure 5.6. Programme design, monitoring and evaluation



Whichever representation is chosen, logic modelling provides a useful and *explicit* way both to test designs and to understand – after the event – how a programme's implementation differs from its design. The spread of logic modelling in programme design may result both from its benefits and from the growing use of logic modelling techniques by evaluators, and the accompanying risk that they will discover logical flaws in programme design.

Organising evaluation – international practice

International practice in organising evaluation offers some useful clues about requirements for an effective evaluation system. This section considers: who should be responsible for evaluating whom; the importance of separating evaluation from line management and securing evaluators' independence; and the need to embed an 'evaluation culture' and build evaluation capacity in order to establish a well-functioning evaluation system.

The 'waterfall' principle

The idea of a hierarchy of performance contracts connecting through ministers, ministries and agencies with research and innovation project performers pervades the New Public Management and therefore current thinking about policy and evaluation. There is no cast iron rule but, in general, within the public service these kinds of performance contracts and their associated indicators are supplemented by evaluation studies from the ministry level and downwards, so that each level in the hierarchy evaluates the level below it. Thus, ministries evaluate agencies; agencies evaluate programmes; programme managers evaluate projects.

In some cases, ministries explicitly or implicitly contract programme management out to competing agents. Examples include New Zealand's Ministry of Research, Science and Technology, the UK Department of Trade and Industry and the Dutch Ministry of Economic Affairs (EZ). In these cases the agents cannot evaluate their own programmes as they would have a clear conflict of interest. Hence, the ministries themselves take responsibility for the evaluations.

Separating evaluation from line management

The so-called 'EPUB' report (Fahrenkrog *et al.*, 2002) points to a trend, following the lead of the UK Department of Trade and Industry, to separating the evaluation function in ministries and agencies into a

specialist, in-house group. This group can assist research funders to evaluate their research programmes by advising on the format for the preparation of terms of reference, organising tendering processes, managing contractors and interpreting and disseminating results of evaluations. They may propose evaluation strategies for the organisation, for example maintaining rolling programmes of evaluation to ensure that all policies and interventions are evaluated regularly. Encouraging the use of evaluation results is typically their responsibility. They may hold evaluation budgets.

Georghiou (1997) argues that such groups should be separate not only from 'line' programme management but also from the strategy function. The European Commission's evaluation good practice network also proposes (Network of Evaluators of the European Union, 2000) that the evaluation function should be separated from 'line' functions within the Commission's Directorates-General and placed close to policy functions.

- It should have an adequate budget, human resources and training to do its job.
- Its annual evaluation plan should be integrated with the wider work programme of the Directorate-General.
- *There should be feedback mechanisms in place that connect evaluation results to policy and practice.*

Other examples of such separation include well-established agencies or government departments such as:

- *TEKES*, the Finnish Agency for Technology and Innovation, where a specialised staff department handles both evaluation and the agency's system for project-level impact assessment, attempting to estimate the economic effects of TEKES funding. This department advises on evaluation strategy, establishes contracts with external evaluators and manages their work.
- *VINNOVA*, the Swedish Governmental Agency for Innovation Systems, where two members of the Analysis department are responsible for evaluation. They provide evaluation advice to the 'line' departments, manage the evaluation contracting process and assist in managing the contractor when that is desired, but evaluations are funded by the 'line' departments themselves. Their work also links to VINNOVA's work on understanding and explaining its socio-economic impacts.
- *Department of Trade and Industry*, UK, where evaluation is formally a responsibility of the Technology Economics, Statistics and Evaluation Directorate. This Directorate undertakes evaluations itself but also contracts in outside evaluators. There is a separate, specialist Evaluation Methods Group, which provides advice and guidance.
- *Forfás*, Ireland, which is the national policy and advisory board for enterprise, trade, science, technology and innovation and has a specialist evaluation and statistics group working on research and innovation. Formerly, this group did some evaluation itself, but most evaluation is now contracted out. It has its own budget to fund evaluations and other studies.

Evaluators tend to prefer to work for these separate functions rather than directly with the managers of the programmes and institutions they evaluate, so that they are not forced to evaluate the people who pay them. Internal evaluation specialists also tend to make sure that evaluations are better specified and that

they have a greater chance of being used than is the case when line management operates as the evaluation customer.

Making sure evaluators are independent

Independence is widely referred to as a key requirement for evaluation (Georghiou, 1997; Tavistock *et al*., 2003; Lengrand *et al.*, 2006). Naturally, internal evaluation groups can behave as if they were independent, but there are many circumstances where the credibility of an evaluation, and therefore its purchaser, relies on the use of external evaluators (Tavistock *et al.*, 2003).

Use of external evaluation contractors reinforces the need for internal evaluation capacity – in order competently both to buy and to quality assure evaluations. The quality of the evaluation as a whole is conditional upon:

- The quality of the planning and design phase, including the commissioning of the evaluation.
- The quality of the implementation of the evaluation itself.
- The quality of the monitoring system and of the available data.
- The organisational arrangements for dissemination.
- The quality of the evaluation work.
- The involvement of stakeholders alongside evaluators and administrators.
- The involvement of senior managers.
- The application of a system of systematic follow-up of the conclusions of evaluation.
- The institutional arrangements for conducting evaluation, especially the separation of the evaluation function from others (Tavistock *et al.*, 2003).

Evaluation culture

Some countries have a legislative framework that requires evaluation. Others do not. The difference is largely a matter of national tradition. Legislation can, however, be used as a way to emphasise the priority given to evaluation and to promote the creation of an evaluation culture.

John Killeen (Killeen and White, 1992) is credited with generating the term ‘evaluation culture. The current Guide to evaluation of the EU Structural Funds (Tavistock *et al.*, 2003) concludes: “the creation of an evaluation culture is essential for organisational learning. Key components of an evaluation culture over and above the generation of quality evaluation work include: a presumption that interventions should be designed and implemented in a manner that facilitates subsequent evaluation; an appreciation of the range of purposes of evaluation; a recognition of the limits of evaluation, the scope for interpretation and the need to combine quantitative and qualitative evidence; and, a recognition of the needs of different users of evaluation”.

The Association for Technology Implementation in Europe (TAFTIE) argues that internal evaluation manuals and their dissemination are keys to embedding evaluation culture. The European Commission’s decision to provide large-scale basic evaluation training to managers and project officers represents an unusually strong commitment to the idea of evaluation culture, involving training several hundred people. To an increasing extent, other R&D funders are also taking up this kind of training, so that evaluation (and

the clarity of planning that accompanies the use of logic models) becomes embedded in programme design and delivery.

A study of the use of evaluations in the European Commission (Technopolis, 2005) found that crucial factors in fostering use are:

- The timing and the purpose of the evaluation.
- Support from senior management.
- The quality of the evaluation process and the evaluation report.
- The monitoring and follow-up of evaluation recommendations.

These findings are hardly surprising – but reinforce the point that evaluation needs to be embedded in the processes of the agency involved, if it is to make an important contribution to practice.

Embedded evaluation

These more operational aspects of evaluation practice have important implications for how CNIC needs to design and implement an evaluation system. The 'waterfall' principle implies that there are checks and balances in the evaluation system that allow (particularly) agencies to embed evaluation into their normal processes while also making sure that their use of evaluation is tested when they themselves come to be evaluated at the organisational level. CNIC should encourage actors to develop an internal evaluation function not only because this is good practice but also because it will create the network of specialised people who will need to co-operate in putting together and running an integrated evaluation system. Such specialists also underpin the system's ability to use independent evaluators, whose work must be defined in such a way that it is consistent with the needs of the overall evaluation system as well as the organisation to which the evaluation commissioner belongs.

Embedding an evaluation culture depends upon obtaining management commitment from the organisations affected. These managements need to see the benefits for their own organisation, both of internal use of evaluation and of participating in the national system of evaluation. This involves operational changes in the organisation and investment in training.

Capacity building is an important requirement for building an evaluation culture and implementing an evaluation system. A Centre of Excellence in evaluation, or some other form of evaluation institute, is a useful device not only for defining and maintaining evaluation standards within the national system but also as a place that can organise wider training and evaluation capacity building.

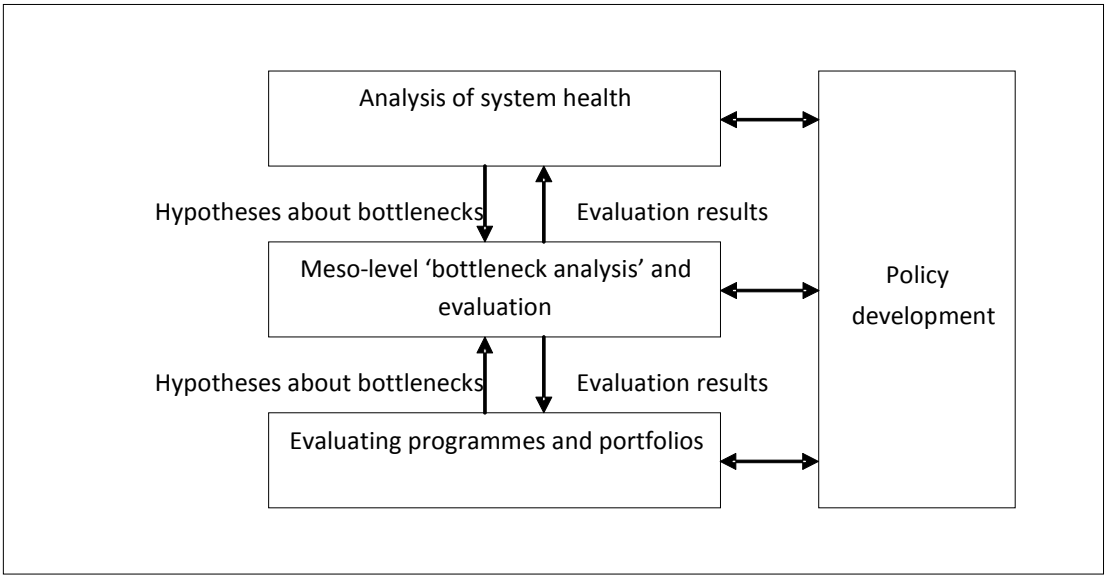
Designing an evaluation architecture

This section discusses the need for a suitable evaluation architecture in order to create consistency among the different planning and evaluation instruments CNIC needs to consider.

The need for an architecture

The systems perspective suggests three levels of evaluation (Figure 5.7). The overall health and functioning of the innovation system need to be analysed. Individual interventions (projects, programmes and programme portfolios) should routinely be evaluated. Sub-systems evaluation or 'bottleneck analysis is the most genuinely novel of the three levels, evaluating and analysing at a meso level, to explore the systems role of institutions, classes of actors, clusters, programme portfolios and so on. The evaluation system CNIC needs to design and manage should handle all three levels.

Figure 5.7. Research and innovation policy evaluation in a 'systems world'



Source : Arnold (2004).

It is hard to make good policy in a centralised way. Certain types of information are only available at a decentralised level so strategic intelligence – in the form of data collection, monitoring, evaluation and analyses – needs to be distributed. Policy evaluation and development need correspondingly to involve interaction among the different stakeholders. The policy system therefore needs to be flexible rather than being prescribed is some permanent way.

The evaluation system to be developed needs to have a static component, in the form of a hierarchy of interrelated evaluations that together allow CNIC to understand the efficiency and impact of the existing agencies, programmes and instruments. The second component must be dynamic and comprise ways not only to change the static system as the agencies and instruments change but also to incorporate evaluations and studies done in response to other needs, such as political change, changes in science and technology or the appearance of new needs.

Using logic models to hold the system together

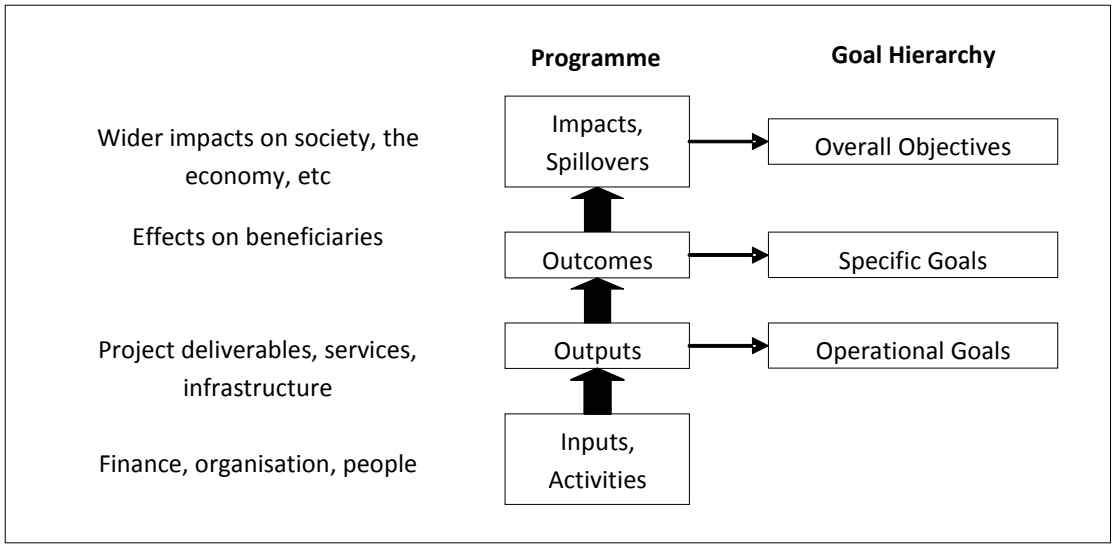
Logic modelling offers a useful tool for constructing the evaluation system. Logic models are becoming increasingly common both in evaluation and in the design of interventions. A logic model shows step by step how an intervention is expected to lead to results. Sometimes this is called an 'intervention logic' or a 'programme theory'. Planners increasingly use logic models because they make the programme theory explicit, so it can be discussed and analysed and so that it becomes clear what performance indicators can be used. Evaluators use logic models because they provide hypotheses about the intended effects of interventions that can be used to structure the evaluation. More generally, the benefits of logic modelling are

- Building a common understanding of programmes.
- Helping in articulating and quality-assuring programme design.
- Communicating about programmes.

- Generating performance indicators.

The different stages of such a logic model connect quite directly to different types of goals (Figure 5.8) and to performance indicators. The intervention's outputs should satisfy its operational goals while the outcomes address its specific objectives. For example, the outputs of an industrial R&D support programme would be things made during projects, such as software or intellectual property. The outcomes could, for example, include increased market share for the beneficiary. Improving the performance of many firms would have more general effects, such as increasing the competitiveness of a branch or cluster.

Figure 5.8. How the Logic Model connects actions to goals



Source : Technopolis.

The Luxembourg research agency FNR has recently adopted a hierarchical approach internally, using interrelated logical frameworks[20] and nested logical frameworks are fairly widely used in the development world to connect projects and programmes. But logic modelling is rarely used to bridge across institutions. The integrated evaluation system desired by the CNIC however implies building a hierarchy of such models that connects the goals of individual interventions or clusters of interventions with the objectives and operational logic of the agencies, and those logics in turn with the CNIC strategy.

Performance indicators

Once logic models are articulated in some detail (see for example the logic model for the CNIC developed below. It is comparatively easy to develop indicators for the performances required by each box in the model. The main problem is usually to constrain the number of indicators to a manageable list, with as many indicators as possible being based on existing statistics or reporting functions, so as to minimise the administrative burden imposed. For CNIC's set of systems evaluations, an analysis will additionally be required that compares indicators at different levels and selects a sub-set that can be considered at the national level.

20. A particular type of logic model.

Different indicators are used at different levels of evaluation. The following pages show examples of indicator sets, respectively from the national (in this case, European) level, an agency and a substantial programme. In practice, the degree of overlap among the indicators used at different levels is small, but may be increased by design if the whole system of evaluation and performance indication is made the subject of a discussion by CNIC.

Table 5.1. European Innovation Scoreboard Indicators - 2007

INNOVATION DRIVERS (INPUT DIMENSION) 1.1 S&E graduates per 1000 population aged 20-29 1.2 Population with tertiary education per 100 population aged 25-64 1.3 Broadband penetration rate (number of broadband lines per 100 population) 1.4 Participation in life-long learning per 100 population aged 25-64 1.5 Youth education attainment level (% of population aged 20-24 having completed at least upper secondary education)
KNOWLEDGE CREATION (INPUT DIMENSION) 2.1 Public R&D expenditures (% of GDP) 2.2 Business R&D expenditures (% of GDP) 2.3 Share of medium-high-tech and high-tech R&D (% of manufacturing R&D expenditures) 2.4 Share of enterprises receiving public funding for innovation
INNOVATION & ENTREPRENEURSHIP (INPUT DIMENSION) 3.1 SMEs innovating in-house (% of all SMEs) 3.2 Innovative SMEs co-operating with others (% of all SMEs) 3.3 Innovation expenditures (% of total turnover) 3.4 Early-stage venture capital (% of GDP) 3.5 ICT expenditures (% of GDP) 3.6 SMEs using organisational innovation (% of all SMEs)
APPLICATIONS (OUTPUT DIMENSION) 4.1 Employment in high-tech services (% of total workforce) 4.2 Exports of high technology products as a share of total exports 4.3 Sales of new-to-market products (% of total turnover) 4.4 Sales of new-to-firm products (% of total turnover) 4.5 Employment in medium-high and high-tech manufacturing (% of total workforce)
INTELLECTUAL PROPERTY (OUTPUT DIMENSION) 5.1 EPO patents per million population 5.2 USPTO patents per million population 5.3 Triad patents per million population 5.4 New community trademarks per million population 5.5 New community designs per million population

Table 5.1 shows the set of indicators currently used in the European Innovation Scoreboard, which is an instrument of the European Commission's so-called Open Method of Co-ordination, in which it tries to create an arena for policy discussions and comparisons among EU Member states, with the intention of increasing R&D investments and innovation performance. These are typically the kind of indictors with which CNIC will be concerned when looking at the overall health of the innovation system.

Innovation agencies internationally work with a wide range of different performance indicators. Those for TEKES in Finland, for example, run to several pages and include indicators such as business expenditure on R&D as a share of GDP – which is arguably problematic for an agency, whose influence over the indicator is rather limited. The TAFTIE Association for Technology Implementation in Europe[21] (a network of European innovation agencies) has brought together its' members thinking on indicators for evaluation and performance monitoring (TAFTIE, 1997) and more recently reviewed the performance indicators to which its members are subject (TAFTIE, 2003). European interest in trying to estimate the economic payback to innovation agencies' work was high at the turn of the millennium but has since abated. Partly under TAFTIE's influence, European agencies are also moving from performance indicators towards balanced score cards (which are easier for management to use but may say less that is of interest to those using agency performance indicators as windows on innovation system performance. Table 5.2 shows an example, from the Dutch innovation agency SenterNovem.

Some agencies (for example, TEKES and – in certain of its programmes – the Research Council of Norway) try to estimate the economic impacts of the projects they fund – at least for the beneficiaries of project funding. Most agencies do not do this and focus their performance indicators on outputs rather than outcomes or impacts. For example, the Swedish Competence Centres Programme 1995-2005, which aimed to create larger and longer-lasting on-campus research centres involving both industry and academics than had previously existed in Sweden used the following list of indicators. All but the last two are output indicators:

- Contributions to costs, respectively from industry, the participating universities and state agencies.
- Number of companies participating.
- Number of companies per centre.
- Ration of cash to in-kind resources in industrial contribution.
- Number of company people actively involved in research at the centres.
- Number of company people having some sort of position at the universities.
- Number of workshops.
- Number of peer-reviewed scientific articles produced.
- Numbers of postgraduate degrees produced (licentiates, doctorates).
- Number of start-up companies resulting.
- Number of patents filed (VINNOVA, 2006).

21. http://www.taftie.org/.

Table 5.2. SenterNovem Performance Indicators, 2006

	Performance Indicator	**Quality Objective 2006**	**Actual 2006**
Target Groups			
Client satisfaction	1 Client satisfaction of target groups	On average equal to or more than 7.5	7.3
	2 Number of legitimate complaints	**<10**	**0**
	3 Net processing time of declarations	95% within statutory period	93.8%
	4 Net processing time of commitments	95% within the statutory period	81.0%
	5 Net processing time of juridicial appeals	80% within the statutory period	79.9%
Familiarity	5 Number of external visits to website	Average 2 250 individual visitors per day	4,208
		Client satisfaction survey: on average equal to or more than 7.5	7.1
Accessibility	6 Contactability by telephone	90% of telephone calls answered within 15 seconds	90.6%
	7 Client satisfaction with front office	O n average equal to or more than 7.5	7.2
	8 Reduction of administrative burden	Online subsidy applications 90%	100%
Principals			
Realisation of policy objectives	1 Demonstrability of result-based output	Report on the results and impact of at least 90% of the programmes involving more than 5 000 hours	87%
Low implementation costs	2 Development of average weighted rate	Rate increase of 0.0% (changed compared with 2005)	0.0%
Quality of service	3 Customer satisfaction among clients	On average equal to or more than 7.5	7.4
Owner			
Result	1 Net annual result	≥ 0	EUR 0.5 million
Efficiency	2 Billable hours	76.9%	77.8%
Quality	3 Financial error rate	≤ 0.5%	0.12%
	4 Formal error rate	≤ 5.0%	5.74%
	5 Percentage of awarded juridical appeals	15%	29%
Integrity	6 Number of violations of integrity	0	0
Internal organisation			
Staff flexibility	1 Ratio Civil Servants vs External Personnel	85/15	71/29
Expert and motivated staff	2 Training costs as percentage of wage bill	2.0%	2.4%
	3 Absenteeism rate	<4.5%	4.3%

Source: SenterNovem *Annual Report 2006,* Chapter 3.

Designing the system

The evaluative part of this report concludes that CNIC's role in the innovation system needs to be as an *arena* within which consensual and collective decisions can be made, rather than as a central planner. Without this kind of consensus, it is not likely that the CNIC's decisions will be implemented because *a)* dissenters will simply not comply with CNIC's decisions and *b)* CNIC will be seen as an actor that competes with the others in the system, which will cause resistance.

In practice, the CNIC largely operates in this way (the exception is its perceived role in allocating the FIC's financial resources). A good example of the CNIC's open 'arena' role is the little library of interesting publications that it maintains on its web site, in addition to its own publications. To be an effective way to support CNIC's arena, consensus-building role, the evaluation system needs to be so open that it enables debate about performance.

Despite the growing use of evaluation discussed earlier, there is no known case of a country implementing a system of the type envisaged here.

In trying to establish a system, the Council will have to ensure that it does not develop a 'frozen design' but an intelligent *process* that can cope with changes in the needs of the innovation system and in policies, organisation and instruments. Innovation is inherently unpredictable so many innovations succeed by changing the 'rules of the game' in a particular industry. An evaluation system must be able to deal with this, avoiding lock-ins or blind spots generated by its own structure. One of the major problems of frozen design is that it impedes challenging the relevance of policies or instruments that have worked in the past and may still work but that could usefully be replaced by other ones that work better or may no longer be needed in the context of new framework conditions.

The Council cannot *impose* an evaluation system on everyone. Hence, the development of the system should involve the key stakeholders in order to win their agreement and willing participation. They should be involved throughout the process.

The actors, such as the agencies, who operate the individual parts of the evaluation system will build their inputs to the national system on the back of their own internal evaluation requirements. Thus, for example, CONICYT's evaluation system should first satisfy the information needs of CONICYT management and second provide the national system with inputs. In organisation chart terms, there will be a 'hard' line to CONICYT management and a 'dotted' line responsibility to CNIC, otherwise CONICYT will experience the national system as an irrelevant burden rather than as a useful extension and complement to its own work.

Developing the evaluation system involves:

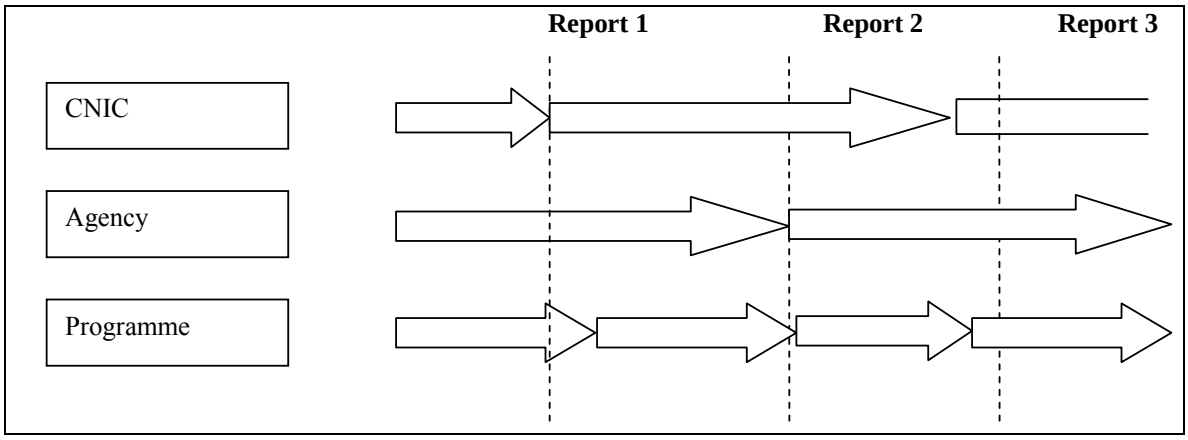
- Documenting the missions of the major state players involved, from CNIC down to the agency level and showing how these fit together.
- Representing these in a 'tree' structure, showing how lower-level activities and goals contribute to reaching higher-level ones.
- Understanding and analysing existing planning and evaluation processes and practices across this hierarchy, in order to 'piggy-back' on these and co-opt them to the national system.
- Proposing systems of information and indicators.
- Where relevant, establishing baselines.

Operating the system

Two key operational issues are the timing differences among various levels of the system and change management.

In planning the system, it will be useful to suggest common reporting points, but it also needs to respect the fact that different levels of the state's part of the innovation system tend to have different natural timing cycles. CNIC's term of office has been designed to be out of phase with that of the government in order to avoid locking it into the electoral cycle but the Council may nonetheless have to deal with the rhythm of government – probably through a combination of annual and periodic reporting. Because there will never be a time when the whole system is 'ready' to report, it will be necessary to evaluate progress by taking 'slices' through the evaluation information available at the different levels of the system (Figure 5.9 illustrates the principle). The use of a hierarchy of logic models supports this kind of reporting where the results are never complete because where interventions are still 'work in progress' their *intended* effects can be well described and evidence (for example) about outputs can be offered as a way to show that progress is being made towards the expected outcomes and impacts.

Figure 5.9. A reporting system robust against timing differences



The second operational issue is to ensure that the system is continuously updated. This means that the logic hierarchy must be modified as policies and interventions change, so CNIC needs periodically to review changes with the agencies involved. Crucially, the evaluation and planning system must not become reasons to prevent change.

Evaluating the Council itself

It has not been possible to identify any evaluations of foreign equivalents to the CNIC, so there is no directly relevant experience upon which to build. The fact that there are no evaluations of equivalent councils suggests that, in practice, governments simply decide on the basis of their experience whether they find the councils useful and act accordingly. There are instances where CNIC-like responsibilities have been built into some large agencies or actors, but these have rarely been evaluated. The Research Council of Norway has responsibility for providing research and innovation policy advice to the Norwegian government, but given its role as an actor and the presence of an advisory council at the level of ministers, RCN's influence has been limited (Arnold, Kuhlmann and van der Meulen, 2001).

Figure 5.10 shows the intervention logic of the Council. Broadly, it says that the CNIC should function as an arena for agreeing policy priorities in relation to research and innovation and that it should document these in an open and accessible way so that they can both be used by policy makers to set policy and serve to explain to a wider audience why innovation is important and what should be done to promote it. The clarity and consensus introduced into innovation and competitiveness policy as a result of this should lead to new and improved, policies and measures for promoting research and innovation that are co-ordinated and consistent across the state apparatus and that are also reflected in growing consensus at the political level of the need to take long-term action to improve research and innovation performance. This political consensus is needed in order to create incentives (and reduce disincentives) for long-term policies that may not have a political payoff within the current electoral period. These policy changes (outcomes) and in turn expected to lead to improved research, innovation and competitiveness performance along a range of dimensions that ultimately support the CNIC's overall objective to contribute to doubling per capita GDP by 2020.

During the first years, the CNIC needs to continue to learn how best to define and perform its role. *Formative* evaluation can play a part in this. Such an early formative evaluation will have to rely on qualitative methods: interviews and potentially focus groups, aimed at understanding key actors' experience and perceptions of the council. It should primarily test the link from the outputs to the outcomes, looking for ways in which the CNIC could increase its effectiveness. This is the key act of persuasion that CNIC must undertake in order to lead to the desired impacts. This kind of early stage evaluation can usefully be done internally, since its entire purpose is to learn how to improve performance. Sometimes it can be helpful to get external assistance in structuring or moderating the evaluation.

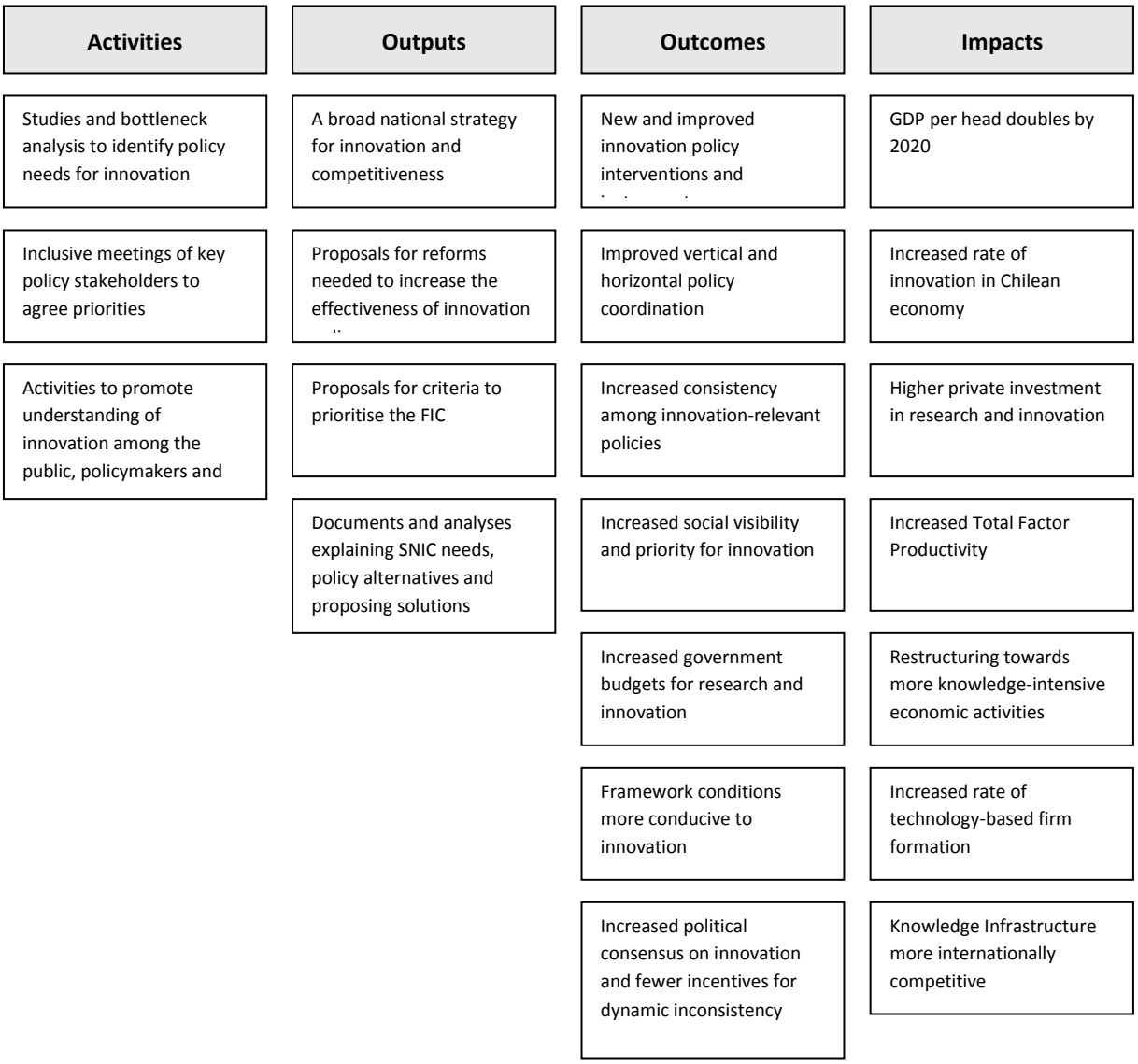
Given its role it may be useful to make it, in the longer term, a (legal) requirement for the CNIC to request periodic and transparent international evaluations. Since the CNIC is expected to have an influence over a rather long period of time, it is not reasonable to stage a formal *summative* evaluation within the first few years. Probably, 3-5 years would be needed before there are clear outcomes that could be assessed. The links to impacts are inevitably hard to assess. Impacts concerned with changed behaviour, such as higher business expenditure on R&D and innovation should be visible in perhaps five years; output changes such as restructuring and increased total factor productivity (TFP) are likely to need longer.

A summative evaluation could have four analytic components. To be efficient, it would have to exploit results from evaluations of actors and programmes at lower levels in the policymaking hierarchy

- A qualitative exploration of the effectiveness of CNIC's intervention logic – exploring stakeholders' experiences of interacting with CNIC and the extent to CNIC induces policy changes in their spheres of influence.
- Identification of specific policy and intervention changes resulting from CNIC's activities.
- Review of monitoring and evaluation information from those new policies or interventions (an area where the suggested overall evaluation system would be very helpful).
- Collation and analysis of information from innovation and other surveys, national and regional statistics to explore early signs of impact at the quantitative level.

These would provide an initial evaluation of the extent to which CNIC's real purposes are being achieved, as well as offering lessons for process improvement. Especially since the government would be the evaluation customer, it will be necessary to involve a high-status panel or reference group – preferably with an international component that includes experience of how CNIC-like councils function abroad. The team should be led by professional evaluators and include specialists both in qualitative analysis and quantitative economics.

Figure 5.10. CNIC intervention logic



Conclusions

CNIC's ambitions for evaluating the system of interventions for which it aims to strategise and co-ordinate are unusual internationally. Other frameworks consider planning and evaluation at the level of individual actors or actions; they do not try to take the multi-level, system-wide approach desired by CNIC. Nonetheless, CNIC's approach may be feasible, provided CNIC can negotiate not only the creation of the evaluation framework but also the wider set of changes needed in planning and in evaluation capacity in order to implement it. This is certainly a challenging tasks.

It would be impractical for the Government to evaluate the Council, but the CNIC itself could be required to periodically request a transparent international evaluation, which relies on the use of professional evaluators, a high-status panel of experts and meta-evaluation to consider the CNIC's performance.

A shared evaluation system needs to be structured around a set of plans and ambitions that are developed in a common planning framework and that can therefore be expressed in common terms: the suggestion here is that this common language should be a nested set of intervention logics, which may be expressed as logic diagrams (other forms are also possible). This will enable CNIC to document a 'meta-intervention logic' that spans CNIC strategy and its implementation by others at lower levels. Such a meta-logic can be analysed and tested as well as serving as a set of hypotheses on which evaluation can be based. This analysis and testing should serve to reinforce CNIC's role as the national innovation policy arena, in which ideas can openly be debated and the various actors recruited to the common purpose.

The meta-logic also provides the 'spine' on which relevant indicators can be hung, showing performance at various levels of the logic tree that point toward impacts. CNIC will have to co-ordinate the design and collection of a set of performance indicators across multiple levels, so that that it collects indicators from lower levels that complement the national-level ones already used in connection with its strategy.

Foreign experience suggests that it will take some years to build the common planning and evaluation culture needed to establish an evaluation system working in a co-ordinated way across multiple levels. Implementing such a common evaluation system requires the creation of planning and evaluation capacity at each level of the system and therefore a programme of training that should cover at least the essentials of evaluation and the construction of logic diagrams, so as to create a common 'language' across the system.

Internal evaluation specialists are required in each agency to embed evaluation culture, to link evaluation properly to the operations and purposes of their agencies as well as to provide the links to CNIC. These evaluation specialists form part of the 'distributed strategic intelligence of the innovation support system as a whole. However, CNIC will have to offer strong co-ordination – more via persuasion than by *fiat*, if the system is to be consistent across different actors. Partner agencies must be involved in the detailed design of the system, otherwise they are unlikely to play their parts.

To the extent that external evaluation specialists will perform the increased volume of evaluation there is a need to foster an evaluation market and evaluation suppliers. Many countries have national evaluation associations or networks that reinforce the community of evaluators, exchanging experience and encouraging the development of good practices. Promoting such a network specialised on innovation and research evaluation in Chile would help develop the needed supply base.

The evaluation system must be a living thing – tied to the policy discussion and capable of constant evolution, in line with changing policy priorities and programmes. Provided it is kept up to date, it can readily be 'tapped' at almost any time for information about progress towards CNIC's overall goals: demonstrating a combination of actual progress and showing how actions are expected to lead to outcomes and impacts.

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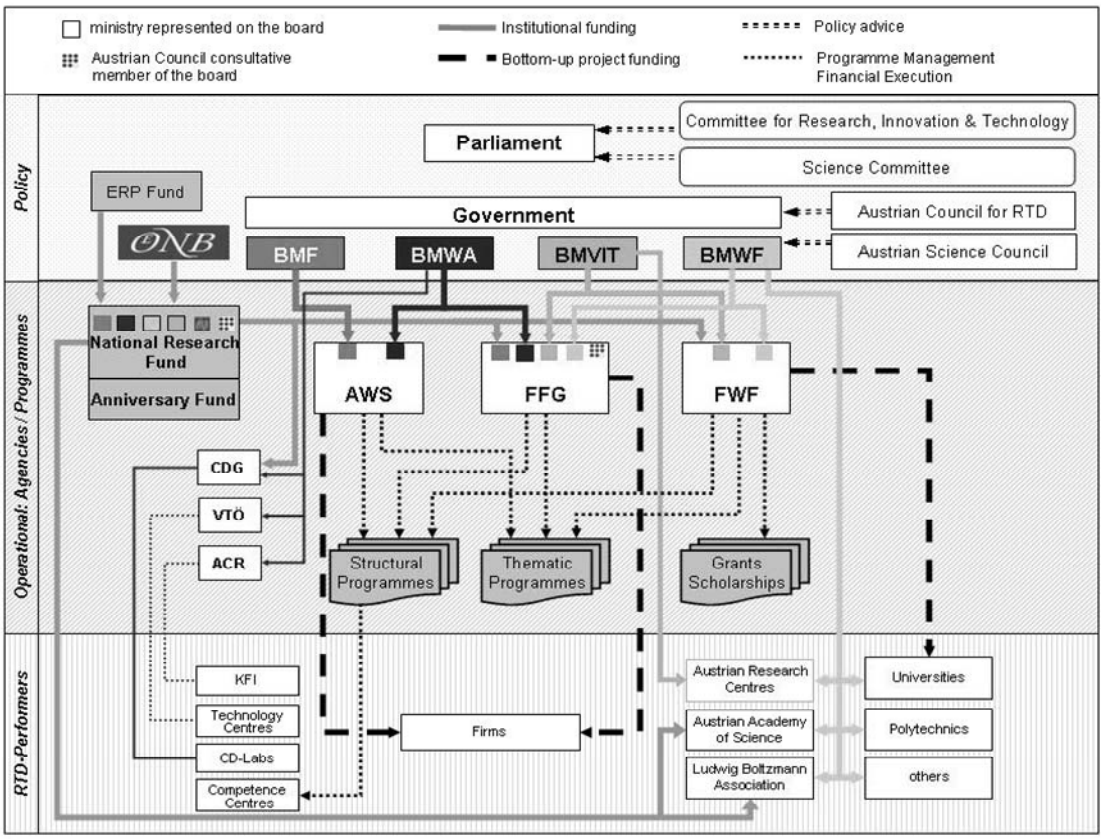
ANNEX - COUNTRY CASES OF INNOVATION COUNCILS

Austrian Council for Research and Technology Development

R&D has not been a strongly politicised issue in Austria, though it receives more political attention than in many other countries. At the federal level, responsibility for research and technology policy is borne by three ministries: the Ministry for Science and Research (BMWF), the Ministry for Transport, Innovation and Technology (BMVIT), and the Ministry of Economics and Labour (BMWA). There is no formal mechanism of co-ordination among these ministries. The Ministry of Finance (BMF) governs the allocation of financial resources and sets, at least implicitly, standards for the design, implementation and monitoring of programmes. Thus, it plays an important role within the research policy system even though it is not directly responsible for the Austrian R&D policy.

Figure A.1. Structure of the Austrian research and Innovation governance system



Source: http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.content&topicID=35&countryCode=AT&parentID=34.

Austria has made considerable progress in the field of research and development and has closed the gap to achieve the EU average in R&D spending and is now among the front-runners in some aspects of research funding. Funding for research, technology development and innovation is managed by three major agencies on behalf of the ministries: the Austrian Science Funds (FWF), the major body for the promotion of basic research, the Austrian Research Promotion Agency (FFG), the major funding body for the promotion of applied research and development, and the Austria Wirtschaftsservice (AWS), specialised in funding innovation projects in companies and hosting the secretariat of the National Foundation for Research, Technology and Development.

Foresight studies were carried out in Austria in 1996 to 1998. These studies were applying the Delphi technique to identify social, cultural, economic and political trends in the country giving an overview of society and culture as well as technology. No further studies of this kind have been performed since.

There are two major advisory bodies in Austria. The Austrian Science Council is the main advisory body in all matters regarding universities. It advises the Federal Ministry for Science and Research, the BMWF, parliament and universities. This function overlaps with the role of the Austrian Council for Research and Technology Development (to be referred to as the "Austrian Council" or "Council"), which is by far the more influential of the two bodies.

The Austrian Council was established in 2000 to provide systematic, independent advice to the government regarding the implementation of a future-oriented policy in the area of research and technological development. The attendance of the Austrian Prime Minister at the Lisbon summit in 2000 triggered the initiation of the Council and the political decision was made to follow the Lisbon agenda, which included providing additional finances for R&D and comparing the policies of neighbouring countries.

The Council was established based on a law, which has since been amended several times. The original Austrian Research and Technology Promotion Act was introduced in 2000 and defines the Council's tasks. This was revised in 2003 to include provision for a secretariat and define the Council as an independent not-for-profit organisation.

The Austrian Council is free to make recommendations on any issue it chooses. The government is not obliged to follow the recommendations of the Council. However, the Minister of Finance informally committed to follow-up the Council's recommendations and has largely done so. Owing to ministerial representation on the Council the formation of recommendations is a negotiation process and outcomes are known to the government well before the recommendations are formalised. Therefore, the majority of recommendations have been implemented.

The Council consists of twelve members; eight voting members and four ministers who act as advisory members, but do not hold a vote. These are the Minister for Transport, Technology and Innovation, the Minister for Science and Research, the Minister for Economics and Labour and the Minister of Finance. Ministers of the government nominate members. In the first term the voting members included three representatives of large companies, one from a small enterprise, two university professors and a university representative from Austria as well as one international university representative. This was altered slightly in the second term with four representatives from big multinational companies, one international university representative, one national university representative, one person from a regional technology policy agency and one museum representative (technical scientific institution). The secretariat consists of eight staff members.

The term of service is five years and can be renewed once. The eight voting Council members are nominated by two ministers, the Minister of Transport, Innovation and Technology and the Minister of Science and Research. The Council in session since 2005 comprised of the following members:

- DI Dr. Knut Consemüller, Chairman.
- Univ. Prof. Dr. Günther Bonn, Deputy Chairman and member of the University Council at the Medical University of Innsbruck.
- Univ.-Prof. Dr. Dervilla Donnelly, Member of the European Science Foundation and the European Science and Technology Association (ESTA), Chairperson of the Dublin Institute of Advanced Studies.
- DI Dr.h.c. Albert Hochleitner, CEO of Siemens AG Austria.
- DI Reinhard Petschacher, Head of development of the Automotive, Industrial and Multimarket division of Infineon Technologies AG.
- Mag. Hans Schönegger, Managing Director of Kärntner Beteiligungs GmbH.
- Prof. DI Jürgen Stockmar, Vienna University of Technology, responsible for global development and technology activities at Magna.
- Dr. Gabriele Zuna-Kratky, Director of the Technical Museum Vienna, also a member of the Council of the University of Applied Arts and trustee of the Deutsches Museum Munich and of the Berlin Museum of Technology.

Advisory members included:

- Werner Faymann, Vice Chancellor and Minister of Transport, Innovation and Technology.
- Johannes Hahn, Minister of Science and Research.
- Martin Bartenstein, Minister of Economics and Labour.
- Wilhelm Molterer, Minister of Finance.

The Council performs a number of functions including the following:

- Advising the federal and state governments (*Länder*) in matters regarding research, technology and innovation; defining a long-term RTD strategy.
- Monitoring implementation of this strategy.
- Providing guidelines for national research programmes and promotion of RTD institutions.
- Making recommendations to strengthen Austria's position in international programmes.
- Making proposals for national RTD programmes.
- Making proposals to improve co-operation between science and industry.
- Providing guidelines for evaluation of institutions.

Decisions are reached by the Council on a consensus basis and in most cases are unanimous. However, if this is not the case a majority of 6 of the 8 members is required.

Stakeholders are often invited to contribute to working groups for different issues. Depending on the topic different ministry representatives, industry representatives, experts and the scientific community will

attend. A member of the Council and the secretariat are responsible for each working group. At times the Council commissions external experts to perform studies on their behalf, such as benchmarking with other countries. The Council uses available data from the EU's Innovation Trend Chart and other sources, but does not carry out any evaluation. However, in 2005, it joined the Platform Research and Technology Evaluation (*Plattform FTE-Eval*) – a network of research and innovation evaluators, funders and ministries that has made a major contribution to improving R&D evaluation practice in Austria since it was set up in 1996. The Austrian Council made a number of recommendations about the type and frequency of evaluations which were adopted by the Plattform and form the basis of an annual Evaluation Day organised jointly by the Plattform and the Council. Since its inception, the Plattform has functioned as a repository for Austrian R&D evaluation (see Zinöcker *et al.*, 2007 and Box A.1).

A strong emphasis is placed on long-term strategy for R&D. The Council has covered a broad range of issues including: research policy priorities, development of long term research agendas, the environment, energy, mobility/transport, security and space, ICT, biotechnology, food and agriculture, nanotechnology, nano sciences, materials and new production technologies, socio-economic sciences and the humanities.

The Council has made recommendations regarding funds, particularly the extra funds gained from privatisation of public companies, which have been provided from the government for R&D in 2000 and from 2004-2006. Overall an extra EUR 1 billion was spent. The Minister of Finance informally committed to following Council recommendations and upheld this to a large extent. The Council receives an operating budget for the secretariat and external experts provided by federal funds. However, it does not fund any research.

The Council initiated a large public awareness campaign in 2002, which was supported by the ministries and employers' and employees' organisations. This was followed by a secondary campaign to promote an understanding of R&D rather than awareness, mainly within educational institutions. To widen communication with stakeholders the Minister for Science and Research has conducted a "research dialogue", a forum for discussion of issues relating to R&D.

The Council has published a number of strategy reports and activity reports are produced yearly. These include the following:

- *Vision 2005 – Among the Best through Innovation*. In this paper the Council defines the goals of its work and details strategic guidelines.
- *2.5% + plus – Prosperity through Research and Innovation*. This strategy is based on the conclusions of "Vision 2005" and supplies initial measures and models to quantify possible paths to achieve the goals. The objective is to improve the quality, efficiency and output of research and eventually lead to better innovation performance.
- *National Research and Innovation Plan* (NAFIP) 2002. This provides the Council's strategy and proposes measures for implementing the structural reform of the national innovation system recommended.

Box A.1. The Austrian Evaluation Platform – an example of mutual learning

Platforms for mutual learning can be important instruments for building consensus and putting policy issues higher on the agenda. For their part, evaluation issues need an underlying culture and common understanding. Both methodological questions and individual evaluations need broad discussion, transparency, standards, feedback and shared values. While the Anglo-Saxon and Scandinavian countries have a longstanding culture in this respect, evaluation of RTD policy in Austria was underdeveloped until the 1990s. Only a few elements, such as *ex ante* project evaluation, met international standards. Reasons included a lack of awareness among policy makers, few existing explicit funding programmes, the predominance of institutional block funding without quality criteria and, more generally, an innovation system that was still in the making.

In the mid-1990s a small number of administrators and researchers created the Austrian RTD evaluation platform (*Plattform FTEval)* as a loose network to discuss methodological issues and to present new evaluations. "Struggling for a higher rank on the policy agenda" (Stampfer, 1998) was its mission and main goal. A workshop series regularly brought together Austrian and foreign experts, and a newsletter documented and diffused the results. Over the years the community grew, partly because of the platform's work, partly owing to the growing need for legitimacy of public spending. "Value for money", outputs and impacts as well as indicators for measuring them became more pressing issues, as public R&D expenditure started to accelerate. The platform grew as three ministries, many important federal and regional funding agencies, the Austrian Council for Research and Technological Development, the Quality Assurance Agency and five evaluation research institutions joined the *Plattform*, which is now an association of more than 15 institutional members. Its annual budget of EUR 100 000-150 000 comes from membership fees and contracts.

The scope of its activities is broad. Apart from regular workshops and newsletters, Austrian RTD evaluation standards were developed, which include teaming up Austrian and foreign evaluators. Studies include an evaluation manual for the Austrian Council for Research and Technological Development. Training courses for programme managers assist them to get a basic understanding of project, programme and policy evaluation. In 2003, an international RTD evaluation conference was jointly organised with the OECD in Vienna; a second conference took place in spring 2006. Internationally the platform serves as a contact point for the European Commission, US networks and the German Evaluation Society, among others. To avoid collusion, the platform's mission does not extend to specific evaluations.

This initiative – with low costs and a "militia-based" administration – has helped to give evaluations a higher profile in Austria. Methods, standards and common understanding undergo continuous improvement. Internationally it is seen as a good practice learning initiative.

Sources: OECD (2006), drawing on OECD (1998); Plattform Forschungs- und Technologieevaluierung (2003); Stampfer (1998).

Perhaps the most significant paper produced was *Strategy 2010 – Perspectives for Research, Technology and Innovation in Austria*. This paper builds on the National Research and Innovation Plan (NAFIP). It provides guidelines for research, technology and innovation policy up to 2010. The paper recommends maintaining a high level of investment in R&D, with improvements needed in the quality and efficiency of the Austrian innovation system to increase the return on these investments.

The strategy proposes three basic principles: to promote quality and excellence, to strengthen networking and co-operation between science and industry, and to improve the efficiency of the promotion system. Recommendations made included more funds for university research through competition based on "excellence", with greater emphasis on the promotion of women, and a greater role for the importance of the humanities and social and cultural sciences, therefore more funding for these disciplines.

The ten goals and fields of action recommended were the following:

- In order to create and guarantee conditions that enable research in universities: provide more funding.
- To strengthen the innovative ability of business enterprises by optimising the system of indirect research promotion and strengthening start-up strategies and increasing funding.

- To promote collaboration between science and industry by continuing with the growth strategy, merging the BRIDGE programmes started by the FWF and FFG, and providing appropriate funding to the programme.
- Developing a strategy for excellence and improved quality of the innovation system at all levels by developing a concept for all sectors, a strategy for excellence and measures to facilitate new centres of excellence.
- Developing an international focus to comply with the European Research Area, therefore developing a national strategy for participation in the ERA-NET programmes and increased participation in existing research structures in Europe.
- To co-ordinate regional and national R&D activities by establishing a platform for co-operation and bundling federal technology transfer programmes.
- To safeguard human resources for R&D by increasing the percentage of women in research, ensuring first-class university education and measures to foster mobility of the research population. Recommendations for this include: implementing gender mainstreaming in research, technology and innovation (RTI) policy; developing an Austrian strategy to promote lifelong learning; and reorganization of grant programmes.
- For the state to act strategically in its roles as promoter, customer, regulator and administrator of innovation the Council recommends expansion of e-government services, reinforcement of research themes with greater funds.
- In order for efficient management of the funding portfolio at the programme level the Council recommends concentrating on RTI competences of the federal government within two ministries, outsourcing programmes that have previously been handled by ministries to the funding agencies, drawing up a concept for the portfolio of RTI funding programmes and obligatory evaluation for all programmes longer than five years or with over EUR 1 million.
- Increasing spending on R&D is a major objective. In order for this to be efficient the Council recommends: increased public funding for R&D to nine percent annually with the greatest increase in the co-operative sector which is to take 80% of the budget by 2010, a 70% increase for the business sector and 40% for universities, financing of basic programmes within a clear structural logic, open-ended funding from ordinary budgets and a National Foundation for RTD funding for new programmes with a long term focus, an Action Programme for funding of impulse programmes of a temporary nature.

Feedback from the Strategy 2010 report highlighted the debate on the structure and distribution of funds in the tertiary education sector. Sources of funding have altered significantly in recent years and the 9% increase in budget was welcomed.

The Austrian Council appears to have had a mixture of impacts. In the area of public understanding of science, it has persuaded multiple ministries to work together and agree a division of labour. It similarly persuaded multiple ministries to co-ordinate their programmes to support women's role in innovation and R&D via the FFORTE platform (an initiative for the advancement and encouragement of women in science and technology). Its initial allocation of the extra funds for research – the so-called "Offensivmittel" – set a new pattern of expenditure but in the second round it proved almost impossible to *change* the proportions of the extra money allocated to the spheres of different ministries. In that round, too, the Council found itself in the odd position of, on the one hand, criticising what it called the "support jungle" comprising a large number of instruments and actors and, on the other hand, trying to insist that the Offensivmittel should only go to new initiatives – thereby making that jungle even thicker.

Austria's major Nano Initiative was largely based on a concept that was presented to and endorsed by the Council. Some parts of the Strategy 2010 (such as the focus on "excellence") have survived the change of government in 2007, but this appears to be because they were already on the political parties' agendas rather than because of the Council's powers of persuasion.

Especially since the change of government in 2007, the Austrian Council appears to have lost some influence. Its suggestion after the expiry of the "Offensivmittel" that it should continue to play a role in allocating funding was not well received and its role and influence appear less clear than earlier. Austria continues to enjoy complex research and innovation governance with a great deal of role overlap, unclear division of labour (for example between ministries and their agencies) and constant policy competition. This seems to be exacerbated by the needs of coalition governments to allocate ministries among political parties, thereby multiplying the number of ministries and creating policy conflicts and tensions within the government itself.

Lessons from the Austrian experience include:

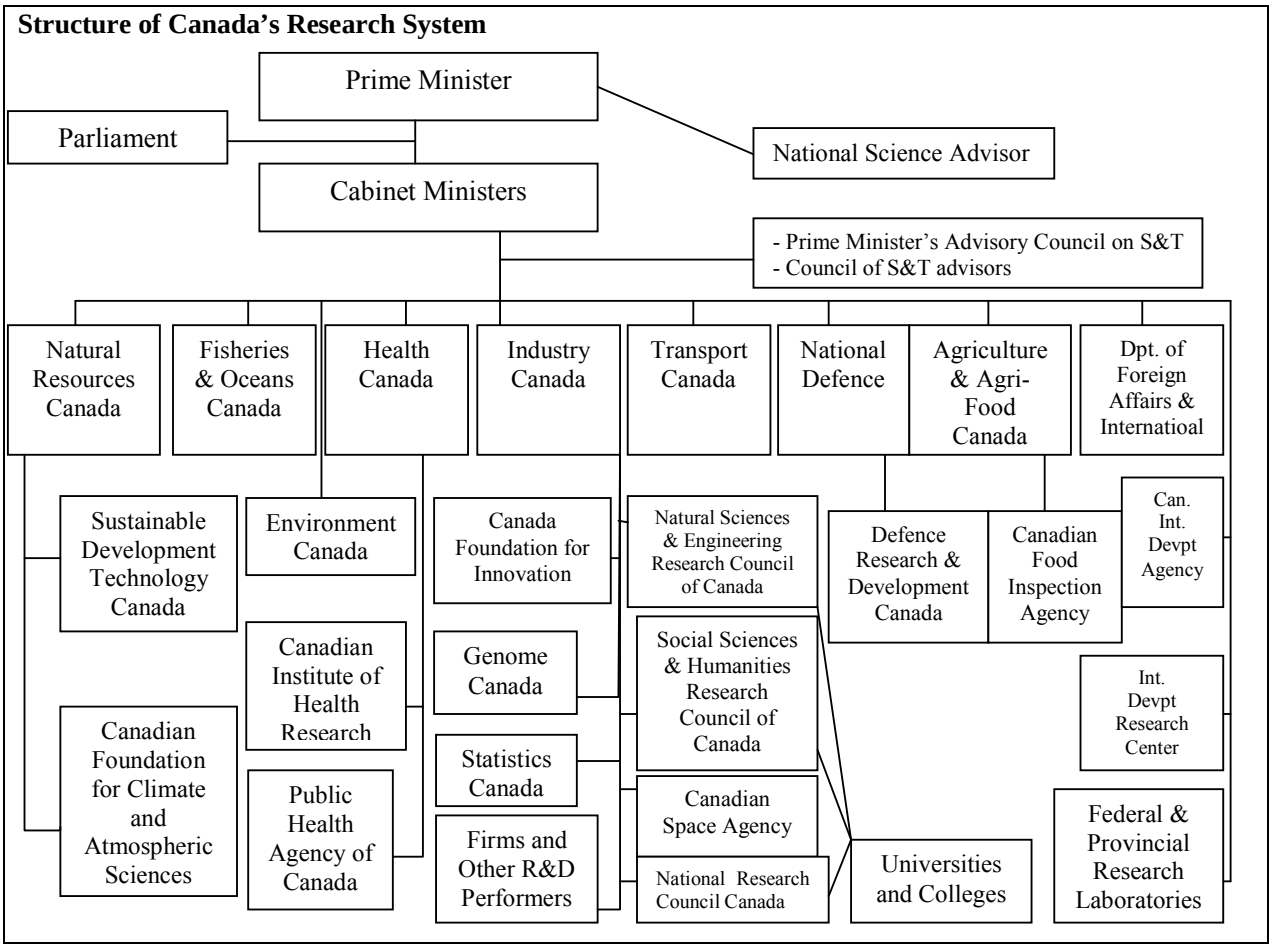
- The difficulty of managing the transition between successive governments.
- The observation that tt is easier for an advisory council to play a role in allocating new or temporary resources than in intervening directly in the allocation of mainstream budgets.
- The rapidity with which newly allocated resources become locked in and difficult to steer.
- The key role of the interface to government in determining whether recommendations will be implemented.
- The additional limitations to the co-ordinating influence of an advisory council in systems that have strong internal incentives to fragmentation.

Canada's Science, Technology and Innovation Council

In Canadian, over 20 federal organisations fund and/or perform R&D and 120 federal research laboratories. The provinces provide the majority of infrastructure and operating costs for education and research within universities and teaching hospitals. Some provinces also perform and fund research outside of universities. In many cases provincial and regional governments have collaborated with the federal government to create venture funds and research facilities at a local level. The government has also founded innovative schemes for delivering and expanding research support including: The Canada Foundation for Innovation, The Canadian Institutes of Health Research, Genome Canada, Canada Research Chairs. There is also a growth of research in the voluntary sector. There is a network for those working in scientific departments and agencies, the Federal Partners in Technology Transfer (FPTT), providing an opportunity to establish a common base of practices and policies for effective research and technology transfer from government laboratories to the private sector.

Research and development is rising on the Canadian government's agenda with increasing visibility over the past twelve years. The government is devoting increased resources to research and development, mostly through research councils or external organisations, primarily universities.

Figure A.2. Structure of Canada's research system



Source : http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.content&topicID=35&countryCode=CA&parentID=34.

The treatment of science, technology and innovation in the Canadian governance system has not in the past been well integrated, and innovation has tended to have a low profile (Teather, 2007). The present government does not even have a junior minister for science, though others in the recent past have done so. There have been several changes in the structures used for advising government. In 2000, the Council of Science and Technology Advisors (CSTA) was set up to provide advice on how to make better use of government investments in S&T and integrate S&T into government policy decision making. It essentially comprised "insiders" from the state research and innovation system and was said to be influential for a short period only. Three years later, a National Science Advisor was appointed, but his services were dispensed with in early 2008.

The conservative government elected in 2006 has been more interested in listening to advice from industry than some of its predecessors; hence the roles of the CSTA and the National Science Advisor have declined. Innovation policy is increasingly made by the Ministry of Finance through general measure such as investment incentives.

Until 2007, three councils performed advisory functions: the Council of Science and Technology Advisors (CSTA), whose role was specifically for federal science and technology advice; the Canadian Biotechnology Advisory Committee; and the Advisory Council on Science and Technology, a body of

academics which provided advice to the Prime Minster and the Cabinet, in response to specific questions put to it by government.

Increasing overlap between the various councils initiated the reduction to one council giving comprehensive advice. Canada's Science and Technology Strategy of 2007 *Mobilising Science and Technology to Canada's Advantage* announced the decision to consolidate external science and technology advice to the government by launching the Science, Technology and Innovation Council. Canada looked at Australia as an example when setting up their new advisory council.

The chair was appointed in May 2007. The members were appointed by the Minister of Industry responsible for Science and Technology issues, in October 2007. The council consists of 18 members, including representatives of universities, industry, deputy government ministers, and researchers. The Council is supported by a government funded secretariat. The Council may seek advice from external experts, but there is no routine provision for this, such as the working groups held by other councils.

Members:

- Dr. Howard Alper, (Chair), Professor of Organic and Inorganic Chemistry at the University of Ottawa.
- Dr. Francesco Bellini, Chairman, President and CEO of Neurochem.
- Mr. Eric Bergeron, Founder of Optosecurity Inc.
- Mr. Richard Dicerni, Deputy Minister of Industry Canada.
- Mr. David. B. Fissel, on the Board of Ocean Industries BC, Ocean Innovative Systems Inc, the Canadian Ocean Gilder Foundation and a member of DFO's National Science Advisory Council.
- Mr. Peter MacKinnon, President of the University of Saskatchewan.
- Dr. Terence Matthews, non-executive chairman of several technology companies including Mitel Corporation, March Networks Corporation, DragonWave Corporation, Neport Networks and Solace Systems.
- Mrs. Marie-Lucie Morin, Deputy Minister of International Trade.
- Dr. Heather Munroe-Blum, Principal and Vice-Chancellor of McGill University.
- Mr. David O'Brien, Chairman of the Board of EnCana and Chairman of the Board of the Royal Bank of Canada.
- Mr. J. Robert S. Prichard, President and Chief Executive Officer of Tortstart Corporation (media company).
- Mr. Morris Rosenberg, Deputy Minister of Health.
- Dr. Guy Rouleau, Canada Research Chair in Genetics of the Nervous System, Professor in the Department of Medicine at the Université de Montreal.
- Dr. W. A. (Sam) Shaw, president and CEO of the Northern Alberta Institute of Technology.
- Dr. Molly Sholchet, NSERC Canada Research Chair in Tissue Engineering, Professor of Chemical Engineering & Applied Chemistry, Chemistry and Biomaterials & Biomedical Engineering at the University of Toronto.

- Dr. Mihaela Ulieru, NSERC Canada Research Chair in Adaptive Information Infrastructures for the e-Society at the University of New Brunswick.
- Dr. Harvey Weingarten, President and Vice-Chancellor of the University of Calgary.
- Mr. Rob Wildeboer, Executive Chairman and co-founder of Martinrea International (auto parts supplier).

The mandate of the new Council is to encourage "a more competitive Canadian economy and improved quality of life for Canadians through science and technology".[22] This is to be done by providing evidenced-based science and technology policy advice to the government on issues referred to the Council by the government. Advice will be formalised in reports, the first of which will be "The State of the Nation" report defining the current position of R&D in Canada using benchmark evidence. The mandate differs from previous Councils in a number of ways. Firstly, the remit is for confidential advice. However, a minister may later chose to reveal the source of their information when justifying a course of action. The second important alteration is that issues on the Council's agenda are referred by the government. Finally, there is a plan for a report on science and technology, which will be an overview of how the country is performing against international standards, which is still in preliminary stages. Other foresight-related activities are ongoing in Canada, but there has been no extensive formal foresight exercise. So far, the Council has produced preliminary advice to the government although no significant documents have been produced. The Council can provide advice regarding funds, but does not make decisions about budgets.

Officially, the degree of influence is expected to be high as the Council is specifically addressing issues put to it by the government. The government's visible commitment is reflected in the level of engagement already demonstrated by the Minister of Industry, who attends meetings.

Teather (2006) comments:

> Improved co-ordination of innovation policies – in spite of a number of attempts to develop and implement high level interdepartmental committees to co-ordinate S&T and innovation policies, these have proven ineffective. In fact, the organisational linkages are weaker now between government policy makers and those implementing policies and providing advice. The overall structure and operation of the federal government in Canada does not encourage or support co-ordination. Industry Canada has been ineffective in co-ordinating innovation policies. There are very few truly horizontal programmes that co-ordinate policies and instruments among departments and agencies.

Lessons that may be derived from the Canadian experience include:

- New advisory structures sometimes seem to have a short "window of opportunity" during which they gave a chance to influence the government because (in Canada, at least) governments have short attention spans.
- Ineffectiveness may have been caused by having too many advisory bodies with overlapping interests.
- Advisory bodies that do not include the government's key constituencies are easily ignored by the governments themselves; this implies that widely-based councils are better placed to survive changes of government and combat dynamic inconsistency.

22. http://www.stic-csti.ca/epic/site/stic-csti.nsf/en/h_0005e.html.

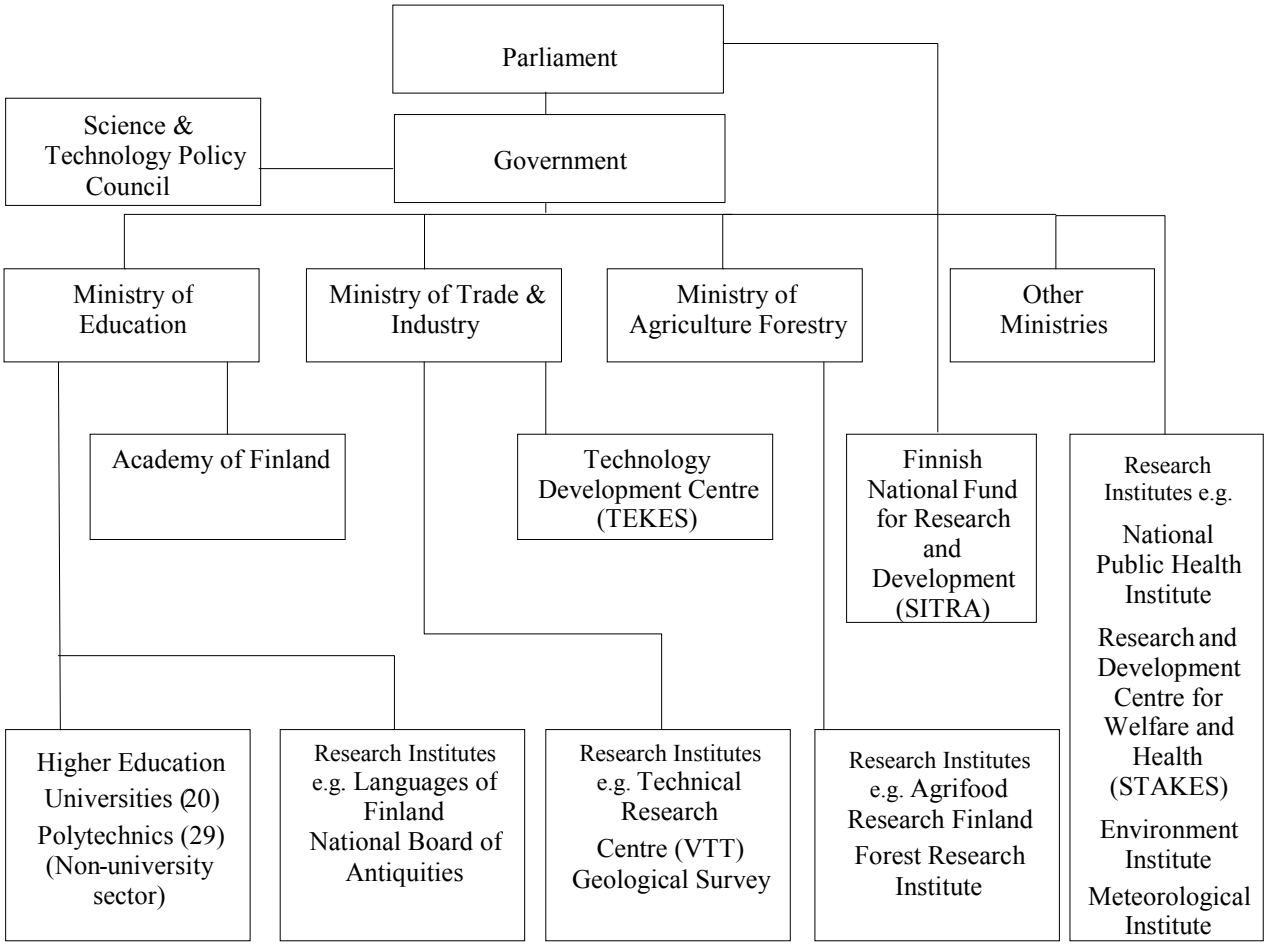
- Including ministers or deputy ministers seems likely to give the advisory structures more "clout" – though it is early days for there to be much evidence of this yet.

Science and Technology Policy Council of Finland

Finland has had some form of Science Policy Council since 1963. The present Council was established in 1987 with a new decree, which has since been updated, most recently in 2005. Pelkonen (2006) argues that the original role of the Council was to act as mediator between the "academic research" and "industrial innovation'' camps, represented by "their" respective ministry.

Figure A.3 shows how the Finnish Council fits into the wider governance structure.

Figure A.3. Policy makers, funders and performers of research in Finland



Source : http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.content&topicID=35&countryCode=FI&parentID=34.

The membership of the Council currently consists of the Prime Minister as chair, the Minister of Education and Science and the Minister of Industry and Trade as vice chairs, the Minister of Finance and up to four other ministers. In addition, the Council comprises ten other members, six of whom represent organisations and interest groups, including the Academy of Finland, the Finnish Funding Agency for Technology and Innovation, the universities, business and industry, and employees. CThe term of service for members was recently changed from three years to four years to reflect the government term and a new

council is appointed when a new government enters office. The fact that the Prime Minister chairs the council, demonstrates that science and technology policy is high on the political agenda. The council has two subcommittees, one for science policy and another for technology policy, chaired by the Minister of Education and Science and the Minister of Trade and Industry respectively.

Members:

- Matti Vanhanen, Prime Minister (Chairman).
- Sari Sarkomaa, Minister of Education and Science (Deputy Chairman).
- Mauri Pekkarinan, Minister of Economy (Deputy Chairman).
- Jyrki Katainen, Minister of Finance.
- Sirkka-Lilsa Anttila, Minister of Agriculture and Forestry.
- Tarja Cronberg, Minister of Labour.
- Paula Risikko, Minister of Health and Social Services.
- Stefan Wallin, Minister of Culture and Sport.

Members appointed by the government:

- Eija Hietanen, Development Manager, The Central Organization of Finnish Trade Unions SAK.
- Olli-Pekka Kallasvuo, President and CEO, Nokia Corporation.
- Erkki KM Lepavuori, Director General, Technical Research Centre of Finland VTT.
- Marja Makarow, Chief Executive, European Sciene Foundation.
- Markku Mattila, President, Academy of Finland.
- Pekka Mattila, CEO, Finnzymes Ltd.
- Veli-Pekka Saarnivaara, Director General, Tekes – Finnish Funding Agency for Technology and Innovation.
- Marja-Lilsa Tenhunen, Rector, Central Ostrobothnia University of Applied Sciences.
- Paivi Torma, Professor, Helsinki University of Technology.
- Keijo Virtanen, Rector, University of Turku.

The Council is supported by permanent experts and a Secretariat.

Permanent experts:

- Risto Volanen, State Secretary, Prime Minister's Office.
- Harri Skog, Permanent Secretary, Ministry of Education.
- Erkki Virtanen, Permanent Secretary, Ministry of Employment and the Economy.
- Sakari Karjalainen, Director General, Ministry of Education.
- Petri Peltonen, Director, Ministry of Employment and the Economy.

Secretariat:

- Esko-Olavi Seppala, Secretary General.
- Kai Husso, Chief Planning Officer.
- Tuomas Parkkari, Chief Planning Officer.

Stakeholders are represented in the membership of the Council. Finland is a small country with a relatively simple innovation system enabling this arrangement. There is no formal attempt to include other people in the Council's information gathering or decisions. However, informal good relations are held with industry representatives.

The government funds a secretariat to support the council, consisting of a General Secretary and two Chief Planning Officers who are also appointed to a four-year term. The Ministry of Education performs clerical tasks. Civil servants from the ministries meet with the secretariat four to five times a year therefore providing a horizontal form of communication.

The composition of the Council changes overtime. In particular, the participation by sectoral ministers has been very variable and Pelkonen (2006) argues that this underlies the Council's focus on a comparatively narrow definition of science, technology and innovation policy that fails to address wider 'horizontal' issues. He also points out that the effectiveness of the Council has continuously depended upon the Prime Minister's degree of interest is research and technology.

The Science and Technology Policy Council of Finland is responsible for "strategic development and co-ordination of Finnish science and technology policy as well as for the national innovation system as a whole". The remit of the Council is to assist the Government and its ministries in the following ways:

- Following international developments in research and technology and the development needs they cause in Finnish research and technology.
- Addressing major matters relating to science and technology policy and preparing plans and proposals concerning them for the Government.
- Addressing the overall development of scientific research and researcher training.
- Addressing the development and utilisation of technology and technology impact analysis.
- Addressing important matters relating to international science and technology co-operation.
- Addressing the development and allocation of public research and innovation funding.
- Addressing important legislative questions concerning research, technology and scientific education.
- Taking initiatives and putting forward proposals in matters within its remit to the Government and its ministries.[23]

In order to fulfil this remit the council produces public recommendations based on a work plan, which the council itself decides upon. The secretariat performs preparatory work before issues are put on the agenda and presented at meetings. The council meets four times a year, in addition to six to eight meetings of the subcommittees. The council produces policy reports or reviews once per term. Therefore, the period

23. http://www.minedu.fi/OPM/Tiede/tiede-_ja_teknologianeuvosto/?lang=en.

of policy strategy is four years with the most recent report produced in June 2006. The Council makes recommendations regarding budgets, but these are not officially binding.

The decree of 1987-2000 allowed for disagreements within the council. For this a fourth body was set up to harmonise views of the subcommittee before issues were put before the council. However, this was last used in 1990 and the provision has been dropped from the current decree. Therefore, the Council effectively works on a consensus basis. Any disagreements within meetings are documented in the minutes, which are publicly available from the secretariat. Typically differences of opinion are most likely to occur in debates relating to funding.

The Council functions partly as a ministerial committee complemented by outside members. Therefore, there is direct contact and communication with the government. There is no two-way communication with the public. Occasional seminars are organised by the Council, but this is rare. Policy reviews are published and distributed for free. There is a "Science Portal" at www.research.fi, which provides regularly updated information on the Finnish Science, Technology and Innovation System and was founded as a joint project of several public sector organisations including the Ministry of Education, the Ministry of Trade and Industry, and TEKES among others.

Publications include the following:

- 2006 Science, Technology, Innovation.
- 2003 Knowledge, innovation and internationalisation.
- 2000 Review 2000: The Challenge of Knowledge and Know-how.
- 1996 Finland: A Knowledge-based Society.
- 1993 Towards an Innovative Society: A Development Strategy for Finland.
- 1990 Review 1990: Guidelines for Science and Technology Policy in the 1990's.
- 1987 Science and Technology Policy Review 1987.

The Finnish foresight "Finsight 2015" was implemented by the Academy of Finland and TEKES and was published in 2006. The council encourages and recommends development of methods for profound projects and programmes for foresight activities. Policy recommendations made by the council make good use of this evidence, which is reflected in the reports.

The effectiveness of the council is a topical question in Finland. The current decree is very flexible in terms of the tasks of the council, which can vary significantly. The new Ministry of Government and Economy was created recently by merging the Ministry of Trade and Industry with the Ministry of Employment. The new ministry is pushing a new "national innovation strategy" which should be completed in 2008. The current S&T Innovation policy will be complemented by demand driven approaches and combining S&T Innovation with other modes of innovation integrating these activities with social innovation. This new approach is broader than the previously introduced model of innovation in the 2003 report, "Knowledge, Innovation and Internationalisation", which contains lessons on the National Innovation System. These alterations in economic strategy are likely to lead to a change of work for the council even within the same decree.

While the Finnish Council is widely admired and imitated, its apparent success is based not only on the largely structural characteristic discussed above but also on important cultural features of modern Finland. One of these (Pelkonen, 2006) is a corporatist tradition in which this type of representative council is seen as a normal way of shaping policy. Another is the Council's place in a rather centralist

administrative culture where the people involved are highly networked. This results in feats of co-ordination that are little reflected in formal processes, such as the choice by TEKES and the Academy of Finland of complementary R&D themes for allocating parts of the additional appropriation for R&D despite the fact that there was no formal consultation and only a single person providing overlap between these organisations; respective committee structures (Arnold *et al.*, 2002). These 'soft' factors have to be taken into account in considering the transferability of lessons from Finland. It is also noteworthy that the Council became much more influential at the end of the Cold War, when about a third of Finland's export markets collapsed, a recession emerged – and Finland, at the advice of the Council, decided to *increase* national investment in R&D. The sense of being "all in one boat" in a crisis appears to have generated an atmosphere receptive to the Council's change of function from mediation to strategic leadership.

That said, lessons appear to stress:

- the usefulness of a flexible membership that can accommodate changes in coalition government structures and roles for the sectoral ministers.
- the importance of a highly networked, corporatist context favourable to developing consensus.[24]
- the role of the Prime Minister's personal interest in the Council and in research and innovation policies more generally.
- abstaining from more than directional guidance on budgets, leaving implementation to government and Finland's 'two pillar' agency structure.

Irish Advisory Council for Science, Technology and Innovation

In 2004 the Irish Government agreed the present structure for the research system for science, technology and innovation. The system is complex with many bodies. The four most significant policy actors include:

- The Cabinet Sub-Committee on Science and Technology, which includes the Prime Minister and Deputy Prime Minister and ministers from departments, which hold a research agenda. This committee existed on paper for many years without meeting.
- The Inter-Departmental Committee on Science, Technology and Innovation, which is chaired by the Minister for Enterprise, Trade and Employment. The members are senior civil servants from the main research oriented departments. The role of the Inter-Departmental Committee is to ensure co-ordination of the government's strategy and to assist with prioritisation of expenditure.
- The Chief Scientific Adviser provides independent advice on matters relating to science, technology and innovation as requested by the government and participates in the Advisory Council for Science, Technology and Innovation.
- The Advisory Council for Science, Technology and Innovation.

The Office of Science and Technology within the Department of Enterprise, Trade and Employment is responsible for co-ordination of the national science, technology and innovation policy. It is responsible for the science and technology budget and is required to promote research and technological development in industry and co-ordinate Ireland's policy on international research activities.

24. Erkki Ormala, former secretary to the Council and Chairman of the OECD Working Party on Innovation Policy, both personal communication and on multiple conference platforms.

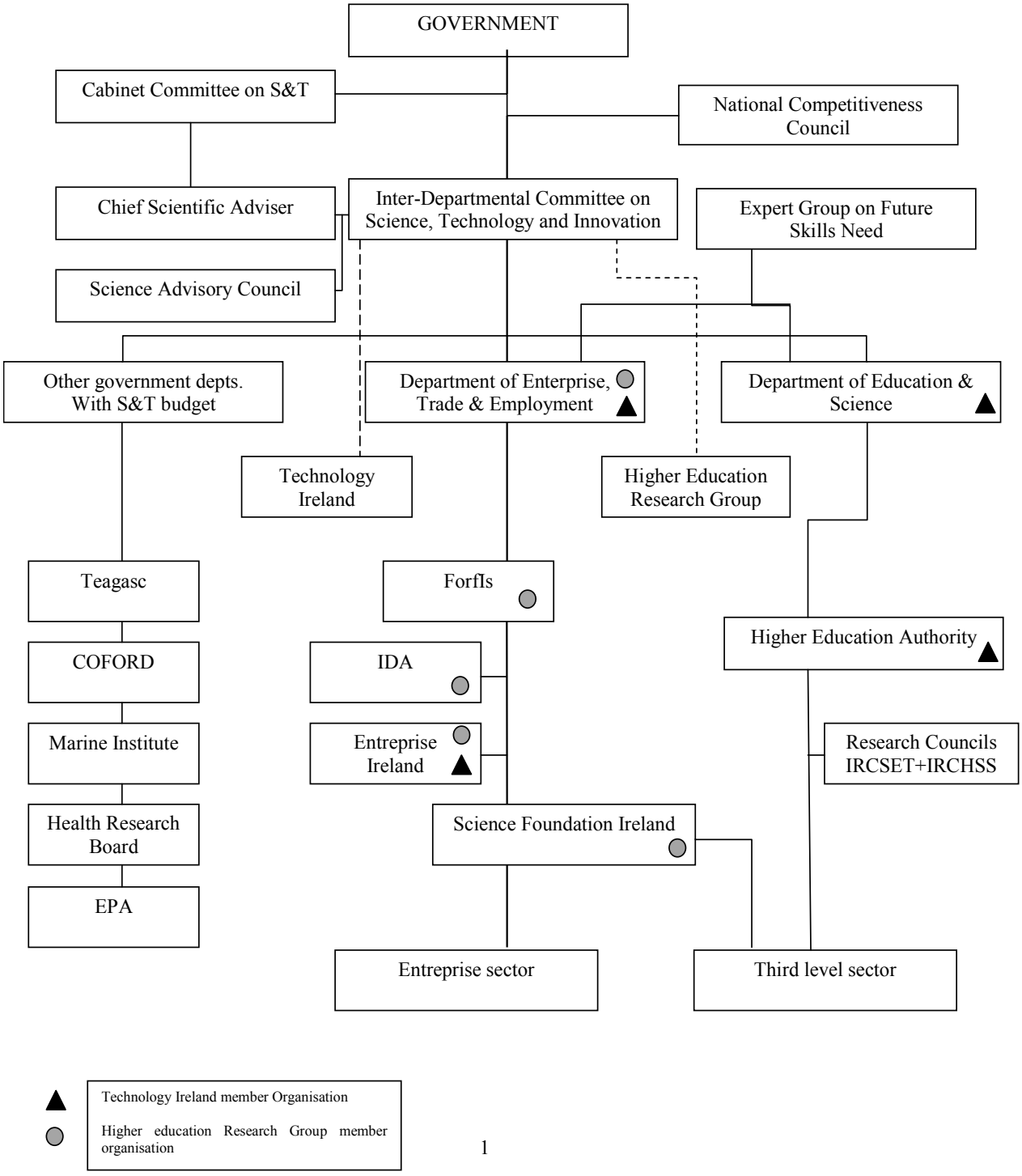
The Department of Enterprise, Trade and Employment and the Department of Education and Science both issue significant funds for research. The Department of Agriculture and Food, the Department of Communications, Energy and Natural Resources and the Department of Health and Children also provide research funding.

Other funding is provided by: the Science Foundation Ireland, which was established in 2000 to administer technology foresight investments in biotechnology and ICT. The Higher Education Authority (under the Department of Education and Science) provides support for institutional strategies, inter-institutional collaboration and large-scale research programmes. The Research Funders' Group under the Chief Scientific Advisor, comprises the main research funding and advisory bodies and co-ordinates the implementation of research funds.

Forfas is the national policy advisory board for enterprise, trade, science, technology and innovation. Its remit is to promote and develop science and technology in Ireland as well as overseas enterprise. Forfas advises the Chief Scientific Advisor. The Science Foundation Ireland was established in 2000 to administer technology foresight investments in biotechnology and ICT it also funds research. The Industrial Development Agency (IDA) and Enterprise Ireland are involved in development of research capabilities in foreign-owned and indigenous enterprise.

Two new bodies were introduced in 2006: Technology Ireland, which is a group of senior executives from Enterprise Ireland, IDA Ireland, Science Foundation Ireland and Forfas who are responsible for overseeing implementation of actions towards improving research and development performance; The Higher Education Research Group (HERG) brings together representatives from the Department of Education and Science and the Department of Enterprise, Trade, and Employment with senior executives from the funding agencies to co-ordinate the funding of higher education research.

Figure A.4. Irish science and technology governance structure



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Source: http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.content&topicID=35&countryCode=IE&parentID=34 accessed 08/02/2008.

The Advisory Council for Science, Technology and Innovation was established in 2005 as a replacement of the previous Irish Council for Science, Technology and Innovation. The new council is embedded within the government structure. The Chief Scientific Advisor is now a member of the council alongside non-ministerial representatives of the Department of Enterprise, Trade and Employment and the Department of Education and Science. It holds a legal status as a sub-board of Forfas, which was established under legislation. The Council also functions under the Science and Technology Act 1987:

> "To act as the primary interface between stakeholders and policymakers in the Science, Technology and Innovation arena, contributing to the development and delivery of a coherent and effective national strategy on STI;
>
> To provide advice to Government on medium and longer-term policy for STI and related matters".[25]

There are fourteen members, reduced from twenty-five during the previous council. Initially this had been reduced to twelve, but this proved too few to ensure sufficient attendance at meetings, particularly with only four to five meetings per year.

Members reflect a mix of stakeholders from universities and industry. No ministers are on the council, but some attend meetings. Members are appointed under Forfas legislation, following consultation with the Minister for Enterprise, Trade and Employment. The board nominate the Deputy Chair. Forfas provide the council with a secretariat, meeting venues and other facilities.

Members:

- Ms. Mary Cryan, Chairperson of Cryan Associates (POS/Cash register software).
- Dr. Leonora Bishop, Industrial Development Agency Ireland.
- Prof. Dolores Cahill, Director, Conway Institute, University College Dublin.
- Mr. Ian Cahill, Director, National Institute of Technology Management, NovaUCD, Chairman, LM Ericsson Ltd.
- Mr Martin Cronin, Chief Executive, Forfas.
- Prof. Donald Fitzmaurice, Prof. of Nanochemsitry, NUI Dublin.
- Prof. Tom McCarthy, Chief Executive Irish Management Institute.
- Prof. Anita R. Maguire, Prof. of Pharmaceutical Chemistry, NUI Cork.
- Prof Timothy O'Brien, Director, Gene Therapy Programme, Regenerative Medicine Institute (REMEDI), National Centre for Biomedical Engineering Science & Prof. of Medicine and Consultant Endocrinologist, NUI Galway.
- Dr Siobhan O'Sullivan, Scientific Director, Irish Council for Bioethics.
- Dr Ena Prosser, Partner, Fountain Healthcare Partners.
- Dr Reg Shaw, managing Director, Wyeth Ireland.

The council's remit is to advise the government on medium and long-term policy and contribute to development of an effective national strategy for science and technology innovation. Its role is to act as the interface between stakeholders and policymakers involved in science, technology and innovation.

25. asc_terms_of_reference_0505.pdf Avail at: http://www.sciencecouncil.ie/.

The mission statement is "to bring the experience, excellence and independence of Ireland's science, technology and innovation practitioners to the heart of Government policy to ensure the application of scientific endeavour for the benefit of the people of Ireland".[26]

The work programme for the Council is agreed with the Inter-Departmental Committee through consultation. Working in close proximity with the Inter-Departmental Committee, gives it a high degree of influence with the Government. The Council is obliged to respond to questions posed by the ministries. Work is performed in task forces chaired by a council member and includes external representatives with relevant expertise. Usually, two task forces run at any one time. The Council deliberately consults widely with stakeholders through meetings, interviews, surveys and public notices in national newspapers with requests to participate. The Council does not give advice to the government regarding budgets.

Current issues on the agenda are: researcher careers, increasing the absorptive capacity for people qualified to PhD level within universities and industry, with a view to increasing the number of PhDs; and internationalisation. The council strives to take a long-term perspective.

Research and development is a politicised issue in Ireland. The National Innovation System in Ireland is relatively young, and the science and technology budget is rapidly increasing.

Forfas is currently concerned with the question of how to optimise scientific excellence with economic results through investments, this constitutes the politicised aspect of innovation. Research and development is therefore high on the agenda and strategic management is embodied in the legislation.

The Council has produced a number of reports including the following

- *Promoting Enterprise- Higher Education Relationships*, 2007. Examines the relationship between enterprise and higher education and identifies points to be addressed.
- *Towards Better Health: Achieving a Step Change in Health Research in Ireland*, 2006. Advises the development of a new strategy for health related research.
- *Comparative Starting Salaries and Career Progression of Graduates in Science, Engineering and Technology* (SET), 2006.
- *Strategy for Science, Technology and Innovation*, 2006.
- *National Code of Practice for Managing Intellectual Property from Public-Private Collaborative Research*, 2005.

Minutes of council meetings are not published, but are available on request.

The evolution of the Irish governance and advisory structures reflects successive refinement of the 'dominant actor' position enjoyed by the industry ministry and its agencies. Forfas and then ICSTI were early attempts to create an advisory umbrella. Despite being in the Industry Ministry realm, ICSTI included representatives of other parts of the policymaking system, notably the head of the Higher Education Authority. Following the report of the Walsh Commission (largely a sub-set of ICSTI members) in 2004 and the appointment of a UK-style Chief Scientific Advisor, the focus of the advisory structures within the Industry Ministry sphere has increasingly been on industry matters and the Education Ministry sphere has built up its own advisory apparatus. In effect, the 'dominant actor' model has had to evolve in order to allow development in the higher education sector, with the new Education Ministry structures having an increasing role in influencing policy in their own sphere. Co-ordination across the system appears,

26. http://www.sciencecouncil.ie/tor.html.

however, to have reduced as a result. For example, in 2007, both the HERG and Advisiory Council for Science, Technology and Innovation produced reports and proposals on researcher careers.

The current governance structure for science, technology and innovation is very complex for its size and appears increasingly fragmented rather than holistic. An interviewee suggested that the system is in a mode of experimentation. In particular, many attempts are being made to create cross-linkages within the system focussing on social partnerships as key to forming effective policy. It is likely that the system will be reviewed within the next eighteen months or so.

Main lessons from the Irish case are:

- The 'dominant player' model appears hard to sustain once important policy decisions have to be made and implemented outside its sphere.
- It appears also to have inhibited the activities of the minister-level co-ordination sub-committee, whose role it formerly made redundant.
- Despite the fragmentation of the governance and advisory structures, Ireland has succeeded in radically expanding is academic and to a lesser extent its industrial research system.

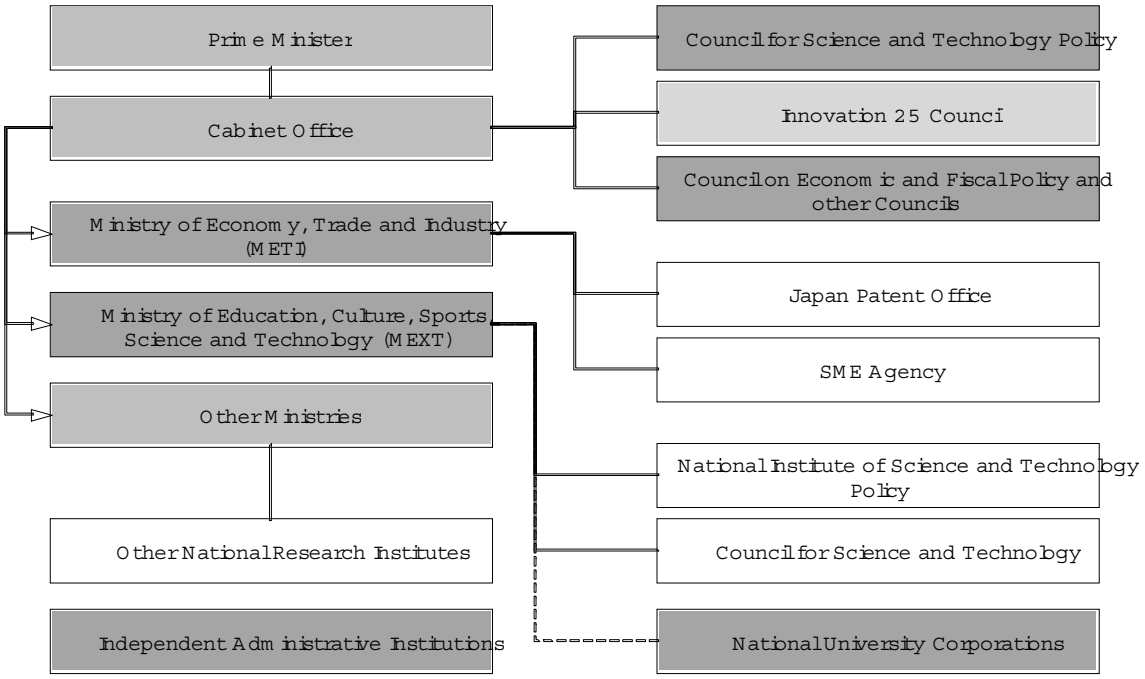
Japanese Council for Science and Technology Policy

The Ministry of Economy, Trade and Industry (METI) holds an important role for the formation of policies regarding industry, industrial competitiveness and the regional economy. Several other ministries are involved in policy regarding research and development within their fields these include: the Ministry of Health, Labour and Welfare (MHLW), Ministry of Agriculture, Fisheries and Food (MAFF), the Ministry of Land, Infrastructure and Transport (MLIT). The Defence Agency funds a significant amount of government research with five percent of the science and technology budget.

R&D funding from the ministries is passed to Independent Administrative Institutions (agencies) such as funding bodies like the Japan Science and Technology Agency, the Japan Society for the Promotion of Science and the National Universities, the Institute of Physical and Chemical Research, the National Institute of Advanced Science and Technology, and the New Energy and Industrial Technology Development Corporation.

The majority of research and development funding in Japan, 74.8%, is industrial. However, there remains poor communication between public and private sectors. Collaborative projects are increasing between the higher education sector and private sector, but these still remain low at 2.5% of university budget coming from industry.

Figure A.5. Structure of the Japanese governance system



Source : http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.content&topicID=35&countryCode=JP&parentID=34.

Science, Technology and Innovation are placed high on the national agenda in Japan with over 3% of GDP spent on research and development. The movement to strengthen this sector involved improving the Council for Science and Technology, which was seen as failing to co-ordinate adequately with the various ministries or to promote greater engagement with other stakeholders in the NIS. The Council for Science and Technology Policy was established in 2001 as one of four policy councils in different key areas. This was the result of a wider reorganization of government ministries and agencies. The Japanese CSTP was intended to address issues with the existing Council for Science and Technology and establish coherence and oversee the different actors within the NIS.

The previous Council for Science and Technology Policy had a more restricted role as consulting body to the Prime Minister. It was available to answer questions the Prime Minister posed, but not to propose policy. The new council independently proposes policy and has been elevated to a position within the cabinet, exercising authority over ministries.

Under the S&T Basic Law of 1995 the government was mandated to provide systematic science and technology policy with a long-term perspective. The law was updated for the periods 1996-2000 and 2001-2005, with a third update currently in place. It states that the government must consult the council regarding the Basic Plan strategy for science and technology.

The law establishing the CSTP in 2001 states the remit of the Council to review Japan's science and technology policy and propose policy. In practice this should include: a strategic response to national issues, inclusion of the humanities and social sciences, and finally responding to issues of debate and consulting with the Minister for Science, Technology and Innovation.

As part of the cabinet office the Council is under the guidance of the law for the function and structure of this office. This law states that the council must meet once a month and review science and technology performance.

The membership of the CSTP comprises seven members of the government, including the Prime Minister, the Cabinet Secretary, the Minister for Science and Technology Policy, the Ministry of Internal Affairs, the Ministry of Finance, The Ministry of Education, Culture, Sports, Science and Technology, and the Ministry of Economy, Trade and Industry. Eight members come from outside of the government as experts in the fields of science and technology including University professors, President of the Tokyo Institute of Technology and the Director of Hitachi. Two members are from private companies and one member from the Japanese Science Council. The Minister of State for Science and Technology Policy leads the Council and is responsible for planning and co-ordination of science and technology policies to ensure that they are implemented nationwide. The executive members are appointed by the Diet for a two-year term, which can be renewed.

Ministers

- Mr. Yasuo Fukuda, Prime Minister (Chairperson).
- Mr Fumio Kishida, Minister of State for Science, Technology and Innovation Policy.
- Mr Nobutaka Machimura, Chief Cabinet Secretary.
- Mr. Hiroya Masuda, Minister of Internal Affairs and Communications.
- Mr. Fukushiro Nukaga, Minister of Finance.
- Mr. Kisacuro Tokai, Minister of Education, Culture, Sports, Science and Technology.
- Mr. Akira Amari, Minister of Economy, Trade and Industry.

Executive members

- Dr. Masuo Aizawa, President, Tokyo Institute of Technology.
- Dr Taizo Yakushiji, Visiting Professor, Keio University.
- Dr. Tasuku Honjo, Visiting Professor, Kyoto University.
- Dr Naoki Okumara, Former Representative Director and Executive Vice President, Nippon Steel Coorportation Ltd.
- Dr Mitiko Go, President, Ochanomizu University.
- Mr. Sadayuki Sakakibara, President, Toray Industries, Inc.
- Dr Yoko Ishikura, Professor, Graduate School of International Corporate Strategy, Hitotsubashi University.

Science Council Representative

- Dr. Ichiro Kanazawa, President of the Science Council of Japan.

The Secretariat of the CSTP consists of around 100 employees led by the Director-General for Science and Technology Policy and three Deputy Directors-General, who report to the Minister of State for Science and Technology Policy. The Secretariat co-ordinates the Council's meetings, provides administrative support and assists in planning and developing matters relating to science and technology.

The Council's remit is to overlook the nation's science and technology policies and to formulate and co-ordinate comprehensive, basic policies. The Council's main responsibilities include providing a comprehensive strategy for science and technology policy, producing an annual policy outline of the main issues for resource allocation, evaluation of national projects and monthly reports on science and technology performance.

The main activities of the CSTP include producing the basic science and technology plan and the five-year plan, which the council decides upon. The Basic Plan states priorities according to key issues and the available funds for science and technology. Several committees produce the Basic Plan, one for each area of interest. They are free to propose new directions. The G8 will in Japan in 2008 had environment and energy on its agenda. The Council has therefore chosen to focus on these topics in order to develop Japan's position. In November 2007, the Council proposed a regional science and technology policy to the Prime Minister who has asked them to write a strategy to promote this.

The Council meets once a week and is chaired by the Prime Minister. It carries out investigations and discusses basic policies relating to science and technology: allocation of the budget and other resources relating to science and technology, and evaluation of national research and development. The Council drafts strategy for science and technology in response to national and social issues. Social science and the humanities are also taken into consideration by the council to improve relations of disciplines with science and society, for example in areas such as ethics.

The government budget for science and technology is set on a yearly basis by the Cabinet Office and implemented by the Ministry of Finance. The Ministry of Education, Culture, Sports, Science and Technology (MEXT), has an important role in research and development within the education system, and receives around 65% of government expenditure on research and development. MEXT also contains the National Institute on Science and Technology Policy (NISTEP), which produces data analysis and reports on science and technology. The CSTP make decisions on budgets. Each year decisions are made for the following year's budget. Ministries must put forward their proposals for their own research and development budget to the Diet and this is checked for coherence by the CSTP to ensure proposals are comprehensive and investigate redundant areas. This way the CSTP can assemble a structured budget. However, there is not a single budget allocated for research and development for the Council to administer. The Council is reliant on ministries applying for funds and on budget approval by the Ministry of Finance. Once the budget is set the Council prioritises the various research and development programmes of the different ministries and ranks them

- S, "Specially important research results".
- A, "Important research results".
- B, "Efficiency requirements".
- C, "a reconsideration of budget efficiency".

The CSTP established five expert panels to approach for advice in 2007:

- The Expert Panel on Basic Policy Promotion, which investigates matters on basic policy in science and technology and to promote the Third Science and Technology Basic Plan.
- The Expert Panel on Evaluation, which prepares rules regarding research and development evaluation and carries out evaluation of major research and development.
- The Expert Panel on Bioethics, which examines the guidelines relating to the use of human embryonic stem cells.

- The Expert Panel on Space Development and Utilisation, which investigates future policy and programmes for space exploration.
- The Expert Panel on Management of Intellectual Properties, which investigates issues relating to the protection and utilisation of intellectual property and to strengthen international competitiveness.

Specialist investigation committees within the CSTP:

- Basic Policy Promotion Committee undertakes surveys and evaluations for the promotion of science and technology.
- Specialist Evaluation Committee is concerned with the competitive research environment and the efficient and outcome oriented use of resources; as well as research evaluation rules and the evaluation and investigation of research activities.
- Strategic Intellectual Property Committee reviews investment in research activities and reviews research results reflecting international competitiveness through a strategy for the use of intellectual property.
- Bioethics Specialist Evaluation Committee is concerned with the development and growth of the life sciences, handling and management of embryonic stem cells, embryos and investigating policy relevant stuff.
- Space Activity Utilisation Committee reviews and investigates activities and frameworks for the promotion of the competitiveness of the space industry and the use of space.

The subcommittees are each headed by a member of the CSTP and share the same secretariat, allowing smooth communication and co-ordination between the main council and the subcommittees. An expert for each issue is appointed by the Prime Minister to each subcommittee and subcommittee discussion is reported to the CSTP at the general assembly.

An ongoing foresight is performed within the Ministry of Education by a division of the National Institute on Science and Technology Policy (NISTEP) who report regularly to the CSTP.

The previous Council for Science and Technology had limited contact with stakeholders, particularly the ministries. There was an attempt to address this in the set up of the new Council for Science and Technology Policy. The CSTP has good communication contact with the ministries, but it may be too dependent on this information at the cost of ground-level sources. Information gathering is a structural problem. For this reason CSTP policies may not always be in line with the needs on the ground level.

A number of examples demonstrate this difficulty. The CSTP would like to increase funding for university research, but this requires negotiation with the Ministry of Finance in order to increase the budget. Another policy the CSTP has put forward is the promotion of work by young scientists. In theory it is simple to set up new competitive funds. However, in practice the young scientists are reliant on their seniors who apply for the grants that fund their work and it is not possible for them to apply in their own right for new funds. The CSTP also proposed to promote the regional innovation system, which would require input of funds. The difficulty here is the need for proposals from the regions to apply for funding. They lack the human capacity to produce effective proposals, however. Further, the lack of regional capacity has led to misallocation of funds in the past. The plan to promote inter-disciplinary research to address social problems has also proved difficult at the implementation level. Within universities researchers are not trained to work together and across disciplines, which compromises the quality of inter-disciplinary proposals.

In the Diet structure it is difficult to overcome the separation between ministries. The role of the CSTP is to enable co-operation between ministries, however this is a difficult task. The CSTP's Secretariat consists of officials seconded from their usual ministries therefore their allegiance remains with the ministry to which they will return. However, the Japanese case shows that is possible to co-ordinate the state's role in the innovation system by operatively bringing together parts of the relevant ministries into a single organisation. This brings a risk, however, of remoteness from policy implementation and the strategic intelligence that is generated at the agency level.

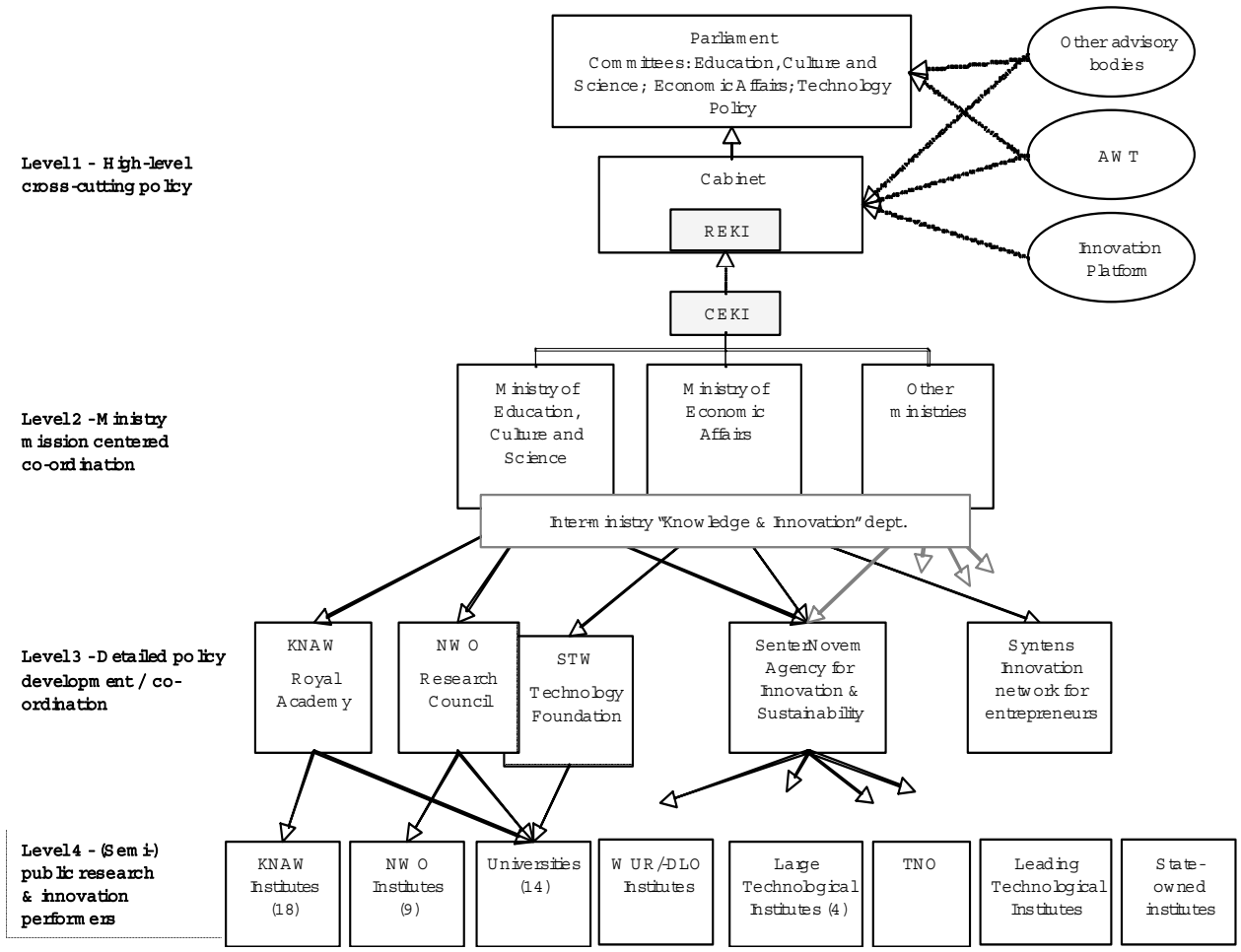
Lessons from the Japanese experience include:

- The viability of a model where an innovation council is used for joint planning by multiple ministries, effectively becoming a 'virtual ministry of innovation'.
- The ability of ministers and ministries to concede some power to this common will.
- The need, nonetheless, for inputs to the council from outside government, both in order to obtain strategic intelligence and to create legitimacy among stakeholders.
- Under-use of existing resources for distributed strategic intelligence by the CSTP is said to undermine the quality of policy decisions, reinforcing the need to interact with the various levels of the system and to limit centralist tendencies in designing and implementing innovation policy.

The Netherlands: Innovation Platform and Council for Science and Technology Policy

The Netherlands has two major advisory bodies in the field of science, technology and innovation. The Innovation Platform (IP) is a high-level advisory council consisting of ministers and external members from the private sector and the scientific community. It tends to produce specific analyses and proposals that lead to policy changes or the introduction of new instruments. The Advisory Council for Science and Technology Policy (AWT) is an independent Council consisting of independent members supported by a Secretariat. It focuses on medium to long-term strategy, providing conceptual advice in contrast to the instrumental advice of the IP. The AWT tends, therefore, to illuminate policy debates rather than to trigger specific policy actions. In practice there is some overlap between the two Councils and the Netherlands is currently in the process of proposing a new structure of advisory bodies, continuing a tradition of having a fairly high rate of change in such structures across many years.

Figure A.6. Netherland's innovation governance structure



Source : Deuten (2007).

The ministries responsible for research and development in the Netherlands are the Ministry of Education, Culture and Science (OCW) and the Ministry of Economic Affairs (EZ). There are several advisory bodies other than the Innovation Platform and Advisory Council for Science and Technology Policy, including: the Sector Councils, which have an advisory role to ministers on specific areas of policy and include representatives from the research community, research users and the government; the Royal Netherlands Academy of Arts and Sciences provides advice to the government on issues regarding science and technology, particularly in the basic research field; the Netherlands Academy of Technology and Innovation gives advice to governmental bodies, societal organisations and political parties; the Netherlands Bureau for Economic Policy Analysis advises the government on social and economic matters.

Poor co-ordination between the economy and education ministries in the Netherlands has increasingly been perceived as a problem in recent years. The IP provides a co-ordinating mechanism between the ministries. The *Delta Plan Science and Technology 11*, for example, is a joint publication of the Ministries of OCW and EZ and Social Affairs and Employment (SZW). Furthermore, the Smart Mix scheme was set up by the OCW and the EZ as a joint effort to prevent fragmentation of research funding and to strengthen demand-oriented research infrastructures.

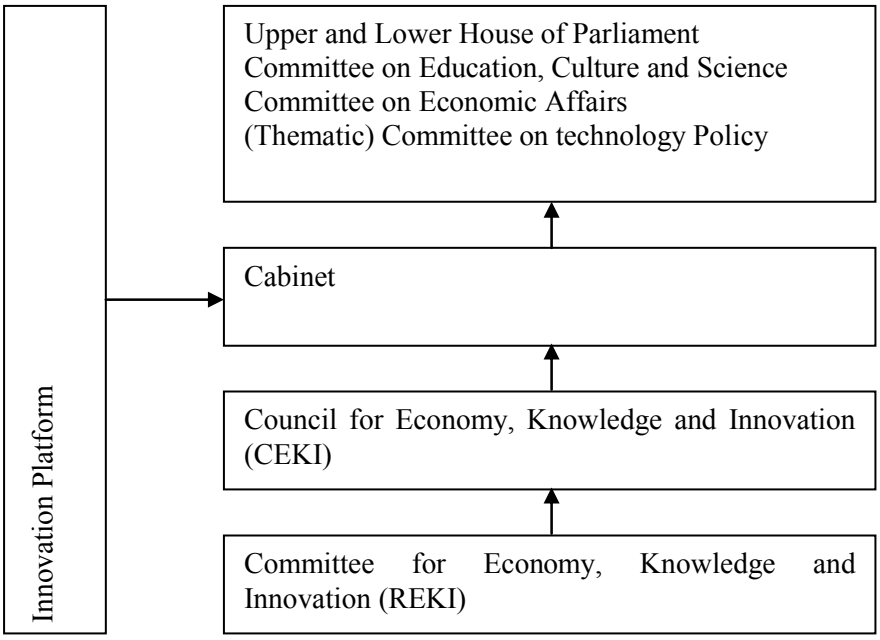
The two key agencies involved in policy implementation are SenterNovem, an agency of EZ which implements innovation schemes, and the national research council, the Netherlands Orrganisation for Scientific Research (NWO), which functions as a funding agency for OCW providing grants for excellent research as well as equipment and funds to co-ordinate research programmes. The Technology Foundation (STW) funds science and technology research and promotes the utilisation of research results by third parties.

The Netherlands has fourteen universities and eighteen Royal Netherlands Academy of Arts and Sciences (KNAW) institutes, as well as nine NOW Institutes and five Large Technological Institutes. The Netherlands Organisation for Applied Scientific Research (TNO) is the largest semi-public research organisation containing several research centres. Besides these institutions there are agricultural research institutes, state-owned research centres in various fields, and four Leading Technological Institutes established in 1997 as virtual organisations to encourage public-private partnerships.

Other bodies in the Dutch innovation system include:

The Committee for Economy, Knowledge and Innovation (REKI), a ministry level committee, and the Council for Economy, Knowledge and Innovation (CEKI) at the cabinet level, the Inter-departmental Policy Research task force (IBO), the Social Economic Council (SER), the Ratheneau Institute performing technology assessment, the Association of Universities in the Netherlands (VSNU), the Energy Research Centre of the Netherlands (LTI), and the Netherlands Organisation for Health Research and Development (ZonMW).

Figure A.7. Netherlands advisory bodies



Innovation Platform

The Innovation Platform (IP) was established in 2003, without a legal decree. Its creation was motivated by the rather poor performance of the Netherlands innovation system in comparison with neighbouring European and other countries. The IP was intended to be a high level, high profile organisation based on the Finnish example, to promote innovation by stimulating business enterprises and organisations in the public sector to work together. It was set up as an interim body with a four-year mandate (2003-7). Following the election in 2006, the new government decided to review the IP's mandate for a further four years, while making some changes in its membership and tasks.

The IP of the period 2003-7 has clearly had a significant influence on policies.

Its recommendation that the Netherlands launch an 'innovation voucher scheme' to subsidise the small-scale use of the knowledge infrastructure by SMEs led the government to launch first a pilot scheme and then a full-scale programme. Almost 10 000 innovation vouchers have so far been distributed for SMEs to buy knowledge from public/private institutions, the aim of which is to stimulate companies to use the knowledge available. In 2006, 6 000 vouchers were supplied with a value of EUR 2 500 to EUR 7 500.

In order to promote SME innovation new performance contracts have been introduced, again based on a recommendation by the IP, which allow a group of up to thirty-five companies to apply for a "co-operation bond" that runs for three years. The companies receive a 50% subsidy with a maximum of EUR 50 000 per company. Other achievements include granting work visas for 4 000 migrants and expanding university funding. Innovation programmes have been introduced in food and nutrition, nanotechnology, and embedded systems.

The IP's 2004 report on creative industries has triggered an innovation programme for that sector. Reports on promoting the immigration of highly skilled labour and innovative procurement continue to be debated, despite the change of government. The IP's report identifying 'key areas' of strength across industry and the knowledge infrastructure forms the basis for continuing policy action to promote these clusters, in which the new IP is instrumental.

This new IP is particularly concerned with the areas of care, education, energy and water management. It also forms part of the "Netherlands Entrepreneurial Innovation Country" project producing long-term strategy for innovation and entrepreneurship working with several ministers. The themes for the innovation platform to address change each year.

The IP Council meets four to five times a year to debate and produce its recommendations in the form of policy advisory reports. Recommendations are made in the form of advice regarding financing of research and development, and the IP has encouraged the government to increase input to the area, although funds have not increased significantly. The investment agenda is an integrated agenda with a multi-annual budget aimed at education, research, innovation and entrepreneurship. The agenda is treated as a guideline for future public and private investment.

The new Innovation Platform has launched the following projects

- The comprehensive innovation agenda of the IP (KIA).
- Knowledge and exploitation: development and exploitation of knowledge.
- Entrepreneurship: Promoting a culture of entrepreneurship.
- The Netherlands in the world: Competitiveness, key areas.

- Social innovation: Space for human talent.
- Social ambitions: Care, education, energy and water.

The new investment agenda has been the most significant achievement of the IP. The agenda plans to increase spending to 2016 to produce a highly skilled work force, improve the quality of education from pre-school upwards, and promote a high level of innovative capacity and entrepreneurship. To encourage companies to double their investment in research and development. In 2006 21 companies declared their support and commitment to participating in the programme.

Plans to implement this agenda include yearly assessment of the progress made identifying opportunities for improvement, which will feed back to the investment agenda and for the cabinet to establish its long-term strategic orientation. The knowledge and exploitation project responds to the IP's aims to keep the Netherlands in the top five knowledge-based economies in the world. This will be achieved through high achieving universities and establishing an attractive destination for foreign research workers. One aim is to maintain public investment in R&D at a fixed 1% GDP. And to take actions towards:

- More international co-operation.
- Increased resources for research.
- Development of dynamic research networks between the public and private sectors.

The IP will work on the innovation agenda (KIA), and alongside partners such as: the Higher Professional Education Council (HBO), the Confederation of Netherlands Industry and Employers (VNO-NCW), the Royal Association MKB-Netherlands (an SME business organisation), the Netherlands Organisation for Scientific Research (NOW), the Technology Foundation (STW), Platform Beta Techniek (commissioned by the government, education and business sectors to ensure sufficient availability of people who have a background in scientific or technical education), Knowledge for Business (TNO) and the association of Large Technology Institutes (GTIs).

The IP has chosen three social subjects as key issues of interest: education, care and water management. Human capacity is a limiting factor in the Netherlands defining a need to increase the productivity of educational institutions and the level of innovation they perform. The IP has recommended an investment agenda leading to 2016, which is widely supported by the stakeholders consulted. Since its inception in 2003, The IP has successfully put innovation on the social and political agenda. It has stimulated communication and new networks of entrepreneurs, institutions and the regional governments.

Extra financial investments in previous years have amounted to EUR 1.22 billion. This included: The "education and knowledge" project for EUR 800 million of which EUR 185 million went to research and innovation, EUR 100 million to Smart Mix, EUR 60 million to Beta and Techniek, EUR 25 million to Techno Starters, EUR 100 million to the fiscal incentive scheme for R&D,WBSO. The budget for 2007-2011 is rising from EUR 167 million to EUR 550 million.

In 2008, the IP and Ministry of Finance started a scheme to aid 80 fast growing companies for five years with at least EUR 20 million per year. Aims are to identify business strengths in the Netherlands and improve communication and competition. International expansion is a key aim.

Currently, the major issue concerning the IP is to develop key areas of Dutch industry and innovation. Currently there are six "key areas": Flowers & Food, High Tech Systems & Materials, Water, Creative Industry, Chemicals Industry and Pensions and Social Insurance. ICT and Energy are identified as

"innovation axes" for all sectors of the economy. Life Sciences & Health is a candidate to become a key area. The Innovation Platform identified the key area, based on an open, bottom-up selection procedure.

Key documents are as follows:

- *Work Programme Innovation Platform* (2007).
- *Investment agenda* (2006).
- *The Dutch Innovation Platform* (2006).
- *The Netherlands in 2027* (2005).
- *Political Visions on Innovation* (2005).

The Prime Minster chairs the platform and appoints members alongside the Minister for Education, Culture and Science, and the Minister for Economic Affairs. These members include political experts, and representatives from business, science and education. The current members are:

- Ronald Plasterk, the Minister of Education, Science and Culture and vice chairman of the Innovation Platform.
- Maria van der Hoeven, the Minister of Economic Affairs and (second) vice chairman of the Innovation Platform.
- Hans de Boer, an entrepreneur. Also member of Supervisory Boards and advisor of several companies.
- Piet Borst:, a scientist (biochemist and molecular biologist) working in the Dutch Cancer Institute. Also a member of the Royal Netherlands Academy of Arts and Science and several institutions abroad, such as National Academy of Sciences (US) and the Royal Society (GB).
- Robbert Dijkgraaf, a professor in physics (mathematical physics) at the University of Amsterdam. He is also chairman (from April 2008 on) of the Royal Netherlands Academy of Arts and Science.
- Wiebe Draijer, a managing partner of McKinsey & Company in Amsterdam. He is also chairman of the Future Shape of Technology Foundation (STT).
- Suzanne Hulscher, a professor of Water management (water systems) at the Twente University. She is also a member of the Young Royal Netherlands Academy of Arts and Science.
- Gerard Kleisterlee, CEO of Philips.
- Marjan Oudeman, is a member of the board of directors (governing board) of CORUS Netherlands and a member of the Supervisory Board of the Dutch Railways.
- Alexander Rinnooy Kan, chairman of the Social and Economic Council (SER) (advisory and consultative body of entrepreneurs, employers and independent experts).
- Feike Sijbesma, CEO of DSM. Also member of the Supervisory Board of the University of Utrecht, member of the board EuropaBio en CEFIC.
- René Smit, chairman of the Governing Board of the Free University of Amsterdam (VU) and the Christian school for higher education of Windesheim.

- Kees Tetteroo, chairman of the governing Board of the Regional training Centre (ROC) Eindhoven (school for vocational education).
- Melek Usta owns a company called Colourful People (consultancy in gender and ethnic issues). She is also the director of Tannet (network of Turkish academics).
- Bas Verhart, an entrepreneur. He is the director of Media Republic.
- Claudia Zuiderwijk, chairman of the Governing Board of the Tergooi Hospital in 't Gooi.
- Jan Peter van den Toren, the secretary of the Innovation Platform.

The IP is supported by a Secretariat of ten to twelve staff, which is paid for by the government. The "Project Office", housed within the Ministry of Finance, handles administrative duties and everyday practicalities of the IP. It implements projects and proposals, and performs research for the IP. Working groups are put together to debate specific issues led by one or two members of the IP. They hold separate meetings and events for the working groups, which include a range of relevant stakeholders.

In 2006 a foresight was produced for 2007 and a roadmap for knowledge investments towards 2016, the "knowledge assessment agenda".

The IP has a website to communicate documents and announcements to the public. Press conferences are held when reports are released, but there is no other strategy to reach a wider audience.

The IP was criticised in its first term, and questions were raised regarding its role and efficacy. This may be largely due to the poorly defined remit at the outset of the IP. More recently, in the second term, the IP has been successful in bringing innovation issues to the fore and has placed key items on the agenda. It has also produced a structured funding strategy for the next eight years. In the past government funding for research and development has mainly been distributed in impulse form to programmes with ad-hoc spending.

The IP has also been effective in bringing together stakeholders and amalgamating opinion regarding innovation policy. In many cases this has performed the role of legitimising government policies and has been used to substantiate the new funding strategy with input from stakeholders.

The recent move to house the IP within the new Inter-departmental Department has brought it closer to policy making and implementation in an informal capacity. Furthermore the members of the IP in its second term are considered to have a more practical approach and have brought a fresh outlook to the field. One interviewee suggested that in practice the implementation of policies is complicated within the ministries at the implementation level.

Advisory Council for Science and Technology Policy

The Advisory Council for Science and Technology Policy (AWT) has roots going back forty years to a predecessor introduced to address the poor performance of the Netherlands' research and development in comparison with other European countries (essentially the same reasons for establishing the IP). In 1991, the temporary Council on Innovation Policy and the Science Council were merged. This was at a time when the Netherlands had a growing number of strategic commissions, until a law was passed in 1997 to reduce the number to twelve bodies. The AWT was established according to several laws. The first is a general law on strategic advisory councils to the government, which dictates the composition of the council; before the 1970s members of the councils represented strategic interests. The law passed in 1997 stated that experts on these councils do not represent specific interests. The second law relating to the AWT states that the government is obliged to make a formal response to advice it receives from the AWT

within three months. There are also laws regarding appointments to the council; half the Council (six representatives) are appointed by the OCW and the other half by the EZ.

The government's obligation to react to advice it receives from the council is a critical aspect of the legislation giving the council legitimacy and standing to carry out its functions. Another important aspect is the involvement of the government in drawing up the work programme. Ministries can be short-term oriented and driven by political goals and less inclined to think about strategic questions.

Members serve a three to four-year term, which does not reflect the government term. The Council meets once a month for three hours and members commit two days a month to the Council. Asking for a greater time commitment from members would limit the composition of the council. However, two days a month effectively means their role is to reflect on the writings of the secretariat. A secretariat of ten to twelve people support the Council, five of whom research input for Council meetings and write reports on behalf of the Council. The secretariat generates the work programme for the council once a year. This is a crucial stage of the work to ensure that ministries take an interest in the Council's advice. The secretariat consults with a wide range of stakeholders, including ministries, through face-to-face interviews, in order to find out the current key issues. The process of consulting stakeholders raises interest in the issue at hand and stimulates discussions within ministries.

The draft work programme is submitted firstly to the ministries for feedback and finally to the cabinet to approve. Typically the work programme will include five key areas of interest, leaving room to take on any additional matters of urgency if necessary. The secretariat tries to ensure that about 80% of the work programme consists of government requests and 20% consists of issues developed from its own initiative, including issues of international concern. Two members of the Council lead each subject. The role of the council is essentially to reflect on the information given by the secretariat. Once finalised by the council, advice is presented to the minister concerned and published alongside any research, which has been commissioned. The council focuses on medium to long-term strategy. Recommendations may be taken up years after their initial suggestion. Recommendations made by the council are general and do not specify particular financial modalities or bodies for their implementation. Up until five years ago the AWT performed foresight exercises, however, this was thought to be no longer necessary.

In 2006 the composition of the AWT was altered to include more representatives of the innovation field, as opposed to formal scientific organisations where representatives are not independent in their advice. This was due to reflections on the success of the first period of the council. This suggests an even greater overlap in function with the IP and further redundancy in the system.

Research and development is not a politicised issue in the Netherlands. The Lisbon goals have been taken on board, but no significant funds have been dedicated to innovation. There is a need to increase investment and secure commitment from the government to the advice of the IP. The high degree of involvement of the Prime Minister, as a member of the IP and in selecting the members of the council, would suggest the IP has a significant influence on policy. However, he is not always able to attend meetings. Formally the government has stated its commitment to the recommendations of the IP, but in practice this is not necessarily the case. Ministries hold significant power and departments hold a strong influence on the implementation of policies. More commitment from the Ministry of Finance would also be required to make a significant difference.

Lessons from the Netherlands experience appear to be:

- It is possible to run a high-level advisory organisation (the IP) that uses analysis to build agreement about both broad strategic directions and very specific innovation policies and instruments.

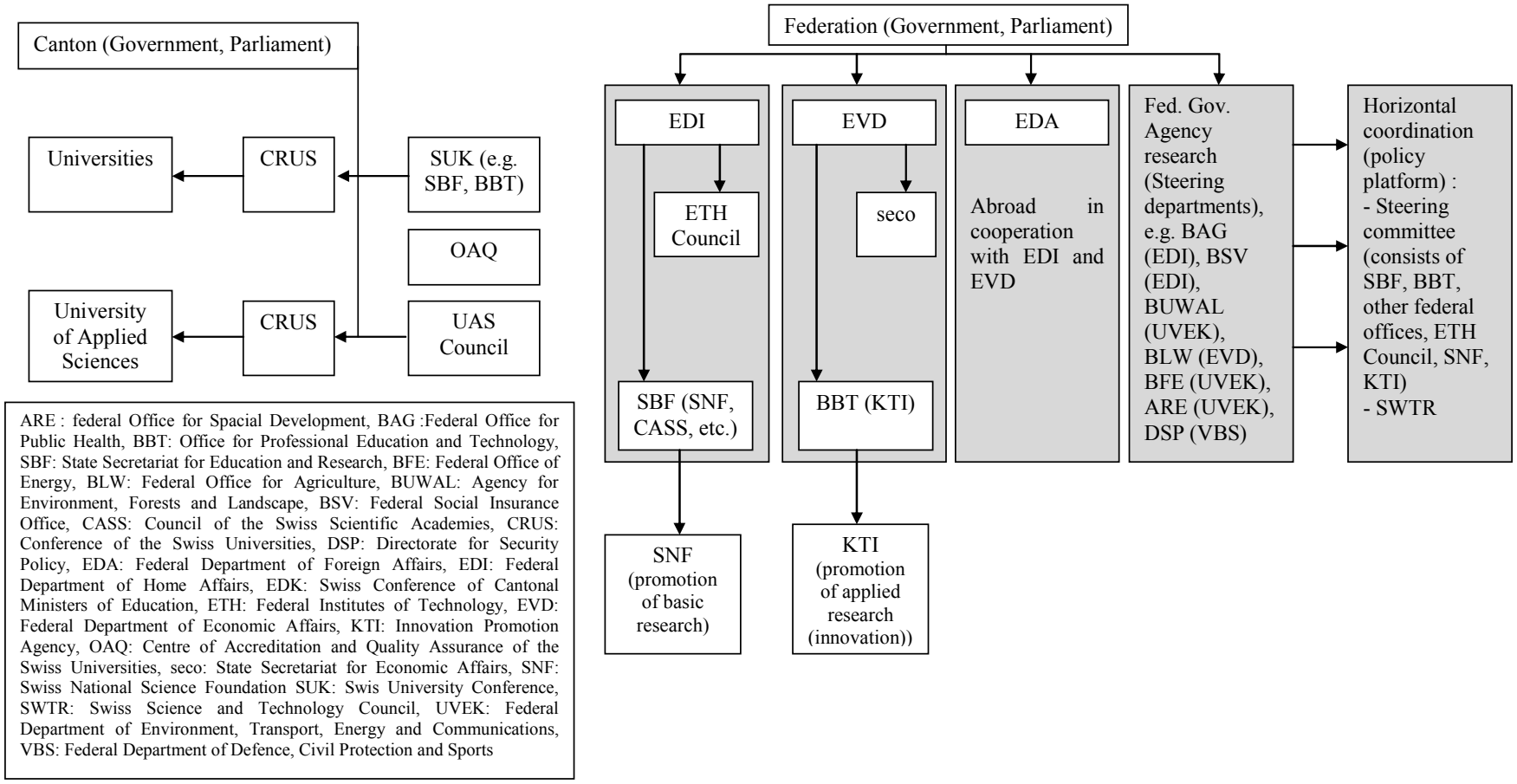
- Such a council can have a high influence on policy – probably aided by the presence of the two key ministers and the inclusion of a number of significant stakeholders from the sectors of society that are affected.
- Cross-government continuity appears to have been helped by the analytical basis of the IP's work and the ability of the new government to adjust the IP's composition and agenda without needing to reject its previous work.
- There is some redundancy in the Netherlands advice system, but it is not clear that this is damaging. The instrumental role of the IP and the longer-term, reflective role of the AWT appear complementary in a culture that is highly consultative in character and where the policy mix deliberately combines bottom-up and top-down elements.

Swiss Science and Technology Council

Swiss political culture is a strong influence on policy and behaviour. The decentralised (Cantonal) Swiss system is in general suspicious of and resistant to central planning or policy and Swiss traditions are strongly non-interventionist, especially in relation to industry policy. The willingness to have an innovation policy at all has increased only slowly over the past 25 years or so.

The Swiss Science Foundation (SNF) and Innovation Promotion Agency (CTI) provide the majority of funds for basic research as well as applied research. The SNF also contributes to policy-making, but the State Secretariat for Education and Research (SBF) and "Steering Committee" for the main part co-ordinate the innovation system.

Figure A.8. Swiss research and innovation governance structure



ARE : federal Office for Spacial Development, BAG :Federal Office for Public Health, BBT: Office for Professional Education and Technology, SBF: State Secretariat for Education and Research, BFE: Federal Office of Energy, BLW: Federal Office for Agriculture, BUWAL: Agency for Environment, Forests and Landscape, BSV: Federal Social Insurance Office, CASS: Council of the Swiss Scientific Academies, CRUS: Conference of the Swiss Universities, DSP: Directorate for Security Policy, EDA: Federal Department of Foreign Affairs, EDI: Federal Department of Home Affairs, EDK: Swiss Conference of Cantonal Ministers of Education, ETH: Federal Institutes of Technology, EVD: Federal Department of Economic Affairs, KTI: Innovation Promotion Agency, OAQ: Centre of Accreditation and Quality Assurance of the Swiss Universities, seco: State Secretariat for Economic Affairs, SNF: Swiss National Science Foundation SUK: Swis University Conference, SWTR: Swiss Science and Technology Council, UVEK: Federal Department of Environment, Transport, Energy and Communications, VBS: Federal Department of Defence, Civil Protection and Sports

Source : http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.content&topicID=35&countryCode=CH&parentID=34.

The Swiss Science and Technology Council (SWTR) is the advisory body to the Federal government in matters relating to science policy. There has been a tradition of similar councils since the 1960s, but the current Council was first reformed and restructured into its modern form in 2000. Towards the end of the 1990s the preference was for large councils providing multiple viewpoints creating a platform concept. This was then changed in 2000 to form a small advisory council intended to be a visionary group. The technology sector was included in the council for the first time, but the council was not focussed on innovation at the time.

Members are key people from the education, research and innovation sectors. The Federal council nominates them, however the President holds a lot of sway and the Federal council may take up informal recommendations. Members serve the Council for a four-year period and are currently:

- Prof Dr. Karl Aberer, Director of the National Center of Competence in Research (NCCR) "Mobile Information and Communication Systems" (MICR). This is a higher education institute and national center of excellence for wireless sensor networks. He was previously chairman of the Institute for Core computing Science at the Department for Computer and Communication Sciences at the Ecole Polytechnique Fédérale de Lausanne. He has been on the SWTR since 2004.
- Prof Dr. Willy Benz, Director of the Physics Institute, University of Berne, since 2002. He is also "Corresponding Member" of the international Academy of Astronautics. He has been a member of the Space Science Advisory Committee of the European Space Agency since 2003 and a member of the SWTR since 2004.
- Prof Dr. Fritz Fahrni, Chairman of the Institute for Technology Management at the University of St Gallen (ITEM-HSG) where he is also a joint professor with the Swiss Federal Institute of Technology (ETH Zurich). He is a director on the boards of five international companies and is a member of the Swiss Academy of Engineering Sciences. He has been on the SWTR since 2000.
- Prof Dr. Peter Fröhlicher, Professor for new French literature at the University of Zurich. He is a member of various scientific societies and boards and a member of the SWTR since 2008.
- Prof Dr. Daniel Fueter, Professor of Liedgestaltung in the Music Department of the Zürcher Hochschule der Künste, also a composer, administrator and teacher. He joined the SWTR in 2008.
- Prof Dr. Bettina Heintz, Professor of general sociology and sociological theory at Bielefeld University. She is a member of various scientific commissions and associations including the scientific commission of the funding initiatives for the humanities and social sciences of the German Research Foundation and the science commission of the science centre in Berlin. She has been on the SWTR since 2000.
- Prof. Dr. Ellen Hertz, Professor at the Institut d'ethnologie, Faculté des letters et sciences humaines at the University of Neuchâtel since 2001. Director of the Swiss Postgraduate Programme in Anthropology/Ethnology. She is also a member of the President of the Commission d'egalite, University of Neuchâtel, Editorial board of the online publication ethnographiques and the Editorial board of the international publication Nouvelles Questions Feministes. She became a member of the SWTR in 2008.
- Prof Dr. Alex Mauron, Associate professor of bioethics, medical faculty of the University of Geneva. He is a member of the Swiss Academy of Medical Sciences (SAMW) and is on various ethics committees including the National Ethics Commission in Human Medicine

(NEK-CEN) and the Ethics Committee for Research at the World Health Organisation. He became a member of the SWTR in 2004.

- Prof Dr. Matthias Peter, Professor of biochemistry at the Swiss Federal Institute of Technology and senior group director at the Swiss Institute for Experimental Cancer Research (ISREC). He is a member of the European Molecular Biology Organisation, EMBO and the Swiss National Science Foundation and the SWTR since 2003.
- Prof Dr. Walter A. Stoffel, President of the Competition Commissions in the Swiss Federal Department of Economic Affairs. He is a member of the Swiss Society for International Law and work on the editorial board of the Swiss Business Law Bulletin. He has been on the SWTR since 2003.
- Prof Dr. Tiziano Teruzzi, Professor of Physics, Construction and Statistik at the Applied University Scuola Universitaria Professionale della Swizzera Italiana and Director of the Laboratorio Technico Sperimantale with research focussing on building diagnostics, interior contaminants and the durability of construction systems and materials. He became SWTR-member in 2008.
- Prof Dr. Walter Wahli, Professor and Director of the Institut de biologie animale of the University of Lausanne. He is a member of the Swiss National Science Foundation research council and joined the SWTR in 2008.

The priorities of the SWTR are described in the biennial work programme, based also on the political agenda and the expectations of the State Secretariat for Education and Research (SBF) and Federal Office for Professional Education and Technology (OPET). In 2006-2007 the work programme included: The position of the SWTR on the Federal Council Dispatch on the 7th EU Framework Programme, and on Education, Research and Innovation (ERI), discussion of the Higher Education Framework Act. Other activities include monitoring institutions affiliated to the SWTR in conjunction with the future university, research, and innovation landscape of Switzerland, giving a position on policy implementation through evaluating the multi-year programmes of several institutions. Recent evaluation projects included: effectiveness of the National Research Programme (NRP), examination of the structure of intermediate academic positions. The SWTR investigated the question of an appropriate administrative structure in the ERI sector and has been involved in organisational reforms of the Swiss National Science Foundation.

The SWTR is legally considered as an extra-parliamentary expert committee. There is a federal law setting down the guidelines and functions of the organisation, which relates to laws on research. Council members are obliged to perform their functions in good conscience and are subject to official secrecy regulations. The Federal council is responsible by law for setting the goals for research policy in Switzerland. These goals then serve as a basis for establishing long-term programmes of the research bodies and financial plans produced by the Confederation. The SWTR makes suggestions for research goals. The recommendations from the SWTR therefore provide the Federal council with the basis for the government message on education, research and technology for the respective legislative period. There is currently a new legal basis in preparation, which will be essentially the same structure with new membership.

Relevant laws include:

- Federal research law (1983).
- Research law ordinance (1985).
- Regulation on the Swiss Science and Technology Council and its associated centres (2000).

- Federal law on the responsibility of the Confederation and its authorities and officials (1958).

The federal research law of 1983 defines the role of the SWTR:

> The SWTR is the advisory body of the Federal Council for all matters relating to science policy.
>
> The SWTR provides and evaluates the fundamentals of a national policy in education, research and technology.
>
> The SWTR submits official position papers at its own initiative or at the request of the Federal Council, the Federal Department of Home Affairs or the Federal Department of Economic Affairs on problems concerning scientific, research and technology policy.
>
> The associated centre TA-SWISS carries out technology assessment studies on behalf of the SWTR.[27]

The SWTR meets several times a year. The president of the council sets agendas for the meetings with input from other council members. The secretariat prepares the meetings, carries out consultations to clarify issues, manages external mandates and co-ordinates with the CEST study centre associated with the SWTR. Representatives from the scientific community and academic institutions are invited to council meetings to give expert input and representatives from the federal administration also attend. Decisions are made on a majority basis with the president holding a casting vote. There are two working groups: humanities and social science, and technology and innovation. The working groups draw up recommendations, which are then presented at the council meetings.

The SWTR organises conferences and meetings, which enable communication with academics and members of the scientific community. These events also provide an opportunity for the general public to hear about the activities of the council. The council's decisions are published as public information in recommendations and theme-specific documents. Key areas of interest have included: higher education policy, research policy, innovation policy, and revision of the research law. Knowledge transfer has been a key issue and the SWTR has identified that despite large potential for knowledge transfer in Switzerland between the education institutions and industry. Recommendations made by the council are both long and short-term with discussion looking as far as twenty years ahead. The SWTR makes some recommendations regarding finances, however, the SWTR itself does not provide any funding. There has been no comprehensive foresight in Switzerland. A new project is being introduced with preliminary studies and comparison with foresights from other countries.

There are subcommittees for Science, Technology and Innovation. Experts are consulted within the subcommittees, which produce papers of recommendation. One interviewee mentioned there is more focus on Science Policy with fewer stakeholders concerned with Technology.

The Council communicates with the Government and the public through their publications and announcements. These include position papers, participation in public meetings, presentation of reports through the media. An interviewee suggested that communication with the public is discouraged due to the advisory role the Council has towards the Government.

Recent key documents include the following

27. http://www.swtr.ch/e/index.html.

- *Promoting, Challenging, and Understanding: For a Future-Oriented Student Policy*, 2006.
- *Perspectives for Humanities and Social Sciences in Switzerland: Teaching, Research, Next Generation*, 2006.
- *Science and Technology Councils in Europe: What kind of advisory body for education, research and technology?,* Report of the meeting and position of the SWTR, 2006.

The secretariat is responsible for administrative support and implementing council decisions. In order to perform these tasks the secretariat can approach outside expertise if necessary. The secretariat prepares the meetings and is responsible for communication between members of the council.

R&D is not a politicised issue in Switzerland. The innovation system is split between the Federal government and the Cantonal governments. The Cantons are responsible for universities. There are a number of institutions with the role of co-ordinating these different levels of government. University policies are co-ordinated by the Swiss University Conference (SUK), which is supported by OAQ (Centre of Accreditation and Quality Assurance of the Swiss Universities). UAS policies are co-ordinated through the UAS council.

The Federal Council separates policy-making for research and education from policy for industry and innovation. The EDI (department of internal affairs) is responsible for research and education policy, whereas the EVD (department of economic affairs) is responsible for innovation and industry policy. A "Steering Committee" co-ordinates several government agencies involved in research and technology. These include: the State Secretariat for Education and Research (SBF), Federal Office for Professional Education and Technology (OPET), ETH-Board, Swiss National Science Foundation (SNF), and the Innovation Promotion Agency (CTI).

The SWTR occupies a unique role as an advisory body. A recent review of its legal basis questioned whether it should be involved in research, innovation and education, and it was decided that it should cover all of these as innovation on its own would be too restrictive.

The OECD Review of Switzerland's Innovation Policy (OECD, 2006) made the following observations about the SWTR

- First, SWTR has produced major documents and activities in recent years, the so-called "Nine Points (*Neun Punkte*) programme (SWTR, 2002a) and the well-planned SNF/CTI evaluation (SWTR, 2002b). More and more of its publications focus on the regulation of higher education. At the same time some stakeholders in the Swiss system point to a lack of visibility and clarity in terms of its role.
- Second, while on paper the SWTR's agenda is very broad, in recent years it seems to have concentrated on a few international issues and especially on matters regarding university reform, convergence of the different university sectors, and the broad introduction of the three-stage university system. As mentioned, all Swiss advisory and co-ordination bodies participate in the Bologna process.
- Third, the Council is composed of scientists, and ten out of the eleven members come from Swiss universities. The composition of the Council may to some degree influence its agenda.
- A fourth issue regards the somewhat precarious standing of SWTR in the debates on Swiss institutional reform. A more active role might mean a stronger position in a changing framework. This would imply a broader agenda, coming from the Council itself.

- Fifth, the SWTR's adjunct think tank CEST has a strong mandate based on SWTR's regulations. Some CEST studies are of high quality and provide a good basis for policy making. Unfortunately, many actors – including SWTR – seem to have mixed feelings about CEST, and in recent years there have been misunderstandings, university criticism targeted at certain studies ("Champions League"), and an unclear governance relation between SWTR and CEST. SWTR seems unaware of its unusual position: few advisory councils in Europe have such resources. TA Suisse, the Council's second adjunct, has also achieved international renown for the quality of its work. CEST appears to be underused as a resource and its future is unclear. It is recommended to find a more effective role for CEST as a provider of strategic intelligence

The Review (OECD, 2006) concluded that:

> It appears doubtful whether the SWTR in its current state and composition can provide the necessary advice and be a catalyst for change in the Swiss innovation policy system. A minimum requirement is a more balanced composition, with a good mix of Swiss and foreign members, and the inclusion of a number of members from industry.

Lessons suggested by anecdotal evidence are as follows. It is important to have a structurally strong system, which provides an interface for politicians and professors to interact. Legitimacy of the organisation is important so a well-defined role is essential. This may be a weak point in the Swiss system. A small "visionary" Council is too narrow and an open platform would allow more discussion. The experience of the Council is that the personal relationship between its Secretary and the President is vital to its effectiveness. If this communications channel functions badly then the government is not necessarily receptive to what the Council has to say. In a small country it is often difficult to get advice which is not attached to special interests. In the UK this is counter-acted by the advanced political system where advisors are obliged to announce conflicts of interest. Another source suggested that finding respected people is the most important job for the council and this is difficult, particularly in a small country if there are many councils/committees. The legitimacy and objectivity of the Council are readily questioned, notably in a small society, so the lack of foreign 'independent' voices is problematic.

The Swiss model was based on Finland, as they are countries of similar size. However, the scale of investment is different and the Swiss economy is more high-tech and complex than Finland's. There are also political differences between the two countries. The tradition of ministers to commit themselves to policies, which is strong in Finland, is not the case in Switzerland. In Switzerland the need for a 70-80% majority in Parliament ensures policies are not put through lightly, but this may also imply difficulties in performing steering functions.

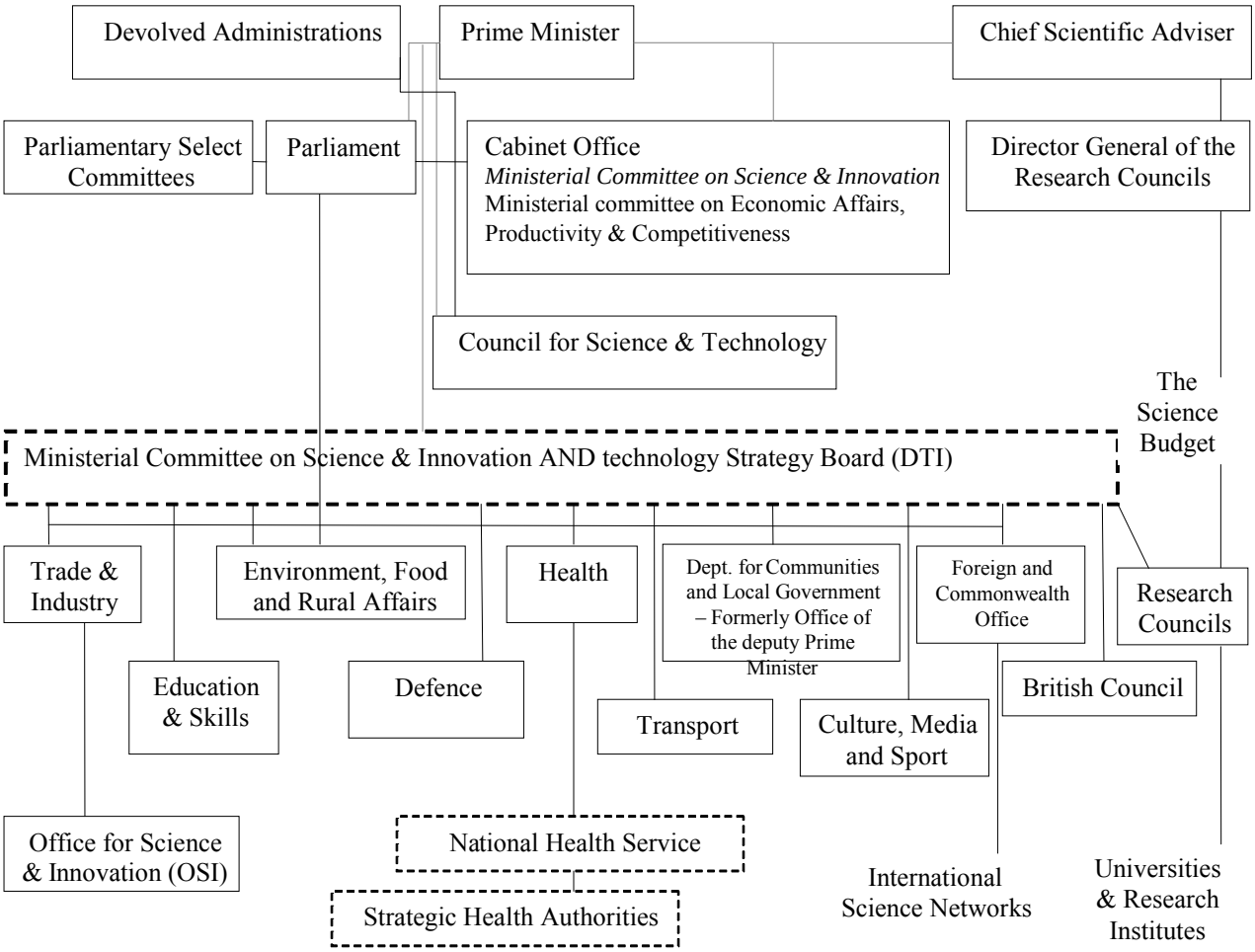
Lessons from the Swiss experience include:

- The importance of good interpersonal relations in making a council's recommendations persuasive to government.
- The limited to extent to which the political traditions in Switzerland allow state intervention limits a council's opportunities to make strong recommendations about innovation policy.
- A council comprising only scientists is neither well placed nor necessarily credible in trying to provide advice on broader issues of innovation.

UK Council for Science and Technology

The Council for Science and Technology (CST) is the British Government's top-level advisory body on science and technology issues of strategic importance to the United Kingdom, reporting directly to the Prime Minister

Figure A.9. UK research and innovation governance structure



Source : Malik, Gagliardi and Cunningham, 2007.

Following the recommendations of the Rothschild review in 1971, the UK Government has sought to maintain a number of interlocking high-level groups one of which has sought to provide an independent check on the balance, priorities and quality of research being undertaken within the science base and supported directly by government departments. From 1976 to 1987, this role was performed by the Advisory Council for Applied Research and Development (ACARD); from 1987 to 1993, the Advisory Council on Science and Technology (ACOST); and from 1993 the Council for Science and Technology.

From 1982 to 1987, ACARD co-ordinated all applied R&D and basic research in collaboration with the Advisory Board for the Research Councils (ABRC). Then, ACARD was absorbed into a new body, ACOST. This had an independent chairman and its role was to advise the Government on the priorities for

and the application of science and technology (S&T), the co-ordination of S&T activities in collaboration with departmental advisory bodies, and the nature and extent of UK participation in international collaboration in S&T. ACOST's secretariat reported to the Government's Chief Scientific Advisor (CSA), who was a member of ACOST.

This system was changed significantly in the early 1990s. Firstly, in 1992, responsibility for S&T was moved from the Department of Education and Science (DES) to a Cabinet Minister, the Chancellor of the Duchy of Lancaster, who headed the Office of Public Service and Science (OPSS) within the Cabinet Office. Within the OPSS, a new Office of Science and Technology (OST) was formed, headed by the Chief Scientific Adviser to the Government. The new office adopted many of the roles of ACOST as its own remit, expanding and professionalising the conduct of various key functions of oversight and co-ordination, including:

1. Advise the Government on all aspects of S&T.
2. Promote the effective use of S&T resources.
3. Develop and co-ordinate S&T policy.
4. Maximise the contribution of government S&T expenditure on national quality of life and economic performance.
5. Assist with taking of decisions on S&T priorities in the Public Expenditure Survey (PES) and the Ministerial Committee on S&T; 27 and
6. Enable the resolution of cross-departmental S&T issues.

The OST also became responsible for the Science Budget and for the work of the Research Councils.

Secondly, in the autumn of 1993, to complement the creation of the OST, ACOST was replaced by a Council for Science and Technology (CST). Chaired by the CSA, who was a member of ACOST rather than the chair, the CST was expected to help push forward the research agenda deriving from the first national Technology Foresight programme (a joint exercise between industry and the science and engineering communities) as well as providing a check on and seeking to ensure that government research spending priorities were informed by outside independent and expert advice.

A further significant change was made from January 1994, when oversight of the Research Councils was brought within central government. The ABRC was replaced by a Director-General of the Research Councils (DGRC) located within the OST. The DGRC's role was to support and advise the Minister responsible for science on 'securing the successful operation of the seven Research Councils in pursuit of their missions'. This included advising on the allocation of the Science Budget and setting out a broad framework reflecting goverrnment and other priorities, within which the Research Councils could decide what science to fund and how.

CST was re-mandated in March 1998 to advise the Prime Minister about the United Kingdom's strategic policies and framework for supporting science and technology and maximising their key contribution to the nation's sustainable development. It provides advice on the balance of UK science, engineering and technology and related policy issues to Cabinet Ministers. At this stage, responsibility for chairing the CST was taken over by the Minister for Science, with the CSA taking on the role of Deputy Chair.

CST's terms of reference were revised again following its five-yearly or quinquennial review in 2002, to make clearer the broad cross-cutting nature of the advice Government needs from CST. The chairing arrangements changed again at this point, with the Council being constituted to two chair persons, each

with a distinct role: the first co-chair is the Government's Chief Scientific Adviser who in the main chairs those meetings of the Council where it is reporting its advice to government and the possible impact/implications; the second co-chair is the independent chair person appointed by the Prime Minister and he or she chairs the general business of the CST where it is discussing and developing its advice to government.

There is no specific law requiring the UK Government to maintain such an oversight committee. The CST has a long history of antecedents. However, it exists in its present form as a result of a public commitment made by the government of the day in a White Paper entitled *Realising our Potential* (1993). This public commitment has been restated at various review points by the independent chairs of the quinquennial reviews, in 1998 and 2002.

The members of the Council are eminent figures drawn from across the field of science, engineering and technology, from academia, commerce and the enterprise sector. Most members hold multiple public appointments within the UK scientific governance system, usually as chairs or members of high-level advisory groups at research councils, academies and learned societies. Many have dual experiences, with both academic and commercial appointments, many held at the same time.

Table A.1. Members of the UK Council on Science and Technology, January 2008

Name	Role	Experience
Professor John Beddington	Co-Chair	Professor John Beddington was appointed as Government Chief Scientific Adviser (GCSA) on 1 January 2008. He specialises in the application of econor biology to particular problems in the management of fisheries and other renewable resources.
Professor Sir John Beringer CBE	Member	Sir John Beringer was Pro Vice-Chancellor and Professor of Molecular Genetics at the University of Bristol. He chaired the University's Research Committee. Chairman of the Advisory Committee on Releases to the Environment from 1990 to 1999 and Chairman of its Sub-Committee on Wider Biodiversity Issues fror 2001.
Professor Geoffrey Boulton OBE FRS FRSE	Member	Professor Geoffrey Boulton is Vice Principal and Regius Professor of Geology and Mineralogy at the University of Edinburgh. Professor Boulton is currently a me the Scottish Science Advisory Committee, and Chairman of the Research Committee of the League of European Research Universities.
Professor Peter Davies	Member	Professor Peter Davies is Chief Economist at BP and an Honorary Professor at The Centre for Energy, Petroleum and Mineral Law and Policy at the Univ Dundee. He held posts previously as an economist at Chase Manhattan Bank, The World Bank, the Government of Swaziland (as a Fellow of the C Development Institute) and the University of Warwick.
Professor Janet Finch CBE DL AcSS	Co-Chair	Professor Janet Finch was appointed independent CST co-chair in March 2007. Professor Janet Finch is Vice-Chancellor of Keele University, a post that she to September 1995. A Sociologist by background, Professor Finch was awarded a CBE in the 1999 New Year's Honours List for services to Social Science. In t year she was named as one of the Founder Academicians of Learned Societies for the Social Sciences. A former Council member of the Economic and Social R Council and Chair of its Research Grants Board, currently she is Chair of the Trustees of the National Centre for Social Research, and a non-executive memb Board of the Office for National Statistics.
Professor Alan Gilbert	Member	Professor Alan Gilbert is President & Vice-Chancellor of Manchester University. Professor Gilbert had previously been Vice-Chancellor of the University Melbou 1996 to February 2004, and Vice-Chancellor of the University of Tasmania, 1991-95. During his term at Melbourne, he initiated and, for the first four ye Universitas 21, an incorporated association of international universities drawn from 10 countries. An historian, Professor Gilbert received a D.Phil. from Oxford He has served as a member of the Australian Higher Education Council (1991-95) and the Hong Kong University Grants Commission (1998-2000).
Professor Wendy Hall CBE FREng	Member	Wendy Hall is a Professor of Computer Science at the University of Southampton in the UK and was Head of the School of Electronics and Computer Scienc 2007). She was the founding Head of the Intelligence, Agents, Multimedia (IAM) Research Group in ECS. She has published over 350 papers in areas hypermedia, multimedia, digital libraries and Web technologies. She is Vice President of the Royal Academy of Engineering, Vice President of the ACM and President of the British Computer Society 2003-2004. She is a member of the executive committee of UKCRC, and Chair of the new BCS Women's Forum. S Chair of the Advisory Board of the new company, Garlik Ltd, and is a founding member of the scientific council of the European Research Council.
Dr Hermann Hauser FREng CBE CPhys FinstP	Member	Dr Hermann Hauser is the co-founder of Amadeus Capital Partners Limited. He was a founder director of IQ (Bio), IXI Limited, Vocalis and SynGenix, Advanced Limited. At Amadeus, he continues to oversee a broad range of early and later stage developing technology companies. He holds an MA in Physics from University and a PhD in Physics from the Cavendish Laboratory Cambridge. He is a Fellow of the Institute of Physics and of the Royal Academy of Engineering Honorary Fellow of King's College, Cambridge.
Professor Alan Hughes	Member	Professor Alan Hughes is Director of the Centre for Business Research (CBR) and Margaret Thatcher Professor of Enterprise Studies at the Judge Business Sc a Fellow of Sidney Sussex College, University of Cambridge. He was from 2000-2003 Director of the National Competitiveness Network of the Cambridge-MIT a joint venture between MIT and the University of Cambridge.
Dr Sue Ion OBE FREng	Member	Dr Sue Ion was Group Director of Technology and Chief Technology Officer of British Nuclear Fuels plc, a position she held from 1992 until 2006. Dr Ion was th of the Hinton Medal for excellence in nuclear engineering in 1993, elected a Fellow of the Royal Academy of Engineering in 1996 and awarded the OBE for se the nuclear industry in 2002. Dr Ion has held a number of non-executive directorships associated with technology-based businesses and consultancies. Dr Ion re the UK on a number of international review and oversight committees including the International Atomic Energy Agency Standing Advisory Group on Nuclear En the Euratom Science and Technology Committee. Dr Ion is currently Vice President of the UK's Royal Academy of Engineering and a member of EPSRS's Cou was formerly a member of Council of the Particle Physics and Astronomy Research Council. She is a non Executive Director of the Board of the Health an Laboratory.

Name	Role	Experience
Sir Paul Nurse FRS FMedSci	Member	Sir Paul Nurse is President of the Rockefeller University, New York. He was previously Chief Executive of Cancer Research UK and has been a member of C 2000. He was joint winner of the 2001 Nobel Prize in Physiology or Medicine. Sir Paul has also received the Albert Lasker Award for Basic Medical Research, Motors Cancer Research Foundation Alfred P. Sloan Jr. Prize & Medal, Royal Society Wellcome and Royal and Copley Medals (U.K.), Pezcoller Awar Rosenstiel Award and Medal, Heineken Prize (Netherlands), Jimenez Diaz Medal (Spain), Jeantet Prize (Switzerland) and the Gairdner Foundation Internationa (Canada). He was awarded the Legion d'Honneur (France) in 2002 and is presently Chair of the Scientific Advisory boards of the Pasteur Institut Paris an Heidelberg, and is a board member of HHMI (USA).
Sir Keith Peters FRS PMedSci	Member	Sir Keith Peters is Emeritus Regius Professor of Physic at the University of Cambridge, where he was Head of the School of Clinical Medicine and Honorary Co Physician at Addenbrooke's NHS Trust. Sir Keith is a founding Fellow and, until November 2006 President of the Academy of Medical Sciences. He is currentl Director of the National Institute for medical research at Mill Hill, London and senior advisor for GlaxoSmithKline pharmaceuticals.
Dr Raj Rajagopal FREng CEng FIEE FIMechE FIE FCMI	Member	Dr Raj Rajagopal was Chief Executive of BOC Edwards and an Executive Director of the BOC Group plc until November 2006. He has worked for over 25 yea field of manufacturing technology and product development and held several positions in BOC Edwards before being appointed Chief Executive. He was appoin executive Director of FSI International Inc in Minneapolis (a NASDAQ company) in January 2001 and Foesco plc in May 2005. Dr Rajagopal is a fellow of th Academy of Engineering and a member of the Council of Cranfield University. He is a member of the advisory board of the Centre for Business Research, Ca University. He is also a fellow of the Institution of Electrical Engineers (IEE), which awarded him the IEE Eric Mensforth International Gold Medal for out contribution to manufacturing technology and management. He is a fellow of the Institution of Mechanical Engineers, a member of the Chartered Institute of Man and chairs the IET's manufacturing sector panel.
Dr Philip Ruffles CBE, FRS, FREng	Member	Dr Philip Ruffles was Director of Engineering and Technology and a Main Board member of Rolls-Royce plc from 1997 to 2001 where he enjoyed a distinguishe in engineering. He is presently a Non Executive Director of Domino Printing Science plc and Diamond Light Source Ltd. He has served on a number of gov bodies. He was Vice Chairman of the Defence and Aerospace Technology Foresight panel, a member of the Advisory Council for Aerospace Research in Euro Council Member of CCLRC.
Professor Michael Sterling FREng	Member	Professor Michael Sterling is Vice-Chancellor of the University of Birmingham. He served as Vice Chancellor of Brunel University for 11 years from 1990 - 2001 appointment to Birmingham and is now one of the longest-serving University Vice Chancellors in the UK. He previously held senior academic posts in the Unive Sheffield and Durham, as well as operating successfully as a consultant and entrepreneur in the private sector. He has served on the Engineering Council undertaken work for the Higher Education Funding Council for England in various capacities. He is a former Chairman of the Russell Group, and also past Pre the Institute of Measurement and Control. He is: a Member of the Council of the Royal Academy of Engineering. He is also Chairman of OCEPS Ltd.
Professor Kathy Sykes CPhys FInstP	Member	Professor Kathy Sykes is Professor of Sciences and Society at Bristol University. She is a trustee for the National Museums of Science and Industry, and NESTA. She sits on advisory groups on public engagement for the Royal Society, the Wellcome Trust, the ESPRC, and the UK Clinical Research Collaboratio Chair of the Sciencewise Advisory Panel and steering group.
Dr Mark Walport FMedSci	Member	Dr Mark Walport was appointed as Director of the Wellcome Trust in June 2003, following a varied career in the medical sciences. Before joining the Trust, Professor of Medicine and Head of the Division of Medicine at Imperial College London where he led a research team that focussed on the immunology and ge rheumatic diseases. He studied medicine at Clare College Cambridge and trained at the Middlesex Hospital Medical School. He is a founder Fellow of the Aca Medical Sciences and an Honorary Member of the American Association of Physicians. He previously served as a member of the Research and Development Board of SmithKline Beecham, as Registrar of the Academy of Medical Sciences and as a Governor of the Wellcome Trust.

The Government's Minister for Science, Mr Ian Pearson, follows the work of the committee closely. Government does commission CST to do specific projects, most recently John Denham, Secretary of State for Innovation, Universities and Skills, who has asked CST to investigate ways in which the interaction between academia and public policy makers in Government could be improved. Ultimately, advice is provided to the Cabinet and to the Prime Minister.

The term of CST membership is usually three years. Members may be asked to serve for another term/s following the end of a three-year term (up to a maximum term of service of ten years). Appointments and reappointments to CST follow Office of the Commissioner of Public Appointment's guidance.[28]

Members are appointed by the Prime Minister and in line with guidance from the Office of the Commissioner for Public Appointments. CST will draw on additional expertise by inviting non-members to join subgroups that are taking forward specific pieces of work.

CST's remit is to advise the Prime Minister and the First Ministers of Scotland and Wales on strategic issues that cut across the responsibilities of individual government departments. CST organises its work around five broad themes (research, science and society, education, science and government, and technology innovation) and takes a medium to longer term approach. The Council's terms of reference reflect its: UK-wide remit; responsibility for looking at issues that cut across government departments; and facility to engage in a wide range of policy areas. They are to advise the Prime Minister and the First Ministers of Scotland and Wales on the strategic policies and framework for

- Sustaining and developing science, engineering and technology (SET) in the UK, and promoting international co-operation in SET.
- Fostering the practice and perception of science, engineering and technology as an integral part of the culture of the UK.
- Promoting excellence in SET education.
- Making more effective use of research and scientific advice in the development and delivery of policy and public services across Government.
- Promoting SET-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 Council for development.

The Council works on cross cutting issues of strategic importance, taking a medium to longer-term approach. In developing its advice it will take into account the cultural, economic, environmental, ethical and social context of developments in SET. CST's business tends to be a mixture of planned and responsive work, with the Council and its sub-groups moving forward with all of its programmed business while at the same time being ready to respond to requests for short term advice or to make more formal submissions to national and even international consultations.

The development of the CST 'planned' work programme is led by its independent chair, in discussion with members, which will also consider proposals from other stakeholders or government itself. The Council conducts its business through deliberation and consensus building. The Council decides the approach to each area of work on a case-by-case basis. It can also choose to deliver its advice to

28. Code of Practice for Ministerial Appointments to Public Bodies, OCPA, December 2003, http://www.ocpa.gov.uk/pages/downloads/pdf/codeofpractice.pdf.

government by various routes including: publishing reports; through confidential written advice; and through discussions with ministers, officials and special advisers.

CST was commissioned by the Secretary of State for Trade and Industry to advise Government on what would be the best areas to focus resources for science, technology and innovation which could lead to applications in around five years time. This work was carried out within the context of the Government's five-year Comprehensive Spending Review and was expected to weigh the challenges of globalisation, demographic and socio-economic change, climate and environmental change, global uncertainty and, most particularly, technological change – looking at acceleration in the pace of innovation.

The Council is said to be influential and well regarded, within the limits of the work it does. Its reports are widely read. The independent chair has a close relationship with the CSA, and the members of the Council are individually and collectively a force to be reckoned with in British science. However, it does not meet frequently with the Prime Minister.

The Council meets quarterly and conducts a majority of its work through its sub-groups. Those sub-groups can draw on the support of a small secretariat (4 full-time equivalents) and a budget to commission supporting studies, consultations and dialogue events.

In terms of monitoring and evaluation, the Council has a clear remit and work methodology, and this is minuted and reported annually, with a majority of its advice being published through its web site and downloadable reports. It has been evaluated successively in its quinquennial review, most recently in 2002. There is no formal evaluation plan however.

The following are examples of consultations where the CST has submitted a contribution, usually wide ranging and challenging:

- Higher Education Funding Council for England- (HEFCE-)co-ordinated national consultation on the proposed a metrics-based research assessment and funding system to replace the Research Assessment Exercise after 2008.
- The Research Councils UK's (RCUK) consultation exercise on the efficiency and effectiveness of peer review.
- The Commission's proposals for the development of a European Institute of Technology (EIT) were put out to consultation in the summer of 2006.

Examples of short-term issues where the government has sought its help/advice include:

- In 2007, Sir Keith O'Nions, Director General of the Research Councils, asked CST for advice on how the contribution of non-research-intensive universities could be better valued and rewarded, to feed into the Government's Comprehensive Spending Review.
- In 2004, Sir David King asked for CST advice/support on the development and implementation of a universal ethical code of conduct for researchers.

In practice, its best work appears to be done around perennial and ticklish questions that relate very closely to the research community itself, and on innovation issues such as innovation in services or procurement, whether that is advising the government how to secure/protect research careers or developing an ethical code of conduct or university industry links. The Council has also taken on a role as an independent evaluator of certain public initiatives, for example the application of public engagement principles; and an evaluation of progress in nanotechnology. Recently it has advised government and the

Technology Strategy Board on what would be the best areas to focus resources for science, technology and innovation which could lead to applications in around five years time.

The Council has no formal role in the setting of the science budget, although it may be asked for advice regarding budgets.

The Council publishes perhaps three topical reports each year and perhaps as many written submissions made to major consultations. Its reports from 2007 are as follows:

- *Strategic Decision Making for Technology Policy* (2007).
- *Pathways to the future: the early careers of researcher in the UK* (2007).
- *Nanoscience and Nanotechnologies: A Review of Government's Progress on its Policy Commitments* (2007).

It publishes a report every year or so, which provides an overview of the Council's business, the advice given and challenges raised and the impact of its work. Minutes of the Council's meetings are also published.

The Council's remit is to give advice and as such its influence is very much based in the quality of that advice and its evidentiary support. Its advice/evidence is published and the Government's responses to that advice are similarly available in the public domain. In a majority of cases, CST advice will lead to some changes and refinements in the government position.

The Government formally responds to all of CST's reports, and CST in general, has been content with the quality and timeliness with these responses. It is clear that the process by which recommendations and conclusions may be accepted by Government, and subsequently acted upon, is complex and not always immediate. There are a number of examples where Government policy has evolved in directions that CST reports have recommended (for an example see Box A.1).

Box A.1 Interactions between CST and Government: The example of nanotechnologies

In March 2007, CST published *Nanoscience and Nanotechnologies: A Review of Government's Progress on its Policy Commitments* which reviewed progress on actions set out in the Government's response (2005) to the Royal Society/Royal Academy of Engineering report "Nanoscience and Nanotechnologies: Opportunities and Uncertainties" (2004).

The CST review concluded that whilst the Government had made good progress in many areas – including standards and metrology, international engagement and minimising workplace and public exposure – it had not provided sufficient support for research into the toxicology and health and environmental effects of nanomaterials.

The Government's response welcomed CST's review and acknowledged the need for greater championship of some of the issues surrounding nanotechnologies. In his eight-page response Malcolm Wicks, the then Minister for Science and Innovation, agreed to be a champion for nanotechnologies across Government and announced that he was establishing a ministerial working group to bring together those ministers with responsibility for the research base, innovation, health and safety and the environment.

The Government issues a Statement on Nanotechnologies in March 2008.

The primary function of the secretariat is to support the CST by assembling and analysing information and recording conclusions. However, the Secretary is a very experienced civil servant with an impressive overview of science governance and as such the chair of the Council – and convenors of the working groups – relies quite heavily on the secretariat to advise her on matters of procedure. In some respects they are the guardians of protocol, and particularly when it comes to the process of dealing with Whitehall and the devolved Administrations. That said, the secretariat takes great care to avoid influencing the content of the work of the Council and works hard to respect / promulgate the committee's independent role. The secretariat team will meet regularly with the Chairs and the convenors, and arrange regular briefing meetings too.

Overall, the secretariat therefore:

- Supports CSA as chair, the independent co-chair, and convenors of project groups.
- Manages CST business between meetings with the independent chair and convenors of project groups.
- Organises meetings.
- Drafts, collates and sends out papers for meetings.
- Records the meetings of the Council and any project groups. These will be agreed through correspondence with members, normally within ten working days of each meeting. The minutes will be non-attributable.
- Supports project group convenors in carrying out CST projects.
- Drafts documents.
- Carries out research for members.
- Helps CST get information from Government and the Devolved Administrations.
- Manages the budget.
- Keeps the register of CST members' interests.
- Networks with officials across Whitehall, the Devolved Administrations and outside Government on behalf of CST bearing in mind at all times CST's independent role.

The secretariat team are civil servants and permanent members of staff within the Department of Innovation Universities and Skills (DIUS), which is the ministry that bears the costs of the secretariat, the Council and any related studies or purchases.

The Council consults with stakeholders at various points in the lifecycle of its work and in the lifecycle of any project.

When determining its business, the Council has the facility to consult with ministries and other public agencies with an interest in a topic, perhaps exploring their views on the importance and tractability of an issue, but also looking to establish links with a liaison person for the work itself, should it be agreed upon (the CST works with a sponsor department on most of its programmed projects).

On most topics, the convenor of the working group will tend to carry out a simple stakeholder analysis possibly inviting particular experts and interested parties to join the group temporarily or requiring consultations to be run or more in-depth studies to gather evidence and gauge opinion.

There is also the provision for officials of interested ministries and agencies to be invited to attend a committee meeting.

The Council is a national body and does not have a regional remit in a formal sense, however the secretariat will work with the chair to ensure that national, devolved and regional bodies and science administrations, and the devolved administrations, are consulted as appropriate. The English regions – as opposed to the countries – will tend to be involved with the work on the Council only occasionally and where there is an evident mutual interest in a given topic or issue.

The UK launched its first national technology foresight programme in 1993, and its second in 1998, and has had a permanent foresight programme operating since 2002, with a rolling programme of thematic panels, supported by the Department of Innovation, Universities and Skills (DIUS). CST tends to look at issues, and identify projects, on the basis of a medium to long-term perspective

The CST communicates with government through written reports and advice, accompanied in most cases by face-to-face meetings where advice is given orally to ministers or the cabinet and questions answered. This written material and the government's response are published on the CST web site, which is the principal public communication channel.

DIUS is the ministry with overarching responsibility for the development, funding and performance management of the science and research base across the UK. The ministry was created in 2007, and amalgamated the science and innovation remits of the former industry ministry (research, innovation) and education ministry (higher education, performance based block grants to HE institutions). It also means that the dual support system (institutional funding and project funding) lives within a single ministry and can be more closely co-ordinated.

DIUS funds the higher education funding councils (HEFCE, SHEFC, etc), which provide around GBP 1 billion a year in research income for the 150 or so higher education institutions across the UK, with these institutional funds awarded in line with institution's past performance (QR - quality of research) in the research assessment exercise. The QR income is supplemented by a number of capital programmes and knowledge transfer funds.

DIUS funds the seven Research Councils, which allocate public funds to projects and teams in the research base, the performance of which the Director General of Science and Innovation (DGSI), Sir Keith O'Nions, is responsible. At present, the seven councils are:

- Arts and Humanities Research Council (AHRC);
- Biotechnology & Biological Science research Council (BBSRC);
- Engineering & Physical Sciences Research Council (EPSRC);
- Economic & Social Research Council (ESRC);
- Medical Research Council (MRC);
- Natural Environment Research Council (NERC);
- Science and Technology Facilities Council (STFC).

Its budget is voted by parliament, based on the proposals arrived at by HM treasury through is biannual zero-based comprehensive spending review. In 2008/2009, DIUS's research budget will be close to GBP 5.3 billion, comprising around GBP 3 billion for the Research Councils, GBP 0.5 billion invested through its own special programmes, run by the Office of Science and Innovation for capital upgrading or

institutional reform, around issues such as commercialisation and public engagement, and the GBP 1.8 billion budget managed by the Funding Councils.

DIUS also plays host to the Government Office for Science, headed by the Government Chief Scientific Adviser (GCSA) Professor John Beddington, who is responsible to the Prime Minister and Cabinet for the quality of scientific advice on scientific and science policy issues. Several individual ministries have substantial research portfolios, to develop policy or improve public services, and in some cases have their own laboratories.

The GCSA also:

- Co-chairs the Prime Minister's Council for Science and Technology;
- Oversees the Government's Foresight programme and Horizon Scanning Centre;
- Chairs the Global Science and Innovation Forum which co-ordinates the UK's international science and innovation strategy and delivery;
- Heads the Science and Engineering profession in Government.

Governance and funding tend to go hand in hand, with a tiered arrangement of policy and performance frameworks, which set objectives and specific testable targets (public service agreements) for all departments and agencies involved in the science funding system. So, for example, each grant awarding research council will negotiate a delivery plan with DIUS, and will provide an annual report on progress against that plan using a common set of performance indicators and balanced scorecard. Performance is aggregated and feeds forward into DIUS negotiations with the HM Treasury during the periodical comprehensive spending reviews, and will influence the size and overall shape of the science budget. This annual process of reporting, competition and negotiation has permitted government to end the previous RC review mechanism, which were the periodical (five-yearly) independent / external reviews.

In addition to this formal performance measurement, the Research Councils and Funding Councils have councils/boards that comprise a large number of scientific and independent members, and which provides the basic leadership and supervisory functions.

The use of stakeholder and public consultation has now become pretty much mandatory for all new policies and programmes of any scale, with the rationale objectives and arrangements all being debated and refined ahead of securing a budget and beginning to spend money.

As the performance management elements have strengthened and extended, oversight of the system, by high-level groups such as the CST, has arguably weakened, inevitably perhaps, as the effort devoted to quality assurance and professional management has soared.

DIUS still maintains a rolling programme of science reviews to evaluate the quality and use of science being made use of within its government departments, but has no equivalent, semi-independent, people-based check of performance of the science system.

Evaluation is pursued routinely at the level of programmes and schemes, although there is no singular framework or timetable or set of principles for this.

There are also high level evaluation functions, which operate on a somewhat unpredictable basis, so for example the National Audit Office has looked at collaborative industrial research or the House of Commons Select Committee on Innovation Universities and Skills might elect to scrutinise a pressing subject like researcher careers or the performance of the Medical Research Council or civil space research.

The tripartite arrangements evident in many other EU member states (government, business and social partners) are almost entirely absent within the governing structures of the UK research and innovation system. However, government requires all public bodies to involve business people and lay people in their governing and advisory bodies, which occurs through public appointments to councils and advisory bodies. There is also extensive business input through the unpaid contributions of senior executives of individual corporations with a major research and innovation brief to task groups and the steering groups of research programmes and projects. Equally, business people and social partners participate in strategic planning exercises, such as the national foresight programme. Business participates indirectly too, as co-sponsor of applied research or through representations to watchdogs and auditors (such as Parliamentary select committee on science and technology[29]) and the ballot box. The larger trade and industry bodies, such as the Confederation of British Industry (CBI) have science and technology committees that poll their members and make representations to national reviews, but their interest and influence is limited."

The UK public sector research base has a research capacity equivalent to around GBP 5 billion a year, and has a scale/complexity in proportion to this. The system is not unduly complex, and government and its principal agencies have been pressing forward with various efficiency-enhancing and streamlining exercises in the recent past. The science system is outwardly far more straightforward and coherent than the government's implementation of support for innovation and business development.

The Science and Innovation Investment Framework 2004-2014: Next Steps sets out the Government's thoughts on the long-term challenges facing UK science and innovation.

The government has created performance-driven structures throughout the research system, made stakeholder and public engagement pretty well mandatory in the definition and implementation of research in higher education. Goal oriented management is the watchword, and outcomes are increasingly the acid test of performance. The UK has built in various checks and balances through "watchdog" organisations such as the Audit Office.

The research and funding councils arguably have somewhat less autonomy than they once did as regards their strategising, with a long-run and general trend towards government, business and society being party to the setting of priorities and budgets, rather than leaving this as the exclusive domain of the researchers (Haldane principle). In practice, one might argue that the councils have more authority and more influence over the direction of research than was the case historically, as the system has evolved from one dominated by individual academics judged by selected peers to one dominated by socially constructed agendas.

The effects of New Public Management on the Council of Science and Technology are evident in its remit (to challenge assumptions, to advise on pressing issues arising), its membership (scientists, business people and social partners) and the manner in which it conducts its business (open, transparent, consensual).

The CST's advice will tend to be forward looking, so its work on researcher careers explored issues facing the UK research base stretching out 10-20 years, and has sought to cast its advice on how best to respond to the evident and anticipated challenges from a perspective of both near term and long term.

In more general terms, short-term political pressures are also accommodated and attenuated through the creation of a published national science and innovation framework, which set broad policy objectives from 2004 – 2014, and is reviewed and refreshed every two years.

29. http://www.publications.parliament.uk/pa/cm/cmsctech.htm.

There are also structural arrangements to ensure a reasonable degree of stability, such as the autonomy of the principal delivery agencies, which work within negotiated five-year and ten-year strategies. The posts of CSA and DGRC also provide a useful bulwark against some of the potential excesses of a politically short-term and volatile environment.

Research and development is not a politicised issue in the UK. Science and innovation has a high political profile in the UK government and in parliament, however it is not political in the sense of party politics or political appointments. Indeed, the only two points in the system where politicians are involved directly is *i)* the science minister and *ii)* the cross-party group of MPs that make up the membership of the House of Commons Select Committee on Innovation, University and Skills.

Within central government, policy makers are almost exclusively civil servants, although they make use of external consultants to conduct studies and provide advice. The great majority of the superstructure involved in the delivery of science in the UK is made up of independent agencies with professional managers and stakeholder based governing bodies rather than political cadres.

The CST has no political appointments, and no political remit.

The UK has a wider pattern of stakeholder and public consultation on research and development such as the following:

- National foresight programme, with rolling process of topical projects.
- A requirement for all ministries and agencies to maintain a science and innovation strategy defined in part through a foresight or horizon scanning exercise and built with stakeholders and approved by them.
- A requirement for all novel and major new programmes to be defined in part through stakeholder consultation.
- A growing tendency towards the creation of a high-level advisory committee on stakeholder and public engagement, evident amongst all delivery agencies.
- A growing tendency to run nationwide public dialogue processes to help to frame national policies and research priorities in major new areas, from genetically modified organisms to nanotechnology.

While there is no good public view of experiences available, the history of the CST and the bodies that preceded it seems to indicate:

- New public management, goal-oriented structures and professional management will reduce the need to rely on the advice of a small group of individuals as a primary basis for deciding the nature and direction of national research policy.
- The Council's most important role presently is its ability to sense risks and to probe and dimension issues in a constructive manner, providing a useful source of insight and challenge direct to the CSA and ministers.
- Its second most important role is arguably its ability to probe issues of particular importance to the research, innovation and business communities and formulate proposals that have a worldliness and rightness, because of their collective eminence, experience and immersion, about them that a policy team or consultant might struggle to attain.

The other challenge likely to be faced by the Council is just how and where to devote its attentions, given the nature and extent of the science system nationally and the manifold issues at play, and the fact that it is a committee of 17 people supported by a four-person secretariat and might be able to count on an input of at most 400 person days (very high grade) a year from the committee, as much again from the secretariat and perhaps as much again in consultancy support, so 6-8 full time equivalents with an overview of a GBP 5 billion activity.

The CST is part of a UK tradition of using 'eminent' people to populate advisory committees, with only modest analytical support. It combines the functions seen in some other countries such as the Netherlands where there are separate bodies that respond to specific questions from government and others that set their own agendas. The CST appears to have influenced a number of modest policy decisions but not to have driven large strategic changes. From evidence in the UK it is not clear whether this is because ministers are not involved.

Lessons from the UK experience include

- In the absence of ministers and a direct connection to the government's innovation policymaking processes, the influence of the CST appears to be somewhat limited.
- The CST appears also to be hampered by the lack of strategic intelligence (evidence) it is equipped to bring to bear on policy problems.

ACRONYMS AND ABBREVIATIONS

ABRC	Advisory Board for the Research Councils (United Kingdom)
ACARD	Advisory Council for Applied Research and Development (United Kingdom)
ACOST	Advisory Council on Science and Technology (United Kingdom)
AWT	Advisory Council for Science and Technology Policy (the Netherlands)
BERD	Business Enterprise Expenditure on Research and Development
BMF	Federal Ministry of Finance (Austria)
BMVIT	Federal Ministry of Transport, Innovation and Technology (Austria)
BMWA	Federal Ministry of Economics and Labour (Austria)
BMWF	Federal Ministry of Science and Research (Austria)
CBI	Confederation of British Industry (United Kingdom)
CEKI	Council for Economy, Knowledge and Innovation (the Netherlands)
CEST	Centre for Science and Technology Studies (Switzerland)
CLP	Chilean peso
CMI	Ministerial Commission for Innovation
CNIC	National Innovation Council for Competitiveness
CONICYT	National Commission for Scientific and Technological Research
CORFO	Foundation for Promoting Development
CSA	Chief Scientific Advisor (United Kingdom)
CSR	Comprehensive Spending Reviews (United Kingdom)
CST	Council for Science and Technology (United Kingdom)
CSTA	Council of Science and Technology Advisors (Canada)
CSTP	Council for Science and Technology Policy (Japan)
CTI	Innovation Promotion Agency (Switzerland)
EDI	Federal Department of Home Affairs (Switzerland)
ERA	European Research Area
ETH	Federal Institute of Technology (Switzerland)
DES	Department of Education and Science (United Kingdom)
DGRC	Director-General of the Research Councils (United Kingdom)
DGSI	Director-General of Science and Innovation (United Kingdom)
DIUS	Department of Innovation, Universities and Skills (United Kingdom)
DTI	Department of Trade and Industry (United Kingdom)
EIT	European Institute of Technology
ESTA	European Science and Technology Association
EU	European Union
EVD	Federal Department of Economic Affairs (Switzerland)
EZ	Ministry of Economic Affairs (the Netherlands)
FDI	Development and Innovation Fund
FDI	Foreign Direct Investment
FFG	Austrian Research Promotion Agency
FIC	Innovation for Competitiveness Fund
FNR	National Research Fund (Luxembourg)
FPIT	Federal Partners in Technology Transfer (Canada)
FTE	Full-Time Equivalent
FWF	Austrian Science Fund
GAO	General Audit Office (United States)
GBP	British Pound
GCSA	Government Chief Scientific Advisor (United Kingdom)
GDP	Gross Domestic Product

GERD	Gross Domestic Expenditure on Research and Development
GPRA	Government Performance and Results Act (United States)
GTI	Large Technology Institutes (the Netherlands)
HBO	Higher Professional Education Council (the Netherlands)
HE	Higher Education
HEFCE	Higher Education Funding Council for England (United Kingdom)
HERG	Higher Education Research Group (Ireland)
IBO	Interdepartmental Policy Research on Technology Policy (the Netherlands)
ICSTI	Irish Council for Science, Technology and Innovation
ICT	Information and Communication Technology
IDA	Industrial Development Agency (Ireland)
IP	Innovation Platform (the Netherlands)
KIA	Innovation Agenda (the Netherlands)
KNAW	Royal Netherlands Academy of Arts and Sciences
LTI	Energy Research Center (the Netherlands)
OMB	Office of Management and Budget (United States)
MAFF	Ministry of Agriculture, Fisheries and Food (Japan)
METI	Ministry of Economy Trade and Industry (Japan)
MEXT	Ministry of Education, Culture, Sports, Science and Technology (Japan)
MHLW	Ministry of Health, Labour and Welfare (Japan)
MLIT	Ministry of Land, Infrastructure and Transport (Japan)
NAFIP	National Research and Technology Plan
NCCR	National Centre of Competence in Research (Switzerland)
NIS	National Innovation System
NISTEP	National Institute on Science and Technology Policy (Japan)
NRP	National Research Programme (Switzerland)
NTBF	New Technology-Based Firm
NWO	Netherlands Organisation for Scientific Research
OAQ	Centre of Accreditation and Quality Assurance of the Swiss Universities
OCW	Ministry of Education, Culture and Science (the Netherlands)
OPET	Federal Office for Professional Education and Technology (Switzerland)
OPSS	Office of Public Service and Science (United Kingdom)
OST	Office of Science and Technology (United Kingdom)
PART	Programme Assessment Rating Tool (United States)
PES	Public Expenditure Survey (United Kingdom)
PSA	Public Service Agreement (United Kingdom)
REKI	Committee for Economy, Knowledge and Innovation (the Netherlands)
ROAME	Rationale – Objectives – Appraisal – Monitoring – Evaluation)
R&D	Research and Development
RCUK	Research Councils UK (United Kingdom)
RPE	Decree on Performance Measurement and Evaluation (the Netherlands)
RTI	Research, Technology and Innovation
RTD	Research and Technological Development
S&T	Science & Technology
SAMW	Swiss Academy of Medical Sciences
SBF	State Secretariat for Education and Research (Switzerland)
SenterNovem	Promotion Agency for Innovation and Sustainable Development (the Netherlands)
SER	Social Economic Council (the Netherlands)
SET	Science, Engineering and Technology
SHEFC	Scottish Higher Education Funding Council (United Kingdom)
SMEs	Small and Medium Enterprises
SNF	Swiss National Science Foundation
SNIC	National Innovation System for Competitiveness
STW	Technology Foundation (the Netherlands)
SUK	Swiss University Conference
SWTR	Swiss Science and Technology Council

SZW	Ministry of Social Affairs and Employment (the Netherlands)
TAFTIE	Association for Technology Implementation in Europe
TEKES	Finnish Funding Agency for Technology and Innovation
TFP	Total Factor Productivity
TNO	Netherlands Organisation for Applied Scientific Research
UK	United Kingdom
UAS	University of Applied Sciences (Switzerland)
US	United States
VBTB	From Policy Budgets to Policy Accountability (the Netherlands)
VINNOVA	Swedish Governmental Agency for Innovation Systems
VNO-NCW	Confederation of Netherlands Industry and Employers
VSNU	Association of Universities in the Netherlands
WBSO	Fiscal incentive scheme for R&D (the Netherlands)
ZonMW	Netherlands Organisation for Health Research and Development

ACKNOWLEDGEMENTS

This owes much to many people who helped by providing information, advice and insights during the OECD team's visit to Chile in November 2007. In particular, it is very grateful to the Secretariat of the National Innovation Council for Competitiveness, Executive Secretary Leonardo Mena as well as Marcía Varela for her efficient and friendly assistance in preparing this visit, arranging the meetings and supporting the OECD Review team during the visit. The participants of the interviews in Chile as well as other individuals who supported the OECD team throughout the process were of great help.

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