Foresight in the Nordic research and innovation council systems

Andersen, Per Dannemand; Borup, Mads; Finnbjörnsson, T.; Vas, E.; Malmér, T.

Publication date:
2007

Document Version
Publisher's PDF, also known as Version of record

Risø-R-Report

Foresight in the Nordic research and innovation council systems

Per Dannemand Andersen, Mads Borup, Thorvald Finnbjörnsson, Eirný Vals and Thomas Malmér

Risø-R-1613(EN)

Risø National Laboratory
Technical University of Denmark
Roskilde, Denmark
January 2007

Author: Per Dannemand Andersen & Mads Borup, Risø National Laboratory, Denmark Thorvald Finnbjörnsson & Eirný Vals, RANNIS, Iceland Thomas Malmér, The Royal Swedish Academy of Engineering Sciences, Sweden
Title: Foresight in the Nordic research and innovation council systems

Risø-R-1613(EN)
January 2007

Abstract

The objective of this report is to describe national (and Nordic) research and innovation councils and similar systems and organisations in order to produce an updated account of the systems that can facilitate a meaningful exchange of information and viewpoints on foresight in this context. The description includes an analysis of current use of foresight within the five national research and innovation council systems.

The report is the outcome of work package 3 of the Nordic Foresight Forum entitled “Mapping of Nordic national research and innovation council system and analysis of the needs for foresight and similar strategic intelligence”.

The report is edited by Per Dannemand Andersen, Risø National Laboratory, Denmark. Contributions by: Mads Borup, Risø National Laboratory, Denmark, Thorvald Finnbjörnsson and Eirný Vals, RANNIS, Iceland, Thomas Malmér, The Royal Swedish Academy of Engineering Sciences, Sweden.

ISSN 0106-2840
ISBN 978-87-550-3614-7

Contract no.:

Group's own reg. no.:
1220068

Sponsorship:
Nordic Innovation Centre

Cover :

Pages:
Tables:
References:

Information Service Department
Risø National Laboratory
Technical University of Denmark
P.O.Box 49
DK-4000 Roskilde
Denmark
Telephone +45 46774004
bibl@risoe.dk
Fax +45 46774013
www.risoe.dk

Contents

1 Introduction 4

1.1 Key questions and methods 5

2 Foresight, innovation and national science systems in the Nordic Countries 7

3 Research and innovation council system in Denmark 10

3.1 Introduction 10
3.2 The Danish research and innovation council system 12
3.3 The current use of foresight and similar strategy processes in this system 15
3.4 Future needs for foresight 19

4 Research and innovation council system in Finland 20

4.1 Introduction 20
4.2 Description of research and innovation councils and similar systems 21
4.3 The current use of foresight and similar strategy processes in this system 23
4.4 Future needs for foresight 24

5 Research and innovation council system in Iceland 24

5.1 Introduction 24
5.2 The Organisation of Science and Technology Policy in Iceland 26
5.3 Governance of the innovation system of Iceland 28
5.4 Policy making and evaluation practices 30
5.5 The current use of foresight and similar strategy processes 31
5.6 Future needs for foresight in the Icelandic Research Council System 32

6 Research and innovation council system in Norway 34

6.1 Introduction 34
6.2 Description of research and innovation councils and similar systems 34
6.3 Appraising progress of policy implementation 37
6.4 Current use of foresight and similar strategy processes 39
6.5 Future need of the Norwegian Research Council System 40

7 Research and innovation council system in Sweden 43

7.1 Introduction 43
7.2 Description of research and innovation councils and similar systems 43
7.3 The current use of foresight and similar strategy processes in this system 46
7.4 Future needs for foresight 47

8 Research and innovation council system at Nordic level 48

8.1 The organisation on the Nordic level 48
8.2 The use and need of foresight on the Nordic level 49

9 Overview and conclusions 50

9.1 Overview of Nordic research and innovation councils 50
9.2 The use of foresight and similar approaches 57
9.3 Future needs for Foresight in research and councils 58

10 Appendices 60

Introduction

National research and innovation councils are potentially important 'customers' of foresight projects and programmes. Research and innovation councils often channel money to new and important emerging research areas and topics. Through this, they contribute to changes and development of new directions for research institutions and for the research community in general. The strategies of research councils can thus have a central role in the broader strategies and developments of science and research systems. Research councils have another cadence than universities. By being a second string of research funding in addition to the basic funding of universities and other government labs, the research councils contribute to competition within the research system. The competition is not only between institutions, but also between individual researchers, research areas and approaches. At the same time, research councils and national research programmes are important arenas for coordination and formulation of common views between researchers and institutions.

Research councils account for a smaller amount of the total research funding compared to governments' direct funding if universities and research institutions and in some countries also compared to the funding from private sources. A recent Nordic study has compiled statistics for five Nordic countries. As can be seen from table 1 research councils account for a sizeable part of the total governmental expenditure on research – 25% in average (TemaNord, 2005). To that can be added expenditures on diverse targeted programmes and projects that accounts for 8% in average in the Nordic countries. In total a third of all governmental expenditures on R&D in the Nordic countries.

Country	Universities & higher education	Other research institutions (places)	Research councils and similar entities	Other projects and programmes	Foreign and international organisations	Total	Total in national currency (billions)
Denmark	51	15	12	17	5	100%	DKK 10.0
Finland	29	16	42	13	-	100%	EUR 1.6
Iceland	37	33	18	8	4	100%	ISK 9.2
Norway	42	10	30	11	6	100%	NOK 13.4
Sweden	43	38	18	-	1	100%	SEK 24.6
Total	41	23	25	8	2	100%	

Table 1. Government expenditures on R&D in the Nordic countries in 2005. Percent. Source: TemaNord, 2005.

The objective of this report is to describe national (and Nordic) research and innovation councils and similar systems and organisations in order to produce an updated account of the systems that can facilitate a meaningful exchange of information and viewpoints on foresight in this context. The description includes an analysis of cur-

rent use of foresight within the five national research and innovation council systems.

The report is the outcome of work package 3 of the Nordic Foresight Forum entitled "Mapping of Nordic national research and innovation council system and analysis of the needs for foresight and similar strategic intelligence". Nordic Innovation Centre co-funded the project. 60 man days were allocated to this part of the project.

Key questions and methods

In recent years, the national research and innovation council systems have in many countries been through significant changes. The changes reflect a number of development tendencies in the societal role and identity of science and research in general and in policy and governance of science and innovation more specifically.

The complexity of knowledge production has increased significantly in the recent decades (Gibbons et.al. 1994, Nowotny et.al. 2001)). The interaction and communication in science and innovation is now rather characterised by changing and heterogeneous networks than by distinct, individual scientific disciplines. There is an increasingly complex landscape of knowledge areas, disciplines and activity fields within innovation and science. It has become difficult, or maybe impossible, for the limited number of people there typically are in councils, advisory boards etc. to keep a full overview. Moreover, the councils face a need for a broader and more extensive communication with a larger set of actors in and around the research and innovation systems. Here foresight can have an important role.

In the same period of time, the strategic turn of science and knowledge production has been significant. Knowledge production has become the central economical driving force and a strategic resource of nations. Hence the notion knowledge society has occurred (Knorr-Cetina 1999 a.o.). In national policies, there has in many countries the last 15-20 years increasingly been focus on research and knowledge production. The area of science and research policy is built-up and a considerable institutionalisation of the field has taken place, e.g. by the creation of ministries of science in many countries. The present situation is a quite another than it was in the 1960s and 1970s when the research council systems were introduced (Aagard 2000, Guston 2000, Grønbæk 2001). Along with the strategic turn of science and knowledge production goes a general and thorough societal tendency of increasing change-orientation and focus on the future rather than on stability and the present. The future-orientation is stronger than earlier (Brown et.al. 2000).

Not least in the latest years, a tendency to increased business and industry-orientation of research and science has occurred. The techno-economical discourse for science and research has become stronger. At the same time, industry policy has to a higher extent become innovation policy, moving science policy and industry policy closer to each other. This is e.g. reflected in the so-called triple-helix model of the interaction between research, industry and governmental efforts (Etzkowitz, Henry & Loet Leydesdorff 1997). These developments can be seen as a part of the focus of the strategic-economical role of knowledge. Both the business and industry orientation and the build-up of science policy reflect that there is demand of some level of outside influence on problem definition, goal-setting and prioritization within research and science. More generally speaking, there is an increased relevance discussion in and around science and innovation. In this, a broader set of relevance criteria than earlier is employed, including general societal relevance and relevance for different societal groups and interest areas. Following the higher complexity and the claim of outside influence, the need for transparency and systematic approaches in the prioritizations of the councils is stronger.

Among the challenges currently facing the councils systems are also the developments in the over-national level in the governance of science and research and the increased international institutionalisation. Not least the developments of the European Union are currently important (Barré et.al. 1997, Meulen 2002, Borrás 2004). Most of the current challenges and tendencies facing the national research and innovation council systems can be interpreted as an indication of a need for visionary, strategic approaches like foresight. In some cases foresight is already used. In other cases, other similar strategy development approaches, e.g. visions processes, hearing processes, etc., are tried out and there seems to be a considerable degree of experimentation and search for ways of dealing with the current challenges.

Although, that strategy and foresight processes in research and innovation councils not in particular have been analysed in international literature a few Nordic (especially Finnish) studies have been reported. Salo and Salmenkaita (2002) have analysed embedded foresight in Finnish national electronics and telecommunication RTD programs. Salo, Gustafsson, Kaakkolammi and Gustafsson (2004) have analysed decision processes and participatory processes in national Finnish research programmes in climate change and mobile gaming. Salo and Liesiö (forthcoming) have studied the same in Scandinavian research programmes for forestry. Based on these studies the same group led by Ahti Salo has developed a methodology called "Robust Portfolio Modelling" for priority setting the RTD programs (Salo, Mild & Pentikäinen, 2006). In Denmark Dannemand Andersen and Borup (2006) have studied strategy processes in science councils and research programmes. An analysis of the Swedish science policy debate has among other issues also discussed priority setting (direction) in science and who are influencing this.

The analysis in this report of the national research council and innovation council systems includes:

- a mapping of the research council and innovation council systems and their the institutional set-up
- overall statistics of the funding function
- overview of foresight (or similar approaches) used by the systems
- overview of thoughts on the national research council and innovation council systems' future needs in relation to foresight and similar strategic intelligence.

Secondly, the above mentioned challenges and tendencies make it relevant to identify:

- What are the specific arguments for employing foresight (or similar approaches) by research councils?
- Which institutions/actors are involved in the foresight exercises?
- Subjects addressed by the foresights exercises?

The report is based on the following sources of information:

- Input from national Nordic research and innovation ministries or agencies prepared for the October 2005 meeting at the Nordic Foresight Forum.
- Desk studies of available literature, web-based material and personal information from key persons.
- Open ended interviews with key persons within the national and Nordic research and innovation council systems. A list of interviewed persons can be found in appendix.

Foresight, innovation and national science systems in the Nordic Countries

The rationale for carrying out public (be it on supra-national, national or regional level) foresight exercises relates to political goals of solving larger societal challenges. On of the most important challenges are to increasing national economical competitiveness by means like technological or societal innovation.

As national research and innovation councils by themselves create innovation, the concepts of national innovation systems (NIS), regional innovation systems (RIS) and sectorial innovation systems (SIS) are important in understanding how new technologies emerge and the forces that influence this process. Especially, in the Nordic countries there is a rich tradition for innovation studies focus on innovations systems and furthermore a tradition of policy making guided by such concepts. In this tradition an innovation system can be defined as "*the elements and relationships, which interact in the production, diffusion and use of new and economically useful knowledge*" (Lundvall, 1992). Furthermore, innovation policies have been suggested to underpin the innovation system through improving its ability to serve five primary functions (Johnson & Jacobsson, 2001):

1) To create and diffuse new knowledge;
2) To guide the direction of the search process among users and suppliers of technology, i.e. to influence the direction in which actors employ their resources;
3) To supply resources, including capital, competencies and other resources;
4) To create positive external economies through the exchange of information, knowledge and vision;
5) To facilitate the formation of markets

To guide the direction of search processes, to supply (and priority) resources and exchange (and create) visions and information are obvious rationales for foresight exercises. That is why foresight is said to be a policy tool for wiring up national innovation systems.

Hence, the "theoretical" rationale for foresight exercises is supported by the evolutionary perspective (or school) within economics. This is also in accordance with the general political discussion on governmental expenditures on research in most Nordic and European countries. To comply with EU's Lisbon target of allocating 1% of the GDP on governmental R&D most European counties needs to increase the expenditures until 2010. As can be seen from figure 1 the Nordic countries led by Sweden, Finland and Iceland are well situated for comply with this political ambition. The arguments for this political aim are more often related to prospects of increased (or just maintained) wealth in a globalized world than to a achieving a better understanding of nature and of mankind (another rationale for science).

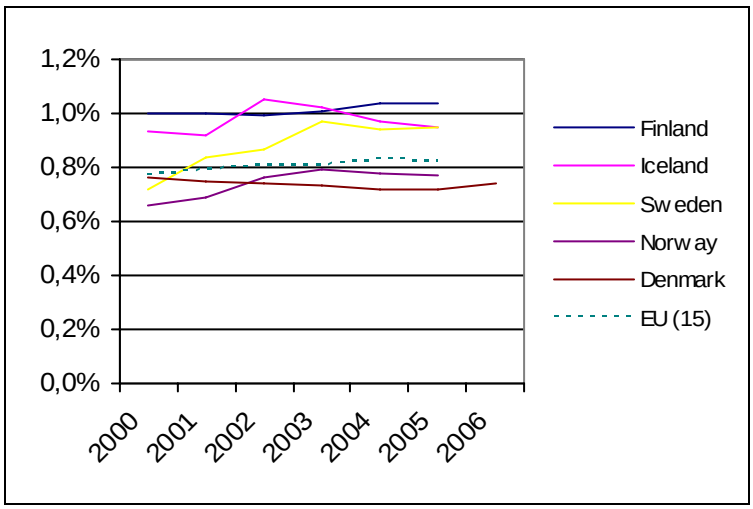


Figure 1 Governmental R&D expenditures as percentage of GDP in the Nordic countries 2000-2006. Source: CFA, 2006.

Because much of the national R&D efforts are related to the countries industrial and innovations structure differences can easily be detected which parts of the central administration that is most active in R&D. In fig. 2 are for the five Nordic countries depicted which ministry are the most important in National governmental R&D appropriations in 2005. As expected in all countries the Ministries of research are leading (deep green colour). The light green colour indicated the second most important ministries, and these vary from between the five countries: Finland: Trade and Industry; Iceland: Fisheries; Norway: Business and Trade; Sweden: Defence; and Denmark: Food, Agriculture and Fisheries. The right third of the bar represent other ministries.

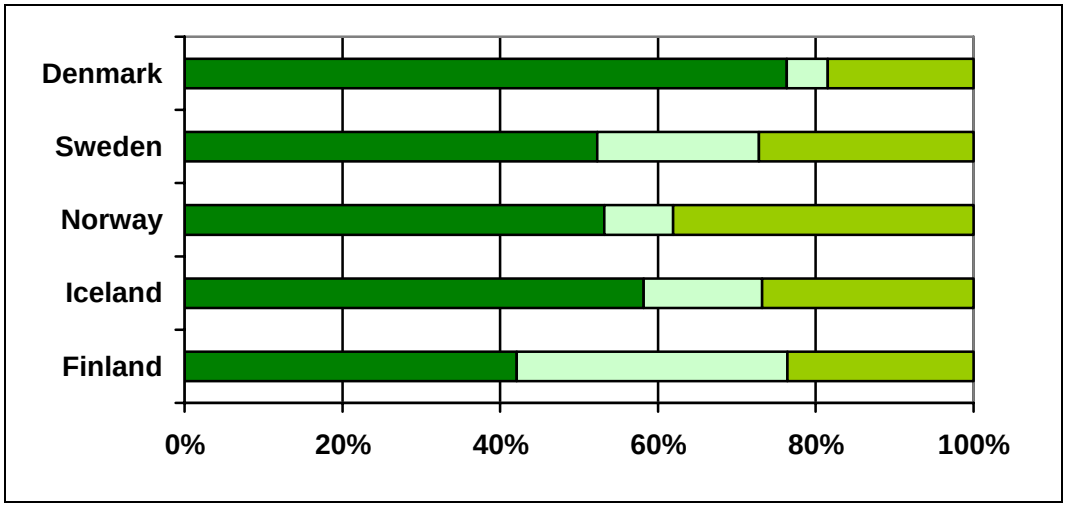


Figure 2 National governmental R&D appropriations by ministries, 2005: 1) Ministries of research, 2) Second-important ministries; and 3) Other ministries (CFA 2006). The second-important ministries are: Finland: Trade and Industry; Iceland: Fisheries; Norway: Business and Trade; Sweden: Defence; and Denmark: Food, Agriculture and Fisheries. Source: CFA, 2006.

The rationales and the objectives for foresight programmes are of course wider than just to decide on how to dole out public funding to R&D as indicated in the reference to Johnson & Jacobsson above. Based on their knowledge on and their understanding of evolutionary economics and national innovation systems Georghiou and Keenan (2006, p764) have listed a list of "common stated goals for foresight":

1) Exploring future opportunities so as to set priorities for investment in science and innovation activities.
2) Reorienting the science and innovation system. This goal is related to priority setting but goes further.
3) Demonstrating the vitality of the science and innovation system.
4) Bringing new actors into the strategic debate.
5) Building new networks and linkages across fields, sectors and markets or around problems.

Research and innovation council system in Denmark

Mads Borup, Risø National Laboratory

Introduction

The Danish system of research and innovation councils and national research programmes makes up an important and central element in the governance and support of Danish research and development activities. The system stands for around 20 percent of the financing of the Danish public research and development activities[1]. This can be seen from the two first columns of external expenditure in table 2. The sum of the two columns can be compared with the magnitude of the internally financing in the research institutions, universities etc. through their basic funds for R&D.

Table 2 'Internally' and 'externally' financed public sector R&D expenditure by scientific discipline, 2003 (per cent). Source: DRA 2006, building on R&D Statistics in the Higher Education and Government Sectors, 2003, The Danish Centre for Studies in Research and Research Policy (CFA).*

Internally financed R&D expenditure (pct.)		*Externally financed R&D expenditure (pct.)*								*Total R & D expenditure*
		Research councils	Other govt. funding[1]	Other public funding	Danish companies	Orgs. and foundations	Foreign companies	EU	Other int'l funding	(pct.)
Natural science	60	14	10	1	2	4	1	6	2	100
Technical science	61	9	12	1	4	3	1	5	3	100
Health science	52	7	9	4	4	16	2	3	2	100
Agricultural & veterinary science	56	9	22	1	1	8	0	3	1	100
Social science	73	6	12	3	1	2	0	3	1	100
Humanities, incl. psych./educa.	78	6	7	2	1	5	0	1	1	100
All scientific disciplines	62	9	11	2	2	7	1	4	2	100

1) Other public funding includes counties and local authorities.
*) For public institutions, a distinction is made between internal and external funding. Internal funding is the research institution's basic funds for conducting R&D activities. These funds are generally allocated without application. External funding includes funds from research councils and other public authorities, private companies and foundations, foreign sources, etc.

Around half of the 20 percent are managed by the research councils while the other half is managed by a number of other governmental institutions and research programmes. The research councils channel funding for around 1.2 billion DKK per year. This can be compared to the total private and public R&D expenditure shown in table 3.

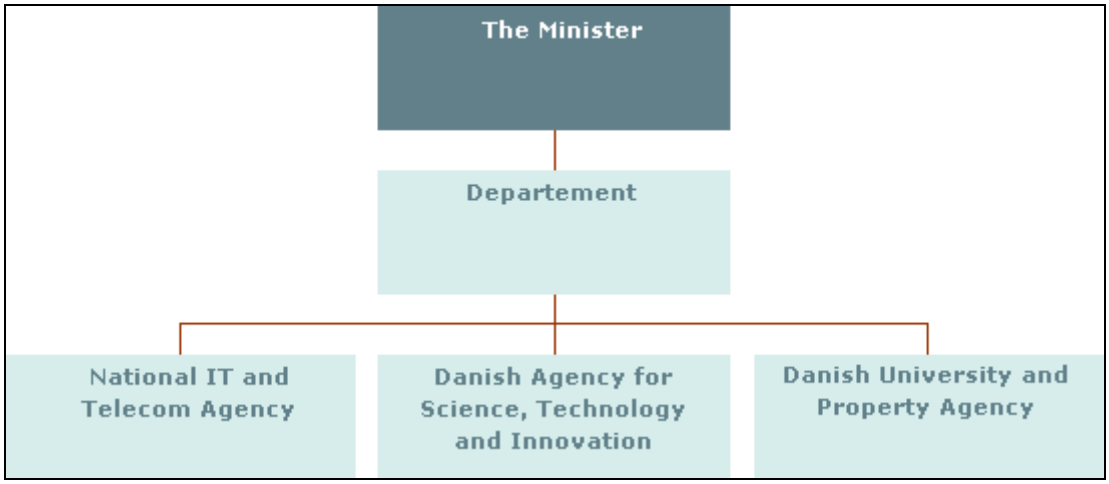
1 The figure varies considerably between scientific main areas, with humanities as the lowest at a level of 13 percent in 2003 and agricultural and veterinary science as the highest on more than 30 percent.

Table 3. Research and development expenditure in the public and private sector in Denmark (2003 figures). Source: DRA 2006

Sector	Expenditure in billion DKK	Percentage of total expenditure	Percentage of GDP
Private	25,6	70 %	1,84 %
Public	11,1	30 %	0,80 %
Total	36,7	100 %	2,64 %

As described above, the Ministry of Science, Technology and Innovation is by far the ministry that is most centrally involved in the national R&D governance, accounting for more than 75% of the R&D appropriations. By spring 2006 the Ministry of Science, Technology and Innovation was completely restructured. One of the major changes is the establishment of a new, large agency for research and development: Danish Agency for Science, Technology and Innovation (DASTI – or FIST in Danish). This agency brings together the former Research Agency with the ministry's innovation policy and research policy activities.

Figure 3. The new organisation structure of the Ministry of Science, Technology and Innovation (from www.videnskabsministeriet.dk, September 2006).



The agency for science, technology and innovation is organised in three centres plus the general management and administration. The centres, which are parallel units in the organisation, are as shown on Figure x the Centre for Independent Research and Ph.D. Education; the Centre for Innovation Policy; and the Centre for Research Policy. The research and innovation council system

Figure 4. Organisation of the Danish Agency for Science, Technology and Innovation, DASTI

Centre for Independent Research and Ph.D. Education	**Centre for Innovation Policy**	**Centre for Research Policy**

The research and innovation council system is going across the three centres with the research councils connected to the Centre for Research Policy and the Centre for Independent Research and some of the other units of the system connected to the Centre for Innovation Policy.

Though indisputably a considerable and significant change, the establishment of the Danish Agency for Science, Technology and Innovation is not a break with the existing policy concerning governance of research and innovation. Rather it can be seen as one step further in a longer lasting development tendency of increasing integration and institutionalisation of the research and innovation policies and of consolidation of the research ministry (the Ministry of Science, Technology and Innovation) as a ministry of central importance for the research and educational institutions as well as for business and industrial development.

The Danish research and innovation council system

Apart from the overall restructuring of the Ministry, also the Danish research funding and advisory system has recently been reformed. Significant renewal of the legislation was made in 2004. The system as of spring 2006 can be seen from figure 5.

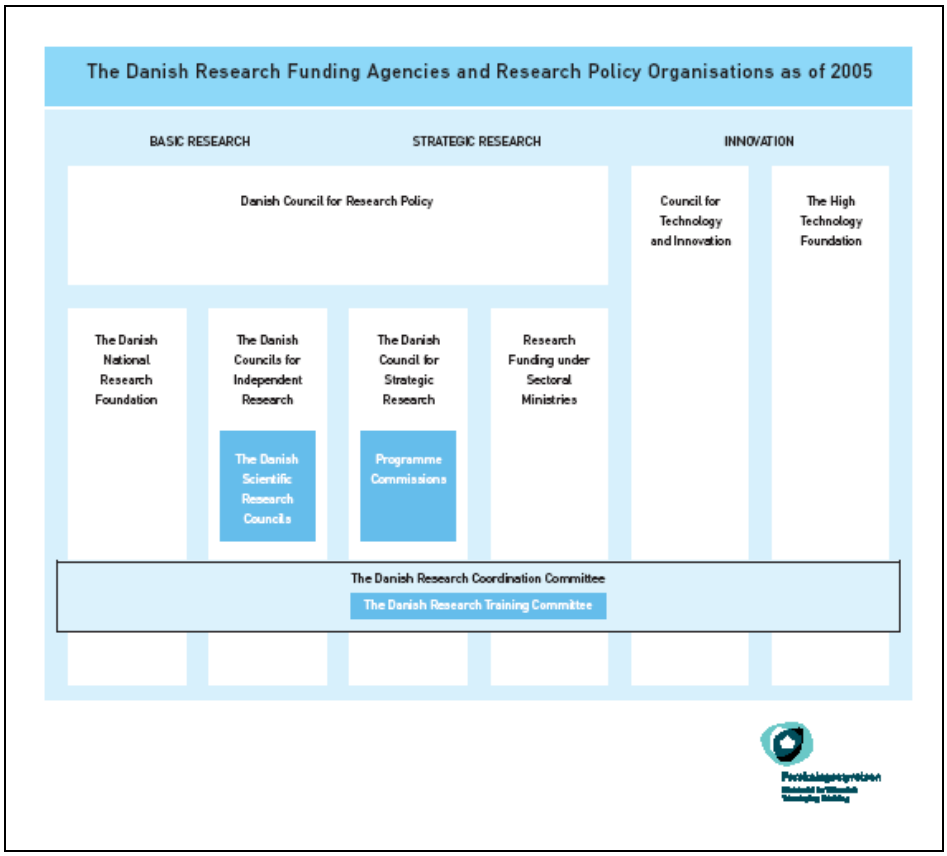


Figure 5. The Danish research funding agencies and research policy organisations as of 2005.

It is only the left part of the diagram in Fig. 5 that is explicitly defined as a council system by a common legislation. The three columns to the right are established more or less independently of the research council system and have each their legislation.

This means that there are some differences in the institutionalisation and legislation of the bodies on research and innovation that makes the research council system a more firm and well-established system than the innovation part.

The main advisory council, the Danish Council for Research Policy (*Danmarks Forskningspolitiske Råd*). The Council advises the Minister for Science, Technology and Innovation on matters concerning research policy. The Parliament and other ministers may also ask for the Council's advice. Advice may be given upon request or on the Council's own initiative. The tasks of the council include giving general advice on Danish and international research policy for the benefit of society including advice on: a) The framework of research, b) Appropriations for research, c) Major national and international research initiatives, d) development of national research strategies, f) Denmark's role and position in international research cooperation, g) Training and recruitment of researchers. In the context of this project especially task d) is of interest. The Council consists of 9 members all of whom must be recognised researchers and/or knowledgeable about research. The secretariat of the Council is based at the Danish Agency for Science, Technology and Innovation (DASTI) – an agency under the Ministry of Science, Technology and Innovation.

The funding part of the Danish research and innovations advisory system is divided into two subsystems consisting of four main bodies and the activities of these 4 bodies are coordinated by: The Danish Research Coordination Committee (Koordinations Udvalget for Forskning). The Danish Research Counselling system is accordingly driven either based on the so called "bottom-up" principle – the Danish Councils for Independent Research and the Danish National Research Foundation - or by top-down, politically prioritized subjects - the Danish Council for Strategic Research and the High Technology Foundation. The pie diagram in fig. 6 shows the share these different institutions have of the governmental research budget.

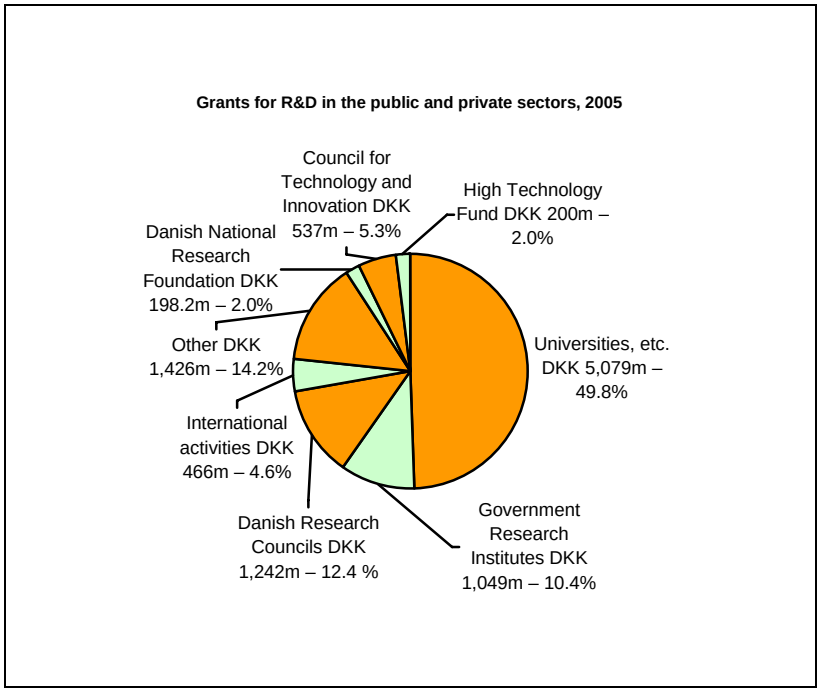


Figure 6. Grants for R%D in the public and private sectror 2005. Source: DRA 2006, Government Research Budget 2005. ("The Danish National Research Budget"). Government budget .appropriations and outlays for R&D (GBAORD), 2005, The Danish Centre for Studies in Research and Research Policy (CFA).

The Council for Independent Research (Det Frie Forskningsråd; www.fist.dk) is the umbrella for presently five research councils and will be supporting research projects based on the researchers' own research initiatives. It will also promote the wide range and quality of Danish research through open competitions based on independent assessment. In addition, the Council will be giving advice on research and technical subjects to applicants and other partners from all scientific domains. The Board of the Council is responsible for defining and putting together the research councils. It is also responsible for deciding the specific allocations of 'free research means' between the various councils. Recently the Council implemented a new structure of the research councils implying a reduction in the number of councils from six to five and a change of their boundaries. According to the Council the new boundaries better reflects the interdisciplinarity of modern research. The new councils are the:

- Research Council for Culture and Communication
- Research Council for Nature and Universe
- Research Council for Society and Trade
- Research Council for Health and Illness
- Research Council for Technology and Production

However, the new council-structure is in reality very similar to the one it replaced. Apart from the merger of two of the previous councils into one, it is more a matter of new labels than an actual change of boundaries. A more far-reaching and very radical restructuring of the council-structure has been proposed, but has not yet been implemented.

The other part of the bottom-up sub-system is the Danish National Research Foundation which is an independent foundation. The Foundation aims at strengthening Danish frontier basic research and the Foundation's primary strategy is to set up and fund Centres of Excellence. Since 1991, the Foundation has supported the Danish research environments with more than 3 billion DKK.

The other subsystem of the funding structure is made up of the Council for Strategic Research (Det strategiske forskningsråd; www.fist.dk) and the The High Technology Foundation which will support research based on politically defined programmes.

Apart from funding the Council for Strategic Research gives advice on research and technical subjects to applicants and others within its scope of activities. The Council has an obligation to contribute to an increased co-operation between public and private research. Furthermore, the Council shall evaluate applications regarding the individual ministries research appropriations. The Strategic Research Council consists of a Board and a limited number of programme committees. The board has a chairman and eight members. The chairman and the members are appointed by the Minister or Science, Technology and Innovation. To allocate the programme appropriations ad hoc committees are set up and the members of these programme committee are to be recognised researchers. To ensure 'societal relevance' of projects, applicants, to be eligible for funding, are to specify more immediate or direct success criteria of the project such as number of jobs created as a result of the project. Furthermore, a special following group with participation from the business sector will be attached to each project to ensure that the goals are achieved.

The other part of the top-down subsystem is the High Technology Foundation which supports research and innovation. However, it is a precondition for all initiatives taken by the Foundation to be based on public-private collaborations and have a special focus on either nanotechnology, biotechnology, ICT or the border-areas between these fields. The majority of the app. 30 million Euros, allocated by the foundation

this year, will be directed to large high technological initiatives, while a smaller proportion of the funds will be directed to initiatives including small and medium-sized companies. The foundation finances up to 50% of the expenses of the selected initiatives.

There are two objectives of the Council for Technology and Innovation. One is to give advice to the Minister of Science, Technology and Innovation about technology and innovation policy. The second is to administrate a number of initiatives initiated by the Minister concerning e.g. collaboration and diffusion of knowledge (innovation consortia; 'knowledge pilots'; high-tech networks; business Ph.D.s), entrepreneurship and commercialisation, regional development, and support for international collaboration about deployment of knowledge and technology. The R&D funding from the Council for Technology and Innovation was 537 million DKR in 2005.

A few private foundations make funds available for science and innovation. Among these are: the Carlsberg Foundation, the two Velux foundations (Villum Kann Rasmussen Fonden and Velux Fonden), and the RealDania Foundation. Also a number of private medicine and health oriented foundations exist. It is outside the scope of this report to collect data on these foundations funding activities, but as an example the two Velux Foundations in 2005 funded projects at a total of 127.7 M DKK.

The current use of foresight and similar strategy processes in this system

The use of foresight in the Danish research and innovation council system has until now primarily consisted in the Danish Technology Foresight programme. The programme was established as a unit in the Ministry of Science, Technology and Innovation in 2001. Originally it was given funds to carry out technological foresight activities during a three-year period, from 2001 to 2004. This period has been extended and by the beginning of 2006 five technology foresight projects have been completed while four are still in progress. The subjects of the nine technology foresight projects are listed in table 4.

Table 4. Technology foresight projects carried out by the Ministry of Science, Technology and Innovation.

- Biotechnology and Health Care
- Green Technologies
- Hygiene
- Nanotechnology
- Pervasive Computing
- Ageing Society 2030
- ICT – From Farm to Table
- Cognition and Robotics
- Mobile and wireless technology

As can be seen, the subjects of single the technology foresight projects are in most cases defined by technology area, more or less broadly defined. The exception to this

is the technology foresight on ageing society and to some extent also the hygiene technology foresight.

In the technological foresight programme, foresight is defined as systematic effort to look into the future through dialogue and analysis of potential opportunities within science, technology, society and economy. The point of departure is that there is not one, but many possible technological futures, which can be analyzed, debated and shaped by active, systematic and forward-looking thinking. It is seen as the purpose of technological foresights to inform decisions about where to allocate scarce resources, of both business and society, in order to have the greatest effect with respect to growth and welfare. Moreover it is seen as the purpose to strengthen dialogue between business and research communities and, more generally, to ensure that we already today prepare ourselves for tomorrows technological challenges. Technological foresight is understood as one of several inputs available to politicians and businesses when making decisions concerning investments in the future.

The technology foresight processes have been designed in different ways from project to project employing a number of different methods and process tools. Common features are the establishment of a steering committee with experienced people in the area in case and that a consultant group is hired to run the process in dialogue with the steering committee and the TF secretariat in the ministry.

Of the technology foresight projects carried out it is primarily the foresight on ageing society and the nanotechnology foresight that have explicitly been connected to the research and innovation council system. The foresight on ageing society was carried out directly in collaboration with the Council for Strategic Research, while the end result of the nanotechnology foresight was a description of a Danish action plan for research, education and innovation policy in the area of nanoscience and nanotechnology. The target group of the nanotechnology foresight is the Ministry of Science, Technology and Innovation and the research and innovation council system. Also, the three foresights: ICT – From farm to table, Cognition and Robotics and Mobile and Wireless Technology, have resulted a number of invitations to tender from the Council for Technology and Innovation – and targeted towards these areas of technology. Four regional ICT competence centres (on in each of the cities of Aalborg, Århus, Odense og Sønderborg) have been financed with a total of 23 million DKK: Centre for Embedded Software Systems (www.ciss.dk), Interactive Spaces, Healthcare Informatics and Software Development (www.isis.alexandra.dk), Knowledge Lab DK (www.knowledgelab.dk) and Center for Software Innovation (www.cfsi.dk).

Apart from this most units in the research council and innovation council system have not or only to a limited extent used the results of the technology foresight programme. The units are aware of the technology foresight activities but have not directly employed the results. With the new organisational structure of the ministry the unit working with the technology foresight projects is included in the Agency for Science, Technology and Innovation. Thereby it becomes an integrated part of the research and innovation council system.

Other similar strategic activities

Apart from the technology foresight programme a number of strategy activities similar to foresight are taking place in the Danish research council and innovation council system. Some of the significant activities are:

- Danish Council for Research Policy: Identification of core areas in Danish research
- The Council for Independent Research: Visionary Areas

- The Council for Strategic Research: Innovation-accelerating research platforms
- The Council for Technology and Innovation: Dialogue meetings and analysis based strategy discussion
- Committees under the Strategic Research Council: Coordination networks

The first mentioned activity is a large project going on for a year and involving more than 65 institutions. In most cases, however, the activities are smaller and of more limited in extent than the technology foresight activities. The amount of money spent on the activities is typically also smaller. The activities are not established as recurrent processes carried out frequently, say, every second year. In this sense they are more isolated activities carried out when there is a need for them. The analysis of core areas in Danish research is for example not expected to be carried out again in a similar format. On the other hand, it is not unlikely that the processes of identifying visionary areas in the Council for Independent Research or the process of defining innovation accelerating research platforms in the Council for Strategic Research will be re-initiated again within the next years.

The strategy activities mentioned are similar to foresight in the sense that they are set up as structured processes with the purpose of identifying and describing areas of special importance in a future-oriented perspective. Typically the identified areas will be considered as areas to prioritize in the policies on research and innovation or in the funding and support efforts of the council system.

In the following the character of the different strategy activities is briefly described. The contents of the project on identification of core areas in Danish research consisted in identification and description of 408 particularly promising areas judged on the basis of international calibre, research quality, external funding, industrial and societal relevance and volume. The project firstly consisted in self-evaluating input from research institutions and secondly in dialogue meetings and a hearing process running over 5 months. The project included development of a systematic tool for assessment of the quality and relevance of research (DCRP 2006a and 2006b).

Under the former legislation, the research councils now located under the Council for Independent Research should each develop strategy plans for five years periods. This is no longer an obligatory task. The Council for Independent Research has however carried out a process identifying and describing visionary areas for Danish research. Building on inputs from each of the five specific Councils for Independent Research, the Board of the Council for Independent Research selected eight visionary areas to be prioritised. In some cases, e.g. the Council for Society and Business, the visionary areas were identified on the basis of a public call and suggestions by a number of individual researchers and research groups. In other cases, e.g. the Council for Culture and Communication, the council members themselves described visionary areas. In the Action Plan 2006-2007 for the Danish Councils for Independent Research have in addition defined seven prioritised areas which are not defined as specific research areas are also defined:

- Continued high research quality, including assessment procedures and indicators of research quality.
- Sufficient numbers of researchers at all levels.
- Optimum financing of projects meriting funding.
- Expansion and renewal of the Danish research infrastructure.
- Strong Danish presence in European and international research.
- Simple procedures for preparing and processing research applications.
- Effective communication with all of DFF's target groups.

The Strategic Research Council has carried out a process of identifying what they call innovation-accelerating research platforms (IARP). The innovation-accelerating research platforms are areas of research that can constitute a basis for a long-term, strategic effort resulting in societal benefit. Among the quality requirements are that it should be areas with:

- a Danish strength position seen in international perspective;
- ambitious scientific perspectives;
- large potentials for new solutions;
- identified needs for new solutions;
- public interest; and
- possibility of integration, dialogue and collaboration between different actors.

The suggestions of IARP had format of a combination of a) a description of strategic visions for a research area; b) an expression of interest; and c) a preliminary indication of institutions interested in joining a partnership in the area. The 212 suggestions made came primarily from research institutions and companies but also from interest organisations and public authorities. Building on refinement and integration of some of the suggested platforms, the Strategic Research Council extracted 10 prioritized platforms for their research funding. Calls for applications referring to these platforms were made.

The Council for Technology and Innovation employs processes of dialogue meetings in their strategy development. The participants in the dialogue meetings are primarily managers of research institutions, of innovation-supporting institutions; of companies, and of public authorities. Also individual experts and other interested can participate. The meetings are one-day workshops with vision-building group dialogue as the central methodological element. The sessions can e.g. concern the need for innovations followed by a session on new initiatives and solutions to the needs (see www.innovationdanmark.nu). The dialogue meetings are combined with analysis-based strategy discussion internally in the Council. According to the annual report of the council, the analyses employed are different analyses of the Danish innovation system, e.g., “The participation of small and medium sized companies in the knowledge society”, “Commercialisation of public research”, “Systems of innovation and research in other countries – including the Finnish case” and “Knowledge-based service industry in Denmark” (CTI 2006, own translation).

The Strategic Research Council has in connection with some of their committees established in individual subject areas joined coordination networks with other Danish R&D funding programmes. This is for example the case in the energy area where the Programme Committee for Energy and Environment participates in a coordination network with among others the Energy Research Programme (managed by the Ministry of Transport and Energy) and the ‘PSO programme’ (managed by the larger institutions in the energy system). The coordination network holds meetings on a regular basis. On the meetings they coordinate and discuss the priority areas of each individual programme. Moreover the network group collaborate on the evaluation of the applications to the programmes.

In addition to the above mentioned activities comes strategy development processes in some of the research programmes run by different individual ministries. Apart from the Energy Research Programme, strategy processes are e.g. also carried out in the area of food research and the Directorate for Food, Fisheries and Agri Business in the Ministry of Food, Agriculture and Fisheries. Five-year strategy plans are

made. The Advisory Council for Food Research is a central unit in the development of the strategy plans. In development of the strategy the council takes departure in the development tendencies that influence the societal development of the food area and identifies the demands that the future consumers in Denmark and on the exports markets will make on their food products. Emphasis is put on improved welfare and sustainability and on finding solutions to the societal problems facing the food area in the future. The strategy plan is up-dated every second year with a report on challenges, needs and goals for the food research.

Future needs for foresight

From the analysis of the Danish research and innovation council system it can be concluded that there on a general level clearly is a need for foresight activities. A considerable number of the units in the system employ strategic and visionary analysis processes in their activities. Most of the units set-up specific processes or projects in support of the strategy development and for dialogue and interaction concerning definitions of important areas and priorities in research and technology initiatives. This is on many points similar to foresight. It is worth noting that even in the independent research councils, which by some actors are expected not to make strategy development any more, there appear a need for visionary and future-oriented activities like foresight that can contribute to the definition of areas of importance and support the prioritisation between different opportunities.

The conclusion about a general need for foresight is supported by the interviews made. Most of the respondents indicate that activities like foresight are useful. Moreover, they indicate that they expect to develop their strategic and visionary activities and become somehow more sophisticated in their approaches to this. Hence it must be expected that the need of foresight will also exist in the coming years and maybe even increase.

Despite the general indications of that foresight is useful, most of the units have as mentioned not or only to a limited extent used the results of the Danish technology foresight programme.

The exception to the general conclusion that all the units in the research council and innovation system indicate a need for foresight is the National Research Foundation. They see foresight as something they should stay clear of. The understanding is that the role of the National Research Foundation is complementary to foresight, and not overlapping, as basic science is equal to non-strategic science. The international peer reviewing system and the ambitious and visionary perspective that shall be included in the applications made to the foundation constitute the central strategic element for the funding by the foundation. In addition to this come the coordination nationally through the Coordination Committee and, internationally, the coordination with institutions like European Science Foundation, National Science Foundation (USA), the Chinese science foundation, and the Framework Programmes of the European Union.

The identified need for foresight can be more specifically defined: Most respondents express it as a need for improved and broader communication in the strategy processes. Dialogue with a larger number of actors and a larger number of expertise areas than those directly represented in the units is pointed out as the important advantages. Thereby the strategies can build on a broader and better basis. At the same time, relevant external actors become aware of the strategy developments.

Prioritization directly of funding decisions is usually not seen as a task for foresight. Foresight is rather considered as something that can constitute part of the background for making prioritizations.

The future orientation is important. The very long-term time perspective, however, and the detailed analysis that is carried out in some foresight exercises concerning when what will happen 30, 40 or more years ahead, are aspects that there is not indicated any need of. In this sense, it is acknowledged in the research and innovation council system that science, research and innovation are uncertain activities that cannot be predicted and forecasted in this way.

Though most units addressed in the analysis in general express a need for foresight it cannot be concluded that the different units can all use the same foresight exercises. The units have more or less diverse areas of work and different roles to fulfil. This means that the subjects for the foresight exercises each of the units might think of are diverse. It can be hard to identify a common subject and a common approach for a foresight exercise. The Danish system is constituted in a way where the variety between the institutional units is part of the basic working principle. This influences the opportunities for foresight activities.

If one should draw the conclusions a bit further, this might suggest that central foresight exercises common to the full Danish research and innovation council system cannot produce binding strategies and prioritizations for the different unit in the system, but 'only' recommendations and inspiring suggestions. An organisational location between the units of the system instead of closely connected to one unit might be an advantage.

Research and innovation council system in Finland

By Thomas Malmér

Introduction

The funding for R & D in Finland corresponds to about 3.5 % of GDP. The Business sector stands for about 70 % of the investments in R&D. The public funding for R&D was in 2004 1.03 % of GDP, which is the highest among the EU-countries. Finland is often looked at as a forerunner in the field of innovation policy. The country is also working hard to find best practices from other countries. There is a well-developed cooperation between many actors as the government and the business sector. There is also cooperation between the largest financing bodies TEKES, SITRA, The Academy of Finland and VTT. The Science and Technology Policy council of Finland formulates the national science, technology and innovation policies. The Prime Minister chairs this council and representatives from the industry participate in the council as well as other ministers. This high level council gives priority to the R & D issues and stability in the innovation system.

The public funding has as a goal to match the funding by the business sector (40% government / 60% business). Today the business sector stands for about 70 % of the investments into R & D. Both the Ministry of education and research and the Ministry of industry work with research funding. Of the public funding today, Today 35 % goes to basic research and 65 % to applied research.

Finland does evaluations of their research investments and the research system as a whole. The academy of Finland has every three years evaluated the system and TEKES has a special unit for impact analysis.

Description of research and innovation councils and similar systems

The Governments budget for R & D for 2006 has from the previous year increased with about 5 % to € 1.7 billion. This budget is distributed to these organisations:

Table 5. Budgets of R&D funding organizations in Finland 2006. Source: www.research.fi.

Institution	R & D funding (million €)	Share of R & D funding (%)
Universities	427,5	25,4
Academy of Finland	257,4	15,3
TEKES	478,2	28,5
State research institutes	272,6	16,2
University central hospitals	48,7	2,9
Other research funding	195,6	11,6
Total	1680 M€	100 %

TEKES is an agency under the Ministry of Science and Technology. The annual budget is about 480 mil. € and TEKES mainly funds applied research. The funding is intended for challenging and innovative projects, with the goal that some of them hopefully lead to global success stories. About half the funding goes to all kinds of research while the other half goes to research within strategic areas where TEKES has programs.

TEKES funding may also be a low-interest loan or a grant, depending on the stage of the innovation and the nature of the proposed project. Financing can also be given to foreign entities registered in Finland. Foreign-owned companies with R&D activities in Finland are not required to have a Finnish partner to be eligible for funding. The financed activities should contribute to the national economy of Finland. TEKES offers companies grants, capital loans and industrial loans and funding is given within the following tree areas:

- Industrial R&D grants run from 15 to 50 percent of the eligible costs.
- Capital R&D loans run from 35 to 60 percent of the eligible costs.
- Industrial R&D loans run from 45 to 70 percent of the eligible costs.

Differing funding measures can be combined in a single project. One project may, for example, receive a grant of 15 percent of the eligible costs, and in addition, a loan of 45 percent.

Research institutes and universities can apply for research grants that can range from 50 percent to 100 percent of eligible costs. These projects are usually conducted in cooperation with companies.

The Academy of Finland is an organisation for research funding that operates under the administration of the Ministry of Education. The budget is about 260 M€ and the

focus is on basic research. The mission is “to promote high-quality scientific research by means of long-term funding based on scientific quality and by means of reliable evaluation, science policy expertise and extensive international cooperation”.

The Academy's organisation consists of the Academy Board, four Research Councils and the Administrative Office. The four councils are for Biosciences and Environment, Culture and Society, Health and for Natural Sciences and Engineering. The Council of State appoints the board and the member of the councils for a three-year term.

SITRA, the Finnish national fund for research and development, is a public foundation under the Finnish parliament. The foundation is independent and the task is to promote economic growth and future success of Finland trough international competitiveness and development of international cooperation. SITRA’s operations can be divided into to two parts, research and education/collaboration and venture capital funding. The methods SITRA works with include research, strategy processes, innovative experiments, business development and investing in internationalisation. The first part consists of a number of focus areas which can vary in time and scale At the moment six major programmes are running; innovation, health care, food and nutrition, Environmental technology, Russia and India. An overall goal with the projects is to take Finland up to the lead in high tech areas and also to improve the Finnish innovation system with SITRA as a driving actor. SITRA was one of the first actors in the field of venture capital in Finland. Today the foundation is focusing it´s New venture capital investments to the programme areas. The aim of the investments in early stages is to create and develop competitive and profitable business. At the moment special focus is given on the health, food and nutrition and environment programme.

SITRA has about 90 employees and former prime minister Esko Aho is president of SITRA. Activities are financed trough endowment capital and from return of investments.

The Science and Technology Policy Council is responsible for the strategic development and coordination of Finnish science and technology policy as well as of the national innovation system as a whole. The Council The membership consists of seven other Ministers besides the Prime Minister who is the chairman, and ten other members well versed in science and technology. Other members of the council are representatives of the Academy of Finland, TEKES, universities and industry as well as employers' and employees' organisations. The Council has the following tasks:

- To direct S&T policy and make it nationally compatible and to prepare relevant plans and proposals for the Council of State.
- To deal with the overall development of scientific research and education, to prepare relevant plans and reviews for the Council of State, and to follow up the development and the need of research in the various fields.
- To deal with, follow up and assess measures taken to develop and apply technology, and to prevent or solve eventual problems involved in this.
- To deal with important issues relating to Finland's participation in international scientific and technological co-operation.
- To issue statements on the allocation of public science and technology funds to the various ministries, and on the allocation of these funds to the various fields.

- To handle the most important legislative matters pertaining to the organisation and prerequisites of research and the promotion and implementation of technology.

- To take initiative and make proposals in matters under its competence for the Council of State and its ministries.

The Committee for the Future is one of 15 standing committees in the Finnish parliament. Its task is to have an active dialogue with the government about major future challenges and means of solving them. The committee has also a policy making role about the future ere research is an important part. One special task is to follow and use the result of futures research. The committee also works with issues like internationalisation and the impact on the society due to technological development. The current committee formed after the election 2003, work with 5 major areas;

- The Future of the Finnish Information Society
- The Future of Public Health Care,
- Human Security as an Extensive Long-term Phenomenon
- Regional Innovation Systems
- Social Capital in View of Future Risks for Children and Young People.

The current use of foresight and similar strategy processes in this system

The Academy of Finland and TEKES have recently completed the project FinnSight 2015. The goal with the foresight was to identify important joint future areas of expertise for science, technology, business and society with the help of ten expert panels. The project examined changes in the global operating environment, emerging needs of business and society, and development perspectives in science and technology. This can be seen as a joint effort in supporting the priority setting of basic and applied research. The results from the foresight were presented in June 2006.

TEKES makes a technology strategy process every third to fifth year where the goal is to find focus areas for TEKES funding. Focus areas can be defined by technology, by application and/or by cluster. The strategy is implemented in close cooperation with other stakeholders. About 50% of TEKES funding goes according to these focus area settings and the other 50% reactively.

Also SITRA has recently carried out the first round of its national foresight network exercise. The aim of this foresight work is to recognise the changing trends to which decision-makers should already pay serious attention. The five topic areas included welfare and everyday living, work life, public sector, multiculturalism, and environmental technology. The first results were published in August 2006 (www.sitra.fi).

The Employment and Economic Development Centres (TE-Centres) have played an active role in regional foresight. Foresight studies of specific topics have also been carried out in collaborative work undertaken by sectoral research institutes, academic researchers and private consultants, typically supported by the National Technology Agency.

Finland has earlier run some broad scope foresights exercises. The foresight project "On the Road to Technology Vision" was initiated by the Ministry of Trade and Industry and it was carried out in cooperation with TEKES in 1996-97 in form of eight expert panels.

In addition, a number of foresight studies have been carried out under the auspices of the Ministry of Labour and the Ministry of Education, often co-financed by European Structural Funds. The Finnish National Board of Education also administrates a foresight data base and Internet-based foresight knowledge service (ENSTI) with the focus on future education and labour demand. The broad-scope future outlooks and the more focused future-oriented technology assessments of the Committee for the Future of the Finnish Parliament play, in turn, an important role in raising the awareness and the level of knowledge of the Members of the Parliament (www.eduskunta.fi). The Committee for the Future also prepares Parliament's response to Government's Report on Future during each electoral period.

Future needs for foresight

The overview of the Finnish actors in the innovation system shows that many of the organisations work with foresights, one way or the other. According to Finnish Foresight Forum, in most foresight exercises the purpose seems to be "to create and maintain a reliable picture about the probable technological and societal trends, the developments of world and national economies, the values of people, environmental issues, and many other relevant topics. The purpose with the Foresights can be to initiate discussions about the future, try to find priorities for the future or to make roadmaps for the future in certain areas.

So are the results for foresights used in the strategy work within the organisation in the Finnish innovation system? It is always very hard to draw strong conclusions and prove that the foresights have had a clear impact on strategies etc. But most actors mention foresights as a positive way to discuss the future and that since they exist, the foresights do influence the future strategies.

The future perspective is more and more important when the world is becoming more open to competition and international trade. Finland differs in one way from other Nordic countries by having a very tight cooperation between the actors in the innovation system. They cooperate in the areas of foresights, strategies and defining priorities for the future. Therefore they also seem to know quite well what other actors are doing and if any foresights are being made. Finland is a forerunner in the field of innovation policy and foresights seem to be a part in their strategy process. Finland does not seem to need more foresights then they are doing today. Instead, a better coordination between the various foresight exercises, improved methodologies and formal tools, as well as more conscious and transparent utilisation of foresight knowledge would be welcome.

Research and innovation council system in Iceland

Introduction

R&D performance has improved considerably in Iceland over the past decade. While in absolute terms Iceland retains the lowest level of R&D spending in the OECD area, with total R&D expenditures (gross expenditure on R&D or GERD) of USD 254 million,[4] its relative level of spending is one of the largest in the OECD, at approximately 3% of GDP. This differs dramatically from the situation as recently as in 1995, when R&D intensity in Iceland, at 1.6% of GDP, was significantly below OECD and EU averages. The change reflects the fact that since 1995, GERD has expanded at one of the fastest rates in the OECD over the past decade, rising at more than 12% annually, compared to a rate of 3.6% for the OECD as a whole.[5] Approximately half of Iceland's R&D is performed by the business sector, one-quarter by

government research institutions, and one fifth by universities. *Increased funding for R&D* Public spending on R&D is an important element of Iceland's overall R&D situation. Although absolute funding levels are low compared to other OECD countries, Iceland has the highest level of government-funded R&D in the OECD when measured as a share of GDP. Government R&D funding reached 1.2% of GDP in 2003, up from 0.9% in 1995 (Table 1). Since 1995, government funding for R&D has increased at a rate of 7.2% annually. This stands in contrast to most countries where public funding was already high (as a share of GDP) in 1995, in which government financing of R&D increased less rapidly than GDP growth. In recent decades, a marked shift can be seen in government R&D support, from applied research related to natural resources towards basic research, industrial technologies and, in particular, towards biomedical and health and biotechnology related research and development. Industry-financed R&D has also increased rapidly in recent years, accounting for much of Iceland's overall growth in R&D. From a level of less than 0.6% of GDP in 1995, industry-financed R&D increased to 1.4% of GDP in 2001, before declining to 1.3% of GDP in 2003. These levels are far above the EU average of just under 1% of GDP and roughly equivalent to the OECD average, which stood at 1.4% of GDP in 2003. Industry financing accounted for about 44% of Iceland's total R&D expenditure in 2003 (ISK 10.5 billion or USD 111 million).

Table 6. R&D expenditures by source of funding.

	1995	1997	1999	2001	2003
GERD (PPP per capita)	347	466	646	900	873
OECD GERD (PPP per capita)	495	553	612	691	730
Government-financed GERD (% GDP)	0.91	0.96	0.98	1.05	1.19
Industry-financed GERD (% GDP)	0.55	0.79	1.04	1.42	1.31
GOVERD (% GDP)	0.59	0.56	0.72	0.62	0.74
HERD (% GDP)	0.43	0.54	0.50	0.58	0.63
BERD (% GDP)	0.50	0.77	1.11	1.81	1.54
OECD BERD (% GDP)	1.39	1.45	1.51	1.57	1.53

Source: OECD, MSTI database, November 2005.

Iceland has experienced marked improvements in its economic and innovative performance over the last decade. Per capita income was approximately 20% higher than the OECD average in 2003, up from 10% higher in 1995, and economic growth rates are expected to remain high in coming years. R&D spending has also increased significantly, rising from about 1.6% to about 3% of GDP during the same time period, as both government and industry invested more in R&D. Absolute spending levels are low because of the small size of the economy, but government funding of R&D exceeds that of all other OECD countries in relative terms, standing at almost 1.2% of GDP in 2003. Industry spending on R&D has grown rapidly, increasing from 0.6% to 1.3% of GDP between 1995 and 2003, and is on-par with the OECD average, exceeding the EU average by a wide margin.

With this expanding R&D capacity have come changes in the governance of Iceland's innovation system and in the priorities established for its innovation policy. Under the new Science and Technology Policy Council (STPC), which was established in 2003 to improve government-wide co-ordination of science and technology policy and inform policy making, emphasis has been placed on improving the efficiency of the Icelandic innovation system. The innovation policy objectives promulgated by the STPC aim to strengthen university-based research, restructure the pub-

lic research institutes, improve support to business innovation and entrepreneurship, and enhance science and technology education.

The Organisation of Science and Technology Policy in Iceland

The legislation on the organisation of science and technology policy and public funding of research and technological development in Iceland was enacted by the Althing in 2003. The legislation is composed of three separate laws.

- Law (2/2003) on the Science and Technology Policy Council - under the Office of the Prime Minister
- Law (3/2003) on Public Support to Scientific Research - under the Ministry of Education, Science and Culture
- Law (4/2003) on Public Support to Technology Development and Innovation in the Economy - under the Ministry of Industry and Commerce

The Science and Technology Policy Council (SPTC) is headed by the Prime Minister of Iceland. Three other ministers have a permanent seat on the Council: The Minister of Education and Science, the Minister of Industry and Commerce and the Minister of Finance. At the discretion of the Prime Minister, two other ministers with research in their portfolio may join the Council. Currently these are the Minister of Fisheries and the Minister of Agriculture. Fourteen other members are appointed to the Council upon nominations by the Ministers with research portfolio (6 nominations), parties to the Employers Association and Employees Union (4 nominations) and by the coordinating committee of higher education institutions (4 nominations). The Minister of Education and Science appoints nine of the non- ministerial members to the Science Committee and the Minister of Industry appoints an equal number to the Technology Committee. The mutual overlapping membership on the committees contributes to coordination between science, technology and innovation in the policy making process. The objective of the STPC is to strengthen scientific research, scientific training and technology development in the country in support of Icelandic cultural development and to increase economic competitiveness. The STPC issues declarations for public policy on science and technology. The policy declarations are prepared by the Science Committee and the Technology Committee respectively. The composition of the STPC Council brings STP issues to the highest political level.

The Research Fund was established through fusion of the previous Science Fund and the Technology Fund. The Research Fund is governed by a board, whose chairman also chairs the Science Committee. Linked to the same board is also the Equipment Fund. Similarly the Law on the public support to technology development and innovation established a Technology Development Fund. Thus link a between policy and implementation through funding is provided. This law also established the Innovation Center (IMPRA), operationally linked to Icelandic Technology Institute.
The Ministry of Education Science and Culture and the Ministry of Industry and Commerce provide support for the two respective committees in preparing policy documents. Overall co-ordination is provided by the Science Office including a secretary to the STPC placed at the Ministry of Education Science and Culture.

RANNÍS (The Icelandic Center for Research), reporting to the Ministry of Education, Science and Culture, provides operational support to the committees and funding bodies, to manage the international connections, monitor the effects and impacts of policies and to provide intelligence and informed advice to the STPC and its boards and sub-committees, as requested. Thus RANNÍS administers the Research Fund, the Technology Development fund, the Instrument Fund, the Graduate Training Fund and other funds for science that the government may want to assign to it. It maintains the National Contact Point Coordination and support network to the EU

Framework Program, the Nordic NOS - organizations and membership to several other international bodies in science and technology co-operation.

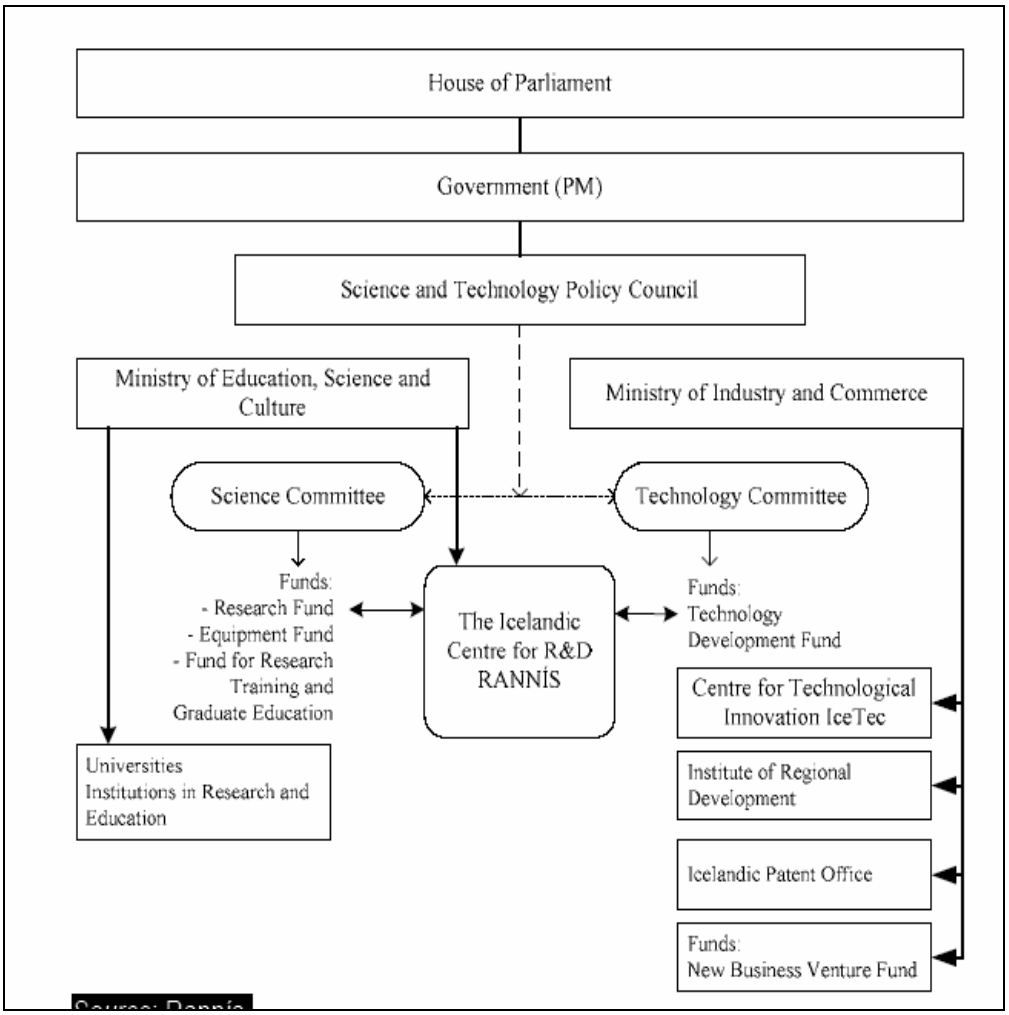


Figure 7.Structure of the Icelandic science and innovation governance system.

RANNIS, the Icelandic Centre for Research, is established by a legislation enacted in 2003 and replaces the office of the earlier Icelandic Research Council established by legislation in 1994. This in turn replaced earlier councils that trace their origins to a research council structure set up before the Second World War. The Icelandic Research Council was abolished by the legislation in 2003, and the Science and Technology Policy Council was established. The Council has 14 members representing the science and technology community and the social partners plus five ministers and is chaired by the Prime Minister.

RANNÍS reports to the Ministry of Education, Science and Culture and its mission is to provide professional assistance to the preparation and implementation of science and technology policy in Iceland.

The main functions of RANNÍS are the following:

- RANNÍS operates the competitive financial public support system for research and technological development This includes the Research Fund, the Fund for Research Equipment and the Graduate Education Fund under the Ministry of Education, and the Technology Development Fund under the

Ministry of Industry. Each of the funds is governed by a Board of Directors, the allocation of grants being subject to extensive peer review processes.

- RANNÍS is actively providing the Science and Technology Policy Council and its subcommittees with information on scientific research and technology development nationally and internationally as a basis for the policy making process.
- RANNÍS coordinates and promotes Icelandic participation in international cooperation in science and technology and interacts with corresponding agencies and research councils in other countries. RANNÍS is the NCP-host organization for 6FP.
- RANNÍS monitors the resource allocation and performance of R&D, evaluates the results of scientific research, technical development and innovation, and participates in international benchmarking of the results.
- RANNÍS promotes public awareness of research and innovation in Iceland.

RANNÍS serves the Icelandic science community across all fields of science and humanities. The staff of RANNÍS is a team of 18, including 12 professionals, led by a Director. RANNÍS relies heavily on the involvement of external contacts in its operation. Around 70–80 working scientists and technical experts are co-opted to assist in the evaluation of grants applications and international contacts at any time on a rotating basis.

RANNÍS runs its internal operation on an annual budget of about 1.9 MEUR, of which about 1.2 MEUR is allocated from the state budget and the rest emanates from service fees and contracts. In addition the main competitive funds operated by Rannis have the following EUR equivalent annual budgets (2004):

- Research Fund: 6.4 MEUR
- Fund for Research Equipment 1.4 MEUR
- Technology Development Fund: 4.4 MEUR
- Graduate Education Fund: 0.7 MEUR
- Program for Nanotechnology and Postgenomics (2005-2009) 1.2 MEUR

RANNÍS thus handles a total turnover of around 14 MEUR a year.

Except for the Program for Nanotechnology and Postgenomics (2005-2009), the competitive funds operated by RANNÍS operate horizontally across all fields of Science, Humanities and Technology, reaching from basic research to technological development and innovation, partly supporting infrastructure. The share of funds allocated to projects related to specific fields and disciplines will thus vary from year to year.

Governance of the innovation system of Iceland

Iceland has taken positive steps to improve the governance of its science, technology and innovation system through the establishment of the STPC. The STPC seems to have greatly improved the spirit of cooperation among ministries and has achieved considerable success in formulating consistent policy and raising the level of discussion of key science and technology policy issues. The culture of discussion and information sharing that has emerged has facilitated decision-making across the innovation system and should be encouraged. At the same time, there are several interrelated issues that could be addressed to further strengthen the co-ordination of government policy and the solicitation of expert advice.

The first relates to the composition of the STPC itself. There appear to be opportunities to broaden participation in the STPC to include a more complete set of ministries

that play (or could play) an important role in R&D and innovation. Furthermore, as Iceland continues to develop knowledge-intensive industries and to harness scientific and technological advances to the benefit of more traditional industries, increased involvement of business leaders will be needed in multiple stages of the policy making and implementation process. Although representatives of the industry are included on the STPC (business and labour have a combined total of four seats), the Federation of Icelandic Industry and Employers Association has sought greater participation on STPC. Such participation can help better align research to industrial needs and ensure that business is prepared to take up research results. Further advantages could be achieved by increasing industrial participation on the boards of directors of other research institutes, as is common in some other OECD countries, such as Finland. A second issue relates to the mission of the STPC. Not all participants appear to be clear about the role, mission and authority of the STPC, and some important issues are not covered by STPC. For example, several institutional mergers were implemented without discussion in STPC because they involved institutions under the authority of individual ministries. Discussion of such issues within the STPC appears to remain voluntary, which contrasts with practices in countries such as Finland and Belgium (Flanders) where a stronger obligation exists to discuss important science, technology and innovation policy issues at the inter-ministerial level.

Part of the difficulty may result from the hybrid structure of the STPC. The STPC combines two functions: one of co-ordinating policy across government ministries, and one of providing expert advice to government officials. These two tasks are handled separately in some OECD countries. Ireland, for example, established a co-ordinating committee to improve inter-Ministerial communication and a separate Advisory Science Council to provide independent advice, including guidance for setting government priorities (Box 4). The United States also operates with separate co-ordination and advisory bodies.[21] That said, a number of countries (including Finland) continue to use hybrid structures similar to Iceland's, and governance structures across the OECD remain highly varied and idiosyncratic (OECD, 2005d). The key is ensuring that instruments exist for improving co-ordination and soliciting expert advice.

Based on the previous discussion the strengths and weaknesses of the Icelandic innovation system can be summarized as in table 7.

Strengths	Weaknesses
Science base	
Above-average performance in R&D expenditure as a share of GDP	Limited financial resources in absolute terms (size limitation)
Positive evolution of research quality (and international visibility)	Limited critical mass and fragmentation of institutes and funding, leading to a limited overall research capacity
Increasing levels of international scientific publications and patents (high international appreciation)	Lack of a systematic approach for identifying future opportunities (prioritisation); *e.g.* foresight studies
Growing expenditures for public sector R&D, in particular in higher education institutions	
Business R&D and innovation	
Innovation performance well above the EU and OECD means for most indicators; Iceland is strongly moving ahead (EIS, 2004)	Fragmentation of Icelandic industry due to small size and small home market
BERD has increased significantly over time	Almost 50% of business expenditure on R&D is accounted for by a single company
As a percent of GDP Iceland has substantial venture capital (early and expansion) compared to other countries	Public R&D remains high in comparison to other countries
Technological performance (measured by patents) is increasing	The majority of SMEs (<50 employers) does not innovate in-house
The majority of the larger companies (>50 employers) innovate in-house; further improvement is possible	The share of so-called strategic innovators is less than 5%
With respect to non-technical innovation Icelandic companies score high	Only 0.5% of innovators in the manufacturing sector judge higher education institutions to be of high importance as a source (for the service sector companies this is 4.8%)
Companies succeed in finding foreign partners for their R&D efforts (due to absence perhaps of local capacity)	Smaller companies do not regard higher education institutions as potential partners for innovation
• Growing share of educated workforce and population • Strong performance in life-long learning • Increase in the number of S&T graduates • Above OECD average spending on education as a percentage of GDP • Increase in the number of S&E graduates • Increase in personnel at Icelandic universities (bottleneck in the past in terms of research capacity)	• Low share of graduates and enrolments in science and engineering disciplines • Stable evolution in the enrolment of students in agriculture, food and services. • Limited number of PhD specialisations (but an increase over time)

Table 7. Summary of strengths and weaknesses in Iceland's innovation system.

Policy making and evaluation practices

Iceland's policy making process is still under refinement; the new STPC is becoming increasingly active in developing and rolling out a long term innovation strategy. The policy making process is to a large extent 'evidence' based, meaning that many policy actions are based on monitoring the evolution of different indicators (provided by international and national organisations); several of the different policy initiatives are based on or supported by the evolution in some of the main R&D statistics. However, policy making is also based on qualitative empirical findings. Further improvement as to the 'input' to the decision making process could take place, for example by defining a set of main innovation indicators that are periodically monitored, and also by deciding on how these indicators will be used in the policy making and evaluation process. It is the role of the STPC to indicate which indicators are judged as 'policy-relevant'. Iceland's national Statistics Office and RANNÍS provide a well-developed range of statistics and indicators which can be used intensively in policy making without basing the latter entirely on the evolution of indicators. A long term vision like the one presented by the STPC in 2003 is also needed as a steering mechanism. However, monitoring also remains essential.

With the introduction of the new policy council, innovation has become an inter-ministerial issue. It has also been made clear where the political responsibility for stimulating innovation rests. This is important in view of sufficient commitment to innovation favouring activities. The evidence suggest that policy actions are based on experiences and good practices observed elsewhere, as in the case of the organisation of the new STPC which is based on Finnish practice. Although some uncertainties in assessing the current operation of the STPC should be taken into account as the new system needs time to reach its full potential, there are several aspects that can already be pointed out.

The visibility of the STPC in its functioning and in its communication, nationally and internationally, can be increased. For example a website could be developed (as

intended) containing, among others, the latest initiatives, actions, and reports on innovation policy in Iceland. Although serious efforts have already been undertaken to inform the 'public' about innovation policy in Iceland (resolutions are available in English), there is still room for improvement. Although priority setting is involving many stakeholders, a clear 'window of opportunity' giving direction to future policy-decisions and making the decision-making process more objective, transparent and consistent still needs to be developed.

The value of 'foresight' as a tool for 'wiring-up' the innovation system and giving direction to all actors has been proven in practice. Despite the resolutions, which are a very important landmark indeed, a more concrete long-term plan (in terms of the 'content' of the STI policy) with concrete targets and evaluation steps should be developed soon.

The policy of the STPC of 'strengthening the research capacity' by cutting back the number of research institutes proves to be quite effective. A number of mergers between research institutes are in progress; some are already in the final stage of completion. The 'delivery' structures with respect to funding are well-developed. Competition in order to receive funding is stimulated. Although highlighted in the resolutions of the STPC, research evaluation is a recent phenomenon in Iceland. One of the first institutes that have been evaluated is the University of Iceland. Some questions have been raised about the objective of this evaluation, its findings, and its added value in terms of 'input' into the policy system. It is important to develop a specific line of action on 'evaluation' and to integrate it into all kinds of actions, such as programme funding, university funding etc. The first signs are positive: the information programme, which has been running for several years now, will be evaluated soon (ex-post) and evaluation is an integral part of a new research programme on "Nanotechnology and Post-genomic biomedicine" (see also innovation policy measures).
A recent evaluation of the Technology Fund as an instrument for supporting technical R&D and stimulating innovation has lead to the identification of a number of strengths and weaknesses in the way the funding is managed. Small grants are the major weakness; however, the ability to link up major actors through financial arrangements is one of the fund's most prominent strengths. A recent analysis of Icelandic research showed that the international presence of Icelandic scientists is rapidly increasing; moreover, the impact of Icelandic research as measured by citations in the peer reviewed literature is also increasing over time.

The Icelandic Research Institute (Rannís) also provides strategic information to the STPC. Moreover, officials from the institute are involved in many international studies on innovation and innovation policy. In view of this position and role, it would be useful to carefully observe the capacity and the compatibility of the tasks of Rannís today and to assess whether the organisation is able to fulfil the expected role to the STPC as far as innovation policy is concerned. In the absence of 'think tanks' on innovation policy, the expertise of Rannís in this field will be crucial to further development. Iceland is receptive to opinions expressed by international organisations and bodies like the OECD (Economic outlook), the EC (Eurostat, Innovation Scoreboards, and Competition Scoreboard), Nordic councils, etc. In the past several OECD evaluations have initiated a number of turnarounds in the economic and techno-scientific landscape in Iceland.

The current use of foresight and similar strategy processes

In a recently decided policy for the new Science and Technology council is stated that: "Foresight leads the way". The Council sees Iceland as a nation in front row with multinational appearance. Quality of life is a characteristic of Icelandic people

and health strong moral awareness and powerful and multiform industries are a fact. There are favourable conditions to perform research and development and knowledge will be utilized to any kind of innovation in industry and public sector. Funds will be spent on education, science, technological development and innovation and it will be returned as social and economical profit.

Compositeness and prosperity in times of globalisation is according to the councils view determined by the capacity to look forward and to identify scientific, technological and/or other opportunities and to exploit future strategic knowledge in a systematic manner. Globalisation does mean more competition but opens up new possibilities at the same time to create value based on good ideas and specialised knowledge, and as such to realise a competitive advantage. The key to success in the future are effective highly educated people that evaluate and exploit possibilities in a time of fast technological changes and of changes in society and in the market. That means that it is necessary to organise harmonised and coordinated efforts by the public and private sectors with the objective that Iceland will be among the front row nations in scientific and technological progress which can be translated into a powerful and effective industry.

Besides the 'ambition' oriented drivers for foresight, there are also 'rationalisation' drivers behind the need for future oriented policies. The Council is aware of these drivers, and seeks for new possibilities to rationalize decision making in its longer term science, technology and innovation policy (STI). Partly this search is triggered by external pressures, like the need to account for public expenditures or the need to argument why certain investment decisions have been or will be taken. However, there is also pressure from within the system, where the different parties involved in policy making increasingly realize the need for a common decision making ground – a way to reach 'consensus'. STI foresight is believed to be a valuable approach in streamlining decision making and reaching consensus among those involved.
The Ministry of Education and Science has initiated a Foresight exercise related to health. This is a national project but in connection with a major OECD emphasis in this area.

Future needs for foresight in the Icelandic Research Council System

The future need of Foresight has been under discussion in the Icelandic Research Council System. The present policy for research and development and innovation made by the Science and Technology Policy Council does start with the necessity of applying Foresight. According to the Director of the Science Office at the Ministry of Education and Science there is a clear interest to include Foresight in the policy and the policy making process of research and development and innovation. The members of the system do want to get to know the working methods, organization, working methods and how to apply these methods. At this moment the Research Council System is waiting for the Finnish "FinnSight" programme to be published which is expected in fall of 2006.

The Ministry is also involved in OECD emphasis related to health and biotechnology. A project group to handle those projects has already been formed and will probably start the operation shortly.

Iceland has not yet gained any experience of foresight exercises yet but there have been several activities in the field of strategic decision making related to the work of the new system of Science, Technology and Innovation under the Science and Technology Policy council. These activities have not necessarily been called foresight but seem to have similar objectives and process.

The most promising recent activities are;

- New policy of the recently installed Science and Technology Policy Council
- Decision of the funding Program for Post Genomics and Nano-technology. The Post Genomics and Nano-technology programme is based on previous programme for Information technology and Environment which was a top-down project not to be.
- It is also useful to point out the sector focused initiative related to cluster initiated by the Ministry of Industry and trade. These are Innovation in the service sector, Innovation in humanities and social sciences, culture related truism and the Spin-off initiative. Finally a Centre of expertise in the regions is on the drawing board.

To establish the new policy direction of the Science and Technology Policy council, the council did gather to gather in Reykholt a group of stakeholders. After two days exercise an ground for building policy was sent to the council. This process was considered to be a success by the council.

The program on Post Genomics and Nano-technology was a bottom up approach by deciding of the council. There was issued a call for proposal for programmes. The council received 35 ideas from teams of experts from various fields of science and from industry. After a considerable effort the council did select the two fields.
There are other initiatives on more sectoral basis that should be mentioned in this context. First is the so-called Third Pillar an initiative of the Ministry of Industry and the Confederation of Icelandic industries. This is a process were members of the Confederation has spent to propose to the Government a way to find alternative way of business development toward innovation.

The experience of the Research council system of foresight exercise or similar is that it is essential to utilize the right group of people and from various parts of society. This makes the process a little heavy but this is considered necessary.

The Research Council system need to link together various fields of science and industries as well as members of research, universities, industry, government and research council system.

Problem with foresight is that the governance system of Iceland in not very much inter linked and the same goes for the industry and research when it comes to fields and industries. There could be for example barriers between fisheries and industry that are an obstacle for development of both these branches. There have to be considerable change of heart to overcome this. Foresight might be a vital instrument in this area.

It is foreseen as one fundamental part of the development of science, technology and innovation that a prioritisation will take place. It seems to be difficult to find out what kind of prioritisation is possible or to be used. Also it is not clear what this will lead to in form of emphasis on not-prioritized field or industry.

Regarding international aspect of foresight Iceland has decided to take part in the OECD foresight imitative on Biotechnology 2030. Iceland is also a partner in foresight initiative supported by the Nordic Innovation Centre and an observer in ForSociety ERA-Net on foresight.

The Research council system does consider the ERA-Net system of the European Commission a approach to follow. This system seems to be directed towards increased prioritisation.

Research and innovation council system in Norway

Introduction

In October 2003, The Norwegian Government launched a Plan for a Comprehensive Innovation Policy titled “From Idea to Value”. The vision is for Norway to be one of the most innovative countries in the world, where resourceful and creative enterprises are given opportunities for developing profitable businesses. Furthermore, Norway shall be in the lead internationally in important areas, in terms of knowledge, technology and wealth creation.

The objective of the Government’s innovation policy is to facilitate increased wealth creation across the country, in order to achieve overarching welfare policy objectives. Increased wealth creation requires increased innovation on the part of Norwegian industry, and the Government has defined five main policy areas:

- General conditions for trade and industry
- Knowledge and competency
- Research, development and commercialisation
- Entrepreneurship
- Electronic and physical infrastructure

The fact that these areas are interrelated calls for a comprehensive approach to innovation policy. The Government has appointed a special Government Committee responsible for developing and coordinating policy at the national level. An important aspect of the plan is to improve mechanisms for dialogue between administrative levels within the public sector, between the public and the business sector, and between research and innovation communities.

As a follow-up of the Innovation Policy Plan, the Government in February 2004 launched an initiative called “Innovation 2010”. This initiative aims to activate and stimulate national, regional, and local actors in the public and the private sectors. Several regional projects have been initiated in order to identify opportunities and obstacles for regional innovation.

Description of research and innovation councils and similar systems

Approximately 30 percent of public funds for R&D are channelled through the Research Council of Norway (RCN). The RCN was established in 1993 as a merger of five existing research councils. The RCN has been subject to an extensive international evaluation. In 2002, the Government concluded that the existing model with one research council should be continued, but with extensive organisational changes. Better co-ordination across disciplines and linking basic and applied research. The RCN shall be more customer oriented, maintaining an open dialogue with external stakeholders.

The Research Council of Norway (RCN) has an annual budget of more than NOK 5 billion and plays a central role in Norwegian research. The mandate of the Council is to promote and support basic and applied research in all areas of science, technology, medicine and the humanities. Important goals include raising the general level of the

understanding of research in society as a whole and supporting innovation in all sectors and branches of industry.

The Research Council of Norway is a strategic body which identifies areas of special effort, allocates research funds and evaluates the resulting research. The Council is the principal research policy adviser to the government, and it acts as a meeting-place and network-builder for Norwegian research.

The Research Council is organized in three research divisions, one division for administrative affairs and one international unit organised directly under the Director General.

The Research Council of Norway is a national strategic body and funding agency for research and innovation activities. The Research Council covers all fields of research and innovation and works together with research institutions as well as the private and public sectors to reach the national financial goals and quality targets set in this area.

The Research Council plays a vital role in developing and implementing the country's national research strategy. It acts as

- a **government adviser**, identifying present and future needs for knowledge and research, and recommending national priorities;
- a **funding agency** for research programmes and independent projects, strategic programmes at research institutions, and Norwegian participation in international research activities. The Research Council has an annual budget of some NOK 4,5 billion and utilises specifically-targeted funding schemes to help translate national research policy goals into action.
- a **co-ordinator**, initiating networks and promoting co-operation between research institutions, ministries, business and industry, public agencies and enterprises, other sources of funding, and users of research.

The Research Council comprises three research divisions, one division for administrative affairs and one international unit organised directly under the Director General. The Research Council has some 350 employees. The Executive Board of the Research Council consists of seven members and two deputy members and is responsible for the Council's policy at the national level. Three research boards, one for each research division, advise and report to the Executive Board.

Division for Science – main roles:

- Serve research institutions
- Contribute to the development of basic research in general
- Contribute to the development of multi- and cross-disciplinary research
- Influence the general conditions for Norwegian R & D institutions

Division for innovation – main roles:

- Serve businesses
- Contribute to the development of R & D activities and innovation in trade and industry on national and regional levels
- Innovation in public services

Division for Strategic priorities – main roles:

- Serve the public sector
- Provide necessary research-basis for policy development
- Large-scale research programmes

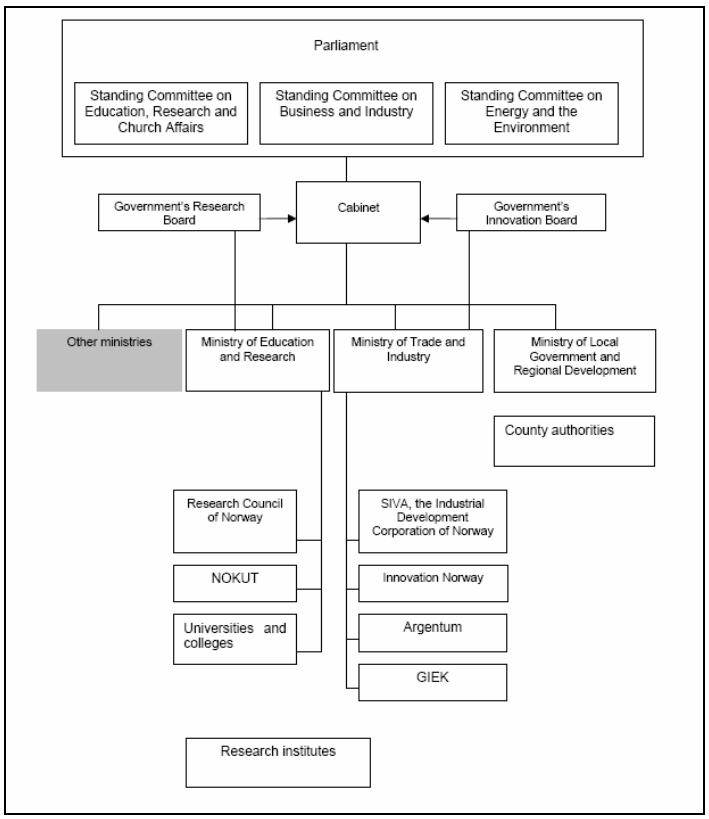


Figure 8. Organisational chart of the Norwegian innovation governance system.

The Council was established in 1993 by merging the five former research councils into a single entity. In its current form, it is made up of two administrative divisions and three research divisions, the latter being: Division for Science, Division for Strategic Priorities and Division for Innovation.

The Council recently established a network of regional representatives. Seated at the regional offices of Innovation Norway, these representatives front the Council's services vis-à-vis target groups in the regions and facilitate a close dialogue between the Council and regional actors.

The Research Council of Norway had a budget of NOK 4.61 billion NOK in 2004 (€557 million).13 Innovation Norway is the main agency for the development and administration of business-oriented policy instruments. Through its network of offices, covering all Norwegian counties and more than thirty foreign countries, the agency acts as a gateway to a well coordinated and easily accessible set of policy instruments in the field of innovation and internationalisation.

Innovation Norway came into operation on 1 January 2004 as a replacement for the four previous innovation policy agencies: The Norwegian Government Consultative Office for Inventors (*Statens veiledningskontor for oppfinnere*, SVO), the Norwegian Trade Council (*Norges Eksportråd*), the Norwegian Industrial and Regional Development Fund (*Statens nærings- og distriktsutviklingsfond*, SND) and the Norwegian Tourist Board (*Norges Turistråd*). The reorganisation took place against the background of a parliamentary bill stressing the need for the policy instrument system to be better coordinated and directed to the common goal of contributing to increased innovation nationwide. Innovation Norway's total budget for 2004 was approxi-

mately NOK 4.2 billion (€508 million), including NOK 2 billion (€242) for loans and (at least) 196 million for administration.

SIVA, the Industrial Development Corporation of Norway (*Selskapet for industrivekst*), is to contribute to the development of strong regional and local industrial environments by providing investment capital, competence and networks for small and medium-sized companies. As co-owner of science and research parks, incubators, business gardens and investment companies all over the country, SIVA is a network organisation offering an infrastructure for entrepreneurship and innovation nationwide. SIVA was established in 1968 and is based in Trondheim. The parliamentary bill proposing the establishment of Innovation Norway (see above) opened up for the incorporation of SIVA into this new innovation policy agency. A subsequent white paper on SIVA's future operations maintained that the company should remain independent, but that it should cooperate closely with both Innovation Norway and the Research Council of Norway. The white paper furthermore recommended that user groups should get access to SIVA's services through Innovation Norway's network of regional offices. In 2004, SIVA had a total turnover of NOK 258 million (€31.2 million). Government allocations to company that year amounted to approximately NOK 60 million (€7.3).

Appraising progress of policy implementation

In general there is reason to say that Norwegian innovation policies are "advanced" or "mature" compared to some European countries. There are strong visions, a sophisticated systemic understanding of innovation, and a will to invest in knowledge and innovation Policy developments over the past few years have indeed responded to several identified challenges.

The fact that the level of national R&D investments as a proportion of GDP is relatively low in Norway has been taken seriously by the Government. It has already increased the public investments in R&D significantly, also in areas of direct industry relevance. However, a parallel increase in GDP means that national investment as a percentage of GDP is not rising. If one measures R&D investments per capita, however, Norway performs much better than the OECD, EU15 and EU25 averages. There has moreover been an increase in Norwegian business investments in R&D. This is probably for a large part due to the general upturn in the economy, but the public tax incentive SkatteFUNN (NO_33) may have had an effect. This has not been documented, however. It is important to keep in mind that Norwegian industry is dominated by low-tech SMEs. There is no way this industrial structure can deliver the same business R&D investments as for instance Sweden, Finland or Germany. This has not stopped the Government from concluding that the business sector is not investing enough in R&D. Because of this the public investments in R&D in general has been increasing, and SkatteFUNN has been implemented. In the recent white paper on research, the Government also announces an increase in direct industry-oriented R&D programmes.

Norwegian companies do not perform as well as one should expect as regards "non-R&D" activities, including learning and cooperation. This gives cause for concern, especially as the present innovation policy is so dominated by the need for increases in R&D investments. One may easily argue that there is an even greater need for investments in other types of innovation activities, including learning practices, networking and organisational change. However, these are exactly the kind of policy measures that have been cut in the latest budget rounds, especially as regards instruments administered by Innovation Norway. The funding of long-term basic research has been given a significant boost, and the establishment of the Centres of Excellence scheme (NO_31) in 2001 was a direct response to Government's ambition to

strengthen Norwegian research in qualitative terms. The Quality Reform of higher education can also be considered a response to the need to improve the quality of research as well as teaching in Norwegian institutions of higher education. The country's low number of S&E graduates has been taken very seriously by the Government. In 2002, it developed a strategy called *Realfag – naturligvis* (Science – of course!) in order to improve the teaching of mathematics and science in primary education. Now the Government is considering paying the student loan of students that decides to become teachers in science and mathematics. Moreover, college students will be given extra credits for scientific disciplines and engineering. The number of science university and college candidates is to increase, as will the number of post doctoral students.

The Government has also made initiatives in accordance with the goal of strengthening knowledge transfer between universities/colleges and industry. Through an amendment to the Act on Universities and Colleges in 2002, Norwegian universities and colleges have been given an explicit responsibility for facilitating the exploitation of research results to the common good. In the wake of this amendment, several universities have established their own technology transfer offices. A related initiative was an amendment made the same year to the Act on rights to inventions made by employees. The amendment gave research institutions the rights to exploit inventions made by their teachers and researchers. This right had formerly belonged to the individual employee.

Policy making and evaluation practices. The processes leading up to the recent publications of the white papers on research and regional policies illustrate the active involvement of stakeholders in the development of Norwegian innovation policies. In preparing their white papers, the Ministries of Education and Research and Local Government and Regional Development both made extensive use of input from various actors in the national innovation system, including policy implementing agencies, county authorities, education and research institutes, and industry organisations. Stakeholders were consulted in meetings and workshops, and were furthermore invited to present their opinions and recommendations in written statements which were published on the Ministries' web pages. Similar lines of action were taken by the Ministry of Trade and Industry when it carried out its evaluation of the national system for business oriented policy measures in 2002/2003.

The ongoing process of developing a new model for innovation policy measures in the Research Council of Norway shows that stakeholders are consulted by the policy implementing agencies as well. In January 2005, the Division for Innovation invited central actors in the national innovation system to a "Forum for the discussion of policy measures". The aim was to initiate a dialogue regarding industry oriented policy measures and present the Council's work on a new policy measure portfolio. Another example is the establishment of the Government's Innovation Forum which is to ensure an ongoing dialogue between policy makers and stakeholders when it comes to innovation policy developments.

Norwegian policy makers also rely strongly on studies, indicators and benchmarks in designing policies, although policy practices in this area may not be coherent and systematic. Important international sources are the OECD, the European Commission and work done within the framework of the Nordic Innovation Centre's Innovation Policy Forum. Central national providers of knowledge and indicators include research environments such as Statistics Norway, the Norwegian School of Management BI, the Centre for Technology, Innovation and Culture, and NIFU STEP. Statistics Norway and NIFU STEP are actively involved in developing the biannual *Report on Science & Technology. Indicators for Norway*, which is published by the

Research Council of Norway. This report is widely used as a basis for formulating and following up innovation policy priorities. Policy reviews, in the form of white papers and public reports (*Norges offentlige utredninger*, NOU), are relatively frequent in Norway. While there are no formal rules with regard to the frequency of white papers, some types are published regularly with only few years' interval. This applies, for instance, to the white papers on research policy. The Government frequently commissions public reports which serve as a knowledge base for designing policies. These reports are prepared by a commission or work group appointed by the Government or an individual ministry to account for and discuss a specific topic. Innovation policy measures are developed in close cooperation between the relevant ministries and implementing agencies, with direct or indirect support from external experts. Stakeholders are not directly involved in designing new measures, but are systematically consulted through meetings, work shops, etc. Stakeholders are moreover typically represented in the programme committees, and thus have influence over the development of a policy measure once it has been introduced. As described in section 1.1.2, a structure of high level government committees is in place for the coordination of innovation policies: the Government's Research Board (RFU), the Government's Innovation Board for ministers (RIU), the Research Forum for Government Officials and the Innovation Forum for Government Officials for civil servants. There is also common policy practice that all relevant ministries are involved in the development of government white papers. Coordination is furthermore facilitated by the fact that Norway has one single research council, and through close contact and regular meetings between the main policy implementing agencies (the Research Council of Norway, Innovation Norway and SIVA).

There is a conscious approach to evaluating innovation policy in Norway, although evaluations of agencies and measures are not carried out systematically. Evaluations are typically initiated internally, but in cases of large-scale evaluations of strategic agencies and measures the initiative often comes from the responsible ministries. Third parties, such as the European Commission, are not central driving forces for the carrying out of innovation policy evaluations. Evaluations are either commissioned to independent experts or carried out internally. Both national and international research institutions are used as external evaluators. Whereas external evaluations are typically published and debated, internal evaluations are usually less transparent. In general, however, all major evaluations of innovation policy agencies and measures are made public and discussed in public forums. There is no overall set of indicators used by the government to benchmark the success of innovation policies vis-à-vis other countries or over time. As noted above, white papers will often include specific targets linked to indicators (like the Lisbon objective in the present white paper on research). Such targets may also be included in budget propositions. At the time of writing the Ministry of Local Government and Regional Affairs was discussing a system for benchmarking regional policies with the Ministry of Finance. According to our sources the Ministry of Finance is looking for indicators that measure the impact measures have on economic growth, while the Ministry of Local Government and regional Affairs are more interested in overall welfare targets. Some civil servants in this ministry argue that it is impossible to ascertain linear relationship between policy measures and growth, even in the area of innovation policy.

Current use of foresight and similar strategy processes

In 2004, the Research Council launched seven large-scale programmes as part of the process of translating research priorities in areas of special importance to society into action. These seven programmes are:

- Research in Functional Genomics (FUGE),
- AQUACULTURE – An Industry in Growth (HAVBRUK),
- Nanotechnology and New Materials (NANOMAT),

- Climate Change and its Impacts in Norway (NORKLIMA),
- Optimal Management of Petroleum Resources(PETROMAKS),
- Clean Energy for the Future (RENERGI) and
- Core Competence and Growth in ICT (VERDIKT).

The Research Council employed foresight techniques in five different fields during 2004 and 2005 in order to identify the basis for future large-scale initiatives. A foresight analysis of the aquaculture sector was presented in 2004, while the foresight reports for energy, ICT, biotechnology and new materials were completed in 2005. More than 300 specialists from various scientific, government and political circles took part in the processes associated with these efforts. The results and future perspectives were presented at a major conference in May.

The Research council of Norway, as a prominent leader of the debate about Foresight, did launch a Report in order to stimulate the debate on Foresight. An internal group was started to initiate a report on form and interplay of multidisciplinary research. The Report did focus on the Foresight project initiated in 2002 to 2005. That is ICT, material, nanotech and biotech, energy and aquaculture. The debate followed by publication of the report was supposed to contribute to the thematically prioritisations in Norway. How to develop holistic knowledge policy with a strong development and utilisation of new technological possibilities? How does prioritisation in the future emerge?

The report "Trenger vi nye former for tverrfaglighet og samspill?" is based on the reports of the foresight projects already started but as a background material was used the discussion for the “Veivalg 21” conference in May 2005, as input.

Future need of the Norwegian Research Council System

The Norwegian Research Council System has been rather efficient when it comes to utilizing Foresight related to various industries. The Foresight method has already been put to general discussion by the publication “Trenger vi nye former for tverrfaglighet og samspill” publishe by Norges forskningsråd 2006.

According to the Department manager of the Department for future technology within the Division for large operation this report, which is based on five large foresight projects will be used as statement of pilot project which will be a base for learning in the field of foresight and a prerequisite for identification of future needs for foresight. Evaluation of the gained experience is under way and will in a given time act as a further ground to identify the needs.

There are two main players in the Research council system in Norway working with foresight. These are the Research council of Norway and Innovation Norway. The main projects that have been ongoing are:
Research council in the area of:

- Advanced material
- Energy Norway
- Ocean fish farming
- Biotech Norway
- Development and strategic alternatives for ICT

Innovation Norway is working on projects or ideas in the area of:

- Food and tourism
- Agriculture and fisheries
- Marin (Cluster project in the south coast)

The foresight projects are in most cases sectorial focused and in few cases regional. The foresight projects in the Research council are related to the fact that in 2003 a massive re organisation of the council took place. This was a result of an evaluation performed by Technopolis consult. A major emphasis fields were identified and the five foresight projects were a result of that. As indicated in this report one of the 3 major divisions were on large operations. In stead of working with mostly smaller projects the government decided to install larger programmes. In connection to that the government wanted to install new instruments. The results were large programmes and foresight projects in connection to those. The Research council did publish report based on the experience of these projects: "Veivalg 21".

The Research council has performed an internal evaluation and the results of that will be published in October 9th in Norwegian and in English before end of 2006. In May 2005 the Research council had a large conference to discuss the experience of the foresight programme, the five projects. The main results were presented and the council tried to come up with some kind of common messages. The messages were that multidisciplinary cooperation will be much more important in the future and that there is an essential interplay between research and society. In stead of the notion that cooperation is nice to the requirement that cooperation is a necessary fact. There will be formed new arenas of science and in connection to that a new for of communication between research and society.

There were even more conferences to discuss the experience of the foresight studies with a broad base of audience for all sectors of the industry, research and governance. The Research council had decided to write a common report or synthesis for all the project but found out early that it was not possible due to very different scope and content of the projects.

The usefulness of the foresight projects has been quite intensive. Not entirely on the results only but on the process of foresight which involved a broad group of relevant experts form the Research council, the authorities, from industry and the research field.

The Research council did not identify any new policy form the programme on foresight. But due to comprehensive discussion the impact is believed to have lead to many changes impossible to measure or monitor. There have been issued various proposals with motivations based on the experience and indirect impact are the multidisciplinary characteristics of foresight or a kind of jigsaw puzzle, vivid discussion and foreseen conversion of many fields of science.

It is essential that the evaluation has reviled that there is a need and almost to be seen that conversion between fields needs to take place in Norwegian research and innovation. It also gave a clearer picture of the stakeholders of the foresight. It is essential that all sectors such as universities, industry and other parts of research take part already from the beginning of the foresight process.

The experience of the programme has lead to more open form of work. The council has identified that the processes have been too closed and there is a will for adding more views to the process in the future. The methods are also to be evaluated and redefined. It is necessary to add other stakeholders to the process. Experts should be working shoulder to solder with the experts and there should be added other competences. It is necessary to add sector specific prioritisation to the process.

Among the results of the internal evaluation is that the process of foresight does contribute to a common vision within fields or industries. This in its own way can contribute to prioritisation of tasks. At the same time the process does influence the relevant actors to be more mobilised towards a common objective.

Even though the results of the foresight initiative have not been visual in the innovation policy of Norwegian government it is clear that the awareness has been raised. There is quite a lot of experience for Foresight in Norway. Outside of the Research Council system are consultants working in this area. This leads to differentiation of methods and less comparability. But at the same time it is expected that development of methods and usefulness of for sight can increase.

It is expected that marine related project will have the most visible impact in near future. It has been noted that the discussion form that has had influence on strategic dialogue in the companies them selves. Other projects have not yet had same impact for example has the project related to tourism not yet had much effect on the industry.

It is clear that all parts agree on the necessity of continuing this instrument as a vital part of policy making. The experience leads to the notion that the right consortia has to be include form the beginning and that it must be clearly defined how to work and what to work with. It is also necessary to link together the technology and the society when it comes to how to use foresight.

Foresight is needed when it comes to design new initiatives such as the Research Councils large initiatives. This has to be done in cooperation with actors from the various fields and industries in order to optimize the selection. It is anticipated that linking to regional development is suitable. Also regarding the design of foresight initiative an early warning mechanism should be embedded.

Foresight has been to heavy and technically focused. This means that layman will have stronger role in the future but these are also expected to contribute with creativity that is not necessary expected by experts.

Both the Research Council and the Innovation Norway are in foreign cooperation related to foresight. Both organisations state that due to the fact that foresight has been under construction for some years, foreign cooperation has not found its time yet. Still both mentioned Nordic Foresight Forum, ForSociety ERA-Net as examples and they aim to increase cooperation with IPTS in Spain.

Research and innovation council system in Sweden

By Thomas Malmer

Introduction

Sweden is said to be one of the leading countries when it comes to spending on research and development (R & D). About 4 % of GDP is spent on R & D, which is more then any other OECD country (but lower than Israel). But Sweden differs in many ways. As in Finland the largest part of the R&D spending (about 75 %,) is invested by the industry, but Sweden is the only Nordic Country with large spending on R & D in the defence sector, which gets about 20 % of the public R & D spending. Public spending on R & D without the defence research is 0.84 % of the GDP witch is just a little bit higher then the EU average of 0.77 % of GDP.

Sweden relies a lot on the larger companies R & D spending and the politicians focus much of their discussion on basic research at the universities. Sweden has separate policies for the industry and for research and education. In 2004 the government made a first innovation strategy where the focus is on how Sweden can get more growth out of the research spending. This strategy has had some influence on the latest research bill, but still, focus in Sweden is more on research then development. The 14 universities and the 25 university colleges do most of the public funded research. The institute sector in Sweden is small with a basic funding on only about 8 %, compared to an average on about 30 % in other Nordic and European countries. Instead the universities are supposed to interact more with the industry and the society within the so-called “third mission”. This task has no specific funding and nor the government or the universities have according to Riksrevisionen (State audit institution) done enough to be successful with this mission.

Description of research and innovation councils and similar systems

Sweden has a research system with various financing bodies, most of them with a focus on basic research. See table 8.

Table 8. Overview of the major research financing bodies in Sweden.

Institution	**Annual financing (Million SEK)**
Governmental Agencies	***6025***
Swedish research council	2700
VINNOVA	1100
Swedish Energy Agency	815
Formas	600
FAS	300
Swedish Environmental protection agency	100
Swedish National Space board	60
SIDA	350
Foundations	***2050***
KAW	700
Riksbankens jubeleumsfond	300
STINT	75
MISTRA	200
The Knowledge foundation	215
The Foundation for strategic research	500
Vårdalstiftelsen	60
Fundraising organisations	***455***
The Swedish cancer society	300
The Children's cancer foundation	75
The Swedish heart-lung foundation	80

All in all the larger financing organisations spend about 8500 Million SEK annually on research. The direct public funding to research at the universities is about 10800 Million SEK.

The Swedish Research Council (Vetenskapsrådet - VR) is an agency under the Ministry of Education. The council has a budget of about 2 700 M SEK and is the largest financing body for external financing of basic research at the universities. Researchers from all scientific disciplines can compete for these grants. The council emphasis of high quality research and has a goal to support Sweden to be a lending nation in scientific research. The research council has a board where the scientific community elects eight members and four are appointed by the government. The board is responsible for policy and strategy. The Council is managed by a Director General and has approximately 140 employees. The Deputy Director General heads the Research Policy department. The Research Council has three Scientific Councils: one for Humanities and Social Sciences, one for Medicine and one for Natural and Engineering Sciences. It also includes a Committee for Educational Science and a Committee for Research Infrastructures. The overall framework for the council is decided by the

parliament in the research bill. The research council participated in the second technology foresight.

The Swedish agency for innovation systems, VINNOVA, has the task of promoting sustainable growth by financing developing effective innovation systems. INNOVA integrates research and development in technology, transport and working life. The agency has about 150 employees and is headed by a Director General. VINNOVA promotes the development of national, regional and sectorial innovation systems through different programmes. Examples of programmes are knowledge platforms, competence centres, excellent institutes, centres of excellence etc. VINNOVA has a budget of 1100 M SEK. Due to requirements of matched funding from other financing bodies, the sum of the resources will be almost twice as much. VINNOVA has participated in both Swedish technological foresights.

The task for the Swedish Energy Agency is to work towards transforming the Swedish energy system into an ecological and economically sustainable system through guiding state capital towards the area of energy. Energy research is an important part in this work that is done in collaboration with trade and industry, energy companies, municipalities and the research community. The agency promotes new energy techniques and energy production and maintains comprehensive research funding in order to make energy use more effective, not least within industry. The authority is in charge of significant areas of the system of certification in electric energy services, which will promote production of electricity from renewable energy sources. The agency has about 250 employees. The Swedish Energy Agency maintains comprehensive research funding in order to make energy use more effective, not least within industry. The research budget is about 800 million SEK annually. Besides programmes for basic and applied research, there are also a programme for demonstration and commercialisation. The Swedish energy agency was the main partner (together with IVA) in the energy foresight (2002).

Formas, The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning has a yearly budget of about 600 million SEK. It is an agency under the ministry of sustainable development. Formas also gets financial allocations from the ministry of agriculture. Formas is supposed to encourage and support scientifically significant research related to sustainable development. This means e.g. the areas of the environment, agricultural sciences, forestry and spatial planning, including building sciences and community systems. The projects supported cover a wide range of approaches from basic research to more applied efforts. The Board consists of 13 members where an electoral community of researchers elects seven members from Swedish universities and the government appoints the chairman and another five members. Formas is headed by a Director General and has about 50 employees. The research of Formas is divided into three principal areas: Environment and nature, Agricultural sciences, animals and food, and spatial planning. Formas participated in the Energy Foresight and has recently made a food foresight as a part in there new strategy for food and agricultural research.

Knut och Alice Wallenberg Foundation supports research and educational projects at universities, university colleges and institutes that will benefit the research community. Most of the grants are given to expensive scientific equipment within natural sciences, biotech and technological research. The research funding is about 700 million SEK, which makes this fund the largest private donator for research in Sweden.

The objective of Swedish Foundation for Strategic Research, SFF, is to support research and postgraduate studies in science, engineering and medicine in order to strengthen research environments of the highest scientific quality in an international

perspective for the purpose of strengthening Sweden's future competitiveness. The annual research funding is about 500 million SEK. SSF is lead by a Governing Board of 11 members appointed by the Swedish government. The secretariat consists of about 15 persons and is headed by an executive director. Examples of programmes run by SSF are Strategic research centres, Strategic framework grants, and Individual grants. SSF participated in the first Swedish Technology foresight (2000).

The current use of foresight and similar strategy processes in this system

Sweden has run two national Technology foresights and one Energy foresight. IVA has been the platform for these three foresights. The first one was made in the year 2000. The government together with national agencies mainly financed it. This foresight involved about 130 representatives of the academic, business and research communities that identified Sweden's weaknesses and strengths in various fields of technology and looked forward towards the year 2020. The foresight was made through eight expert panels that focused on different areas, e.g. ICT, Material, Society infrastructure, biological natural resources and healthcare and medicine.

The energy foresight was an IVA project finalized in 2003, with the purpose of creating a foundation for a broad discussion around the possibilities and problems regarding sustainable development of energy in Sweden (www.iva.se). The time perspective of the project is 20 years, with glimpses 50 years ahead. During 2002 roughly one hundred individuals from business, public administrations, and research, have worked in expert panels where they have studied and discussed different areas of the future. The results from the foresight were presented in four panel reports and in a synthesis report. The panels were:

- The System Foresight panel New energy era – a systems study.
- The User Foresight panel: What happens next?
- The Structure Foresight panel: Can we influence our future? Future scenarios
  for European Energy.
- The Long-term Foresight panel: Energy in 2050 – closer to the sun.

The second technology foresight was finished in 2004. The time horizon was 15-20 years and the purpose was, among other things, to start a debate on how to prioritise research. The budget for the whole project was 14 million SEK and eight large organisations financed the project. The project was divided into a number of subprojects:

- Other national foresights (in other countries)
- Update of the previous Technology Foresight (2000) panel reports
- The context of technology (report: an anthology with different writers)
- Paradigm shaping innovations (report: Inspiration for innovation)
- Synthesis and recommendations (final report)
- Methods for foresights

Regional Foresights activities has been carried out in some parts of Sweden, e.g. in Dalarna. In their process more then 100 persons got involved in a process focused on regional development.

Besides the larger national foresight initiatives there are also other activates related to foresights. Formas recently made a food foresight as an input to their strategy work. VINNOVA has made a strategy for biotech, which is not called a foresight even if the way the strategy was made is very similar to other foresight projects. IVA has in a similar way run some larger projects with focus on the future and with pan-

els. Examples are Production for competitiveness, Business plan Sweden, Environmental foresight etc.
Organisations that funds researches, especially basic research, like the research council (VR) works with grants where excellent research are in focus. VR do not prioritise research areas at all and give grants to researchers within three areas. Besides this, VR also run some smaller projects together with other financing bodies. In these projects, e.g. sustainable development and medical technology, there are small grants for just these areas. The foresights done in Sweden have of course been read by VR, but since the purpose is to give grants to excellent research, priority setting is not an issue.

Today SSF follows an application procedure that involves competitive applications. The Governing Board of SFF decides on offering allocations through calls for proposals, with a competitive application procedure within specified but broadly-based areas. The Foundation welcomes outline ideas from elsewhere, but does not decide upon non-solicited proposals.

SSF has just started a strategy process to identify white spots within the areas they work with but also to find new areas for research. The strategy groups will work for about a year and will consist of about ten persons form the academy, the industry and the society. The areas in focus at the moment are:

- Biotechnology, drug development, medical technology
- ICT, both software and hardware
- Development of new materials, incl. Biomaterials

By the new strategy process new areas can be in focus and the usual procedure for grants can be changed, depending on what the strategy groups will come up with.

Future needs for foresight

There is always a need for foresight to contribute to a debate about the future. The two technology foresights have been large projects with only four years between them. Foresights with a longer time perspective can't in the same way be made to often, instead new approaches or new focuses are needed.

As said above, a lot of foresights or similar activities have been carried out during the last years. Even if all activities do not result in road maps or clear priorities they do influence the way the actors in the innovation system work. The latest research bill referred to the latest technology foresight and VINNOVA has used the foresight results in their strategy process. The choice of certain industries, that the government has had dialogues with about future research and development, has also been influenced by the foresights. Also the organisations that fund research without any priorities to certain areas mean that the foresights contribute to smaller projects in new areas, even if the foresights don't influence their main work processes.

Many actors refer to other possibilities that come up after foresights. Most Swedish foresights so far have been large projects with many people involved, which has broaden the networks and increased the discussion about the future in and among many different organisations. The two rounds of national foresight mainly raised awareness about the need to think systematically about the future, and about the need to make choices. However, with their broad scope and complex ownership, it was hard to dig deep enough to give concrete guidance on issues like setting research priorities. For this purpose it appears that we will need foresight processes designed for specific policy questions.

In the coming years it is probable that there will be a new larger technology foresight and many foresights with a more focused purpose, e.g. to make strategies or road

maps in certain areas. All these activities might not be called foresights even if they will be made like one.

Research and innovation council system at Nordic level

By Mads Borup, Risoe National Laboratory

The organisation on the Nordic level

The research and innovation managing system on the Nordic level consists primarily in the three institutions under the Nordic Council of Ministers:

- NordForsk
- Nordic Innovation Centre, NICe
- Nordic Energy Research

The institutions manage a substantial amount of the research and development programmes established in the Nordic collaboration. With Nordforsk as a research council like unit, the NICe as an innovation-oriented institution, and Nordic Energy Research as a sector specific institution, the Nordic level have similarities with research and innovation council systems seen in individual countries.

NordForsk is an independent institution operating under the Nordic Council of Ministers for Education and Research. The institution is responsible for Nordic cooperation within research and research training. In addition, NordForsk handles cooperation and coordination with Nordic InnovationsCenter, NICe. NordForsk was established in 2005 and replaced the Nordic Science Policy Council and Nordic Academi for Advanced Study, NorFA.

The national research councils, other research-funding agencies and the universities are central players in NordForsk. It is the intention that the cooperation activities of NordForsk shall focus on the areas within research where the Nordic countries are strong scientifically and perhaps also world leaders. The aim is to promote research of supreme international quality. Together, the Nordic countries should thereby obtain a stronger position in the competition for European research funding than each country would have individually.

Nordic Innovation Centre (NICe) is an instrument for the Nordic Council of Ministers for promoting an innovative and knowledge-intensive Nordic business sector. It is the basic assumption that each of the Nordic countries possesses knowledge, which through increased co-operation significantly will improve innovation capabilities and competitiveness for Nordic businesses. It is the understanding that building common Nordic knowledge markets are vital to all Nordic business life, enabling us to compete in a global market which is becoming more and more knowledge driven.

The Nordic Innovation Centre supports the establishment of Nordic knowledge platforms. Currently there are knowledge platforms within the areas of innovation policy, creative industries, biotechnology, food safety and innovative building & construction. Establishing common Nordic knowledge platforms on strategically important areas give Nordic businesses access to the best knowledge possible and greatly enhance their innovation capabilities. The project portfolio of the Nordic Innovation Centre consists of approximately 120 ongoing projects and networks. Nordic Innovation Centre was established in 2004. It can be seen as a successor of the former Nordic Industrial Fund.

Nordic Energy Research was established as an independent institution 1999 designed to further support and develop the Nordic market's energy sector. The size of Nordic Energy Research can be indicated by the figure for project funding which in 2005 was around 37 million NOK. The goal of Nordic Energy Research's Mission is more specifically to contribute to maintaining a high level of energy efficiency and sustainability in the Nordic energy system and to sustaining the Nordic Region as a world leader within some areas of renewable energy technology research and development. Thereby it contributes to the development of research networks and important knowledge in the field of energy. Nordic Energy Research makes action plans for four years periods. This corresponds to the four years periods after which the activities of the programme are structured. The newest strategy plan is the plan for 2007 – 2010. Currently the following areas are in focus:

- Integration of the energy market
- Renewable energy sources
- Energy efficiency
- The hydrogen society
- Consequences of climatic change on the energy sphere

The use and need of foresight on the Nordic level

With the still relatively recent changes in the organisational structure on the Nordic level it is currently difficult to talk about a general, well-established practice in the use of foresight. Foresight is, so far at least, not an inevitable element in strategy and prioritisation activities of the Nordic organisations and the use of foresight is limited. The use seems primarily to occur in the form of that foresight analyses made by others are sometimes referred to in the discussions of strategies and priorities.

Nordic Innovation Centre has for a couple of years had technology-oriented foresight as one of its focus areas.[2] One project on a specific technology area, the Nordic Hydrogen Energy Foresight, has been finalised, while two others will be completed in 2006/2007: Nordic Biomedical Sensor Foresight and Nordic ICT Foresight. The activities in this focus area moreover consist in a forum for foresight practitioners and researchers (Nordic Foresight Forum) and in investigation of the possibilities of creating a common follow-up system for relevant international technological foresight exercises. The hydrogen energy foresight project was co-financed by Nordic Energy Research. The project resulted in a strengthening of the network between hydrogen actors in the Nordic countries and in a considerable attention on the Nordic activities from other countries and from EU. The project has only to a limited extent been used directly in the decision making in the Nordic research and innovation managing institutions or in the overall strategy developments in relation to the hydrogen area.

Despite the limited use of foresight directly as basis for funding decisions and prioritizations, there is identified considerable need for foresight and similar strategic intelligence activities in the Nordic research and innovation management system. Foresight is considered an important activity type for the analysis of Nordic collaboration opportunities within research and innovation. Foresight exercises can moreover constitute central elements in the investigation of added values of cross-national and Nordic activities. National foresight studies can only to a limited extent be used on the Nordic level due to the differences between the countries in the research and innovation systems, and more generally in the economies, industry structures, etc. The national results can usually not be directly transferred. Foresight activities are

2 The effort on technology-oriented foresight was started by the Nordic Industrial Fund. Eerola & Jørgensen (2002) is a feasibility study made in this connection.

most likely to appear in the shape of preparatory background analyses guiding further strategy processes rather than as direct basis for funding decisions.

The contribution to development of networks between actors in the Nordic countries is another important element in the need for foresight on the Nordic level. Both network developments within science and research, e.g., as preparatory steps for establishment of Nordic Ph.D. programmes and research schools, and network developments more broadly, connecting research, business and other activities in an area or a sector, are seen as important potentials of foresight activities.

With the Nordic countries repeatedly scoring high in ratings of countries' capabilities within innovation, science and technology, as well as within broader societal issues like social welfare and happiness, there is strong interest from many sides in the specific Nordic competences. Foresight activities on the Nordic level can contribute to the illumination of the Nordic competences and thereby constitute a basis for international network creation and collaboration within science and innovation.

More specifically, foresight can play an important role in the definition and development of the Nordic Research and Innovation Area, NORIA, which is a central element in the policy of the Nordic Council of Ministers. NORIA is parallel to the European attempts to establishing a comprehensive European Research Area, ERA. With the increased focus in the European Union on the capabilities of different regions in Europe with respect to science and innovation, NORIA can be of considerable importance for the opportunities for international collaboration for the Nordic countries. Apart from becoming increasingly successful in application for EU funding, the Nordic foresight activities might also mean that the Nordic countries can get significant influence on the development of the European research and innovation programmes.

Overview and conclusions

Overview of Nordic research and innovation councils

Denmark
Denmark has - especially in comparison to Finland and Sweden - only recently started to develop a coherent science, technology and innovation policy. High level political interest is not as developed in Denmark as in Finland and Iceland. The Danish Globalisation Council was chaired by the Danish Prime Minister, but it was only operating over less than a year and not a standing council as in Finland and Iceland. The Ministry of Science, Technology and Innovation created by the present government 2001 is the central actor in Danish research and innovation policy. The Compared to the other Nordic countries, the Danish research and innovation council system is dispersed over several institutions. The funding part research and innovation advisory system is divided into two subsystems consisting of main bodies and the activities of these 6 bodies are coordinated by The Danish Research Coordination Committee. The Danish Research Counselling system is accordingly driven either based on the so called "bottom-up" principle or by top-down, politically prioritized subjects.

Science oriented funding institutions

- Danish Councils for Independent Research (basic research) is the umbrella for presently five research councils that are supporting research projects based on the researchers' own research initiatives. The councils also promote the wide

range and quality of Danish research through open competitions based on independent assessment. In addition, the councils give advice on research and technical subjects to applicants and other partners from all scientific domains. The councils includes: 1) Culture and Communication, 2) Nature and Universe, 3) Society and Trade, 4) Health and Illness, 5) Technology and Production.

- Danish National Research Foundation (basic research) aims at strengthening Danish frontier basic research with in the Natural Sciences, the Technical Sciences, the Health Sciences, the Social Sciences and the Humanities. The Foundation's primary strategy is to set up and fund Centres of Excellence for 5-10 year periods.

Application and innovation oriented funding institutions

- Danish Council for Strategic Research (strategic research) support research based on politically defined programmes and gives advice on research and technical subjects to applicants and others within its scope of activities. The Council has an obligation to contribute to an increased co-operation between public and private research. Furthermore, the Council shall evaluate applications regarding other ministries research appropriations. The Strategic Research Council consists of a board and a limited number of targeted programme committees: 1) Food and Health, 2) Energy and Environment, 3) NABIIT (nano, bio and IT), 4) Non-ionising radiation, 5) KINO (Creativity, Innovation, New production forms and the Creative Economy)
- High Technology Foundation (Innovation) supports research and innovation. However, it is a precondition for all initiatives taken by the Foundation that they are based on public-private collaborations and have a focus on either nanotechnology, biotechnology, ICT or the border-areas between these fields. The majority of the funding is to be directed to large high technological initiatives, while a smaller proportion of the funds will be directed to initiatives involving small and medium-sized companies. The foundation finances up to 50% of the expenses of the selected initiatives.
- Council for Technology and Innovation (Innovation) has two objectives. One is to give advice to the Minister of Science, Technology and Innovation about technology and innovation policy. The second is to administrate a number of initiatives initiated by the Minister concerning e.g. collaboration and diffusion of knowledge (innovation consortia; 'knowledge pilots'; high-tech networks; business Ph.D.s), entrepreneurship and commercialisation, regional development, and support for international collaboration about deployment of knowledge and technology.
- Programmes under sectoral ministries such as the Energy Research programme under the Ministry of Business and Economic Affairs and a variety of research programmes under the Ministry of Food, Agriculture and Fisheries. (strategic research)

The Danish research funding and advisory system was reorganised in 2004, and the ministry of Science, Technology and its Agency for Science, Technology and Innovation was reorganised on 2006. Furthermore, universities are presently (2006) undergoing a merger process. The changes have resulted in a distinction between independent research on the one side and strategic research and innovation on the other hand. Second, with the creation of the Danish Council for Strategic Research and the High Technology Foundation and the funding channelled through these entities much more focus has been put on innovation oriented activities.

A few private foundations make funds available for science and innovation. Among these are: the Carlsberg Foundation, the two Velux foundations (Villum Kann Rasmussen Fonden and Velux Fonden), RealDania fonden.

Finland

Finland is often looked at as a Global forerunner in the field of innovation policy. There is a well-developed cooperation between many actors as the government and the business sector. There is also cooperation between the largest financing bodies TEKES, SITRA, The Academy of Finland and VTT – the leading research and innovation institution. A key element in Finnish science and innovation policy is the high visibility in the political system with prime minister and parliament in key roles. The Science and Technology Policy Council of Finland formulates the national science, technology and innovation policies. The council is responsible for the strategic development and coordination of Finnish science and technology policy as well as of the national innovation system as a whole. The Prime Minister chairs this council and representatives from the industry participate in the council as well as other ministers. This high level council gives priority to the R & D issues and stability in the innovation system. The Committee for the Future is one of 15 standing committees in the Finnish parliament. Its task is to have an active dialogue with the government about major future challenges and means of solving them. The committee has also a policy making role about the future ere research is an important part. One special task is to follow and use the result of futures research. The committee also works with issues like internationalisation and the impact on the society due to technological development.

Science oriented funding institutions

- The Academy of Finland is funding basic research and operates under the administration of the Ministry of Education. The mission is "to promote high-quality scientific research by means of long-term funding based on scientific quality and by means of reliable evaluation, science policy expertise and extensive international cooperation". The Academy's organisation consists of the Academy Board, four Research Councils and the Administrative Office. The four councils are for Biosciences and Environment, Culture and Society, Health and for Natural Sciences and Engineering.

Application and innovation oriented funding institutions

- TEKES is an agency under the Ministry of Science and Technology and the key actor in Finnish science and innovation policy. TEKES mainly funds applied research. The funding is intended for challenging and innovative projects, with the goal that some of them hopefully lead to global success stories. About half the funding goes to all kinds of research while the other half goes to research within strategic areas where TEKES has programs. TEKES funding may also be a low-interest loan or a grant, depending on the stage of the innovation and the nature of the proposed project. TEKES can be compared to the Swedish VINNOVA.

- SITRA, the Finnish national fund for research and development, is a public foundation under the Finnish parliament. The foundation is independent and the task is to promote economic growth and future success of Finland trough international competitiveness and development of international cooperation. SITRA's operations can be divided into to two parts, research and education/collaboration and venture capital funding. The methods SITRA works with include research, strategy processes, innovative experiments, business development and investing in internationalisation. The first part consists of a number of focus areas which can vary in time and scale. In 2006 major programmes were: innovation, health care, food and nutrition, environmental technology, Russia and India. An overall goal with the projects is to take Finland up to the lead in high tech areas and also to improve the Finnish innovation system with SITRA as a driving actor. SITRA was one of the first actors in the field of venture capital in Finland. Today the foundation is focusing its new venture capital investments to the programme ar-

eas. The aim of the investments in early stages is to create and develop competitive and profitable business. At the moment special focus is given on the health, food and nutrition and environment programme. SITRA is chaired by the former Prime Minister Esko Aho.

Iceland

R&D performance has increased considerably in Iceland over the past decade. Following this the governance of Iceland's innovation system was reorganised in 2003 with a number of new laws enacted by the Althing in 2003. A new Science and Technology Policy Council (STPC) was established in 2003 to improve government-wide co-ordination of science and technology policy and inform policy making, emphasis has been placed on improving the efficiency of the Icelandic innovation system. The innovation policy objectives promulgated by the STPC aim to strengthen university-based research, restructure the public research institutes, improve support to business innovation and entrepreneurship, and enhance science and technology education. With inspiration from Finland the Prime Minister of Iceland chair this council and three key ministers have permanent seat herein. The Minister of Education and Science appoints nine of the non- ministerial members to a Science Committee and the Minister of Industry appoints an equal number to a Technology Committee.

RANNIS (the Icelandic Centre for Research) was established by the legislation enacted in 2003 and replaced the office of the earlier Icelandic Research Council.
Science oriented funding institutions

- RANNÍS, reporting to the Ministry of Education, Science and Culture, and advised by the Science Committee is the key actor in funding science. Thus RANNÍS administers the Research Fund, the Instrument Fund, the Graduate Training Fund and other funds for science that the government may want to assign to it.

Application and innovation oriented funding institutions

- RANNÍS, reporting to the Ministry of Industry and Commerce, and advised by the Technology Committee is the key actor in funding science. Thus RANNÍS administers the Technology Development Fund.

The Research Fund was established through fusion of the previous Science Fund and the Technology Fund. The Research Fund is governed by a board, whose chairman also chairs the Science Committee. Linked to the same board is also the Equipment Fund. Similarly the Law on the public support to technology development and innovation established a Technology Development Fund. Thus link a between policy and implementation through funding is provided. This law also established the Innovation Center (IMPRA), operationally linked to Icelandic Technology Institute.

Norway

In October 2003, The Norwegian Government launched a Plan for a Comprehensive Innovation Policy titled "From Idea to Value". The vision is for Norway to be one of the most innovative countries in the world, where resourceful and creative enterprises are given opportunities for developing profitable businesses. As a follow-up of the Innovation Policy Plan, the Government in February 2004 launched an initiative called "Innovation 2010". This initiative aims to activate and stimulate national, regional, and local actors in the public and the private sectors.

- The Research Council of Norway (RCN) is the key strategic body which identifies areas of special effort, allocates research funds and evaluates the resulting research. Approximately 30 percent of public funds for R&D or 5 Billion NOK are channelled through RCN. The Research Council of Norway is a strategic

body which identifies areas of special effort, allocates research funds and evaluates the resulting research. The Council is the principal research policy adviser to the government, and it acts as a meeting-place and network-builder for Norwegian research. The Council is the principal research policy adviser to the government, and it acts as a meeting-place and network-builder for Norwegian research. The Research Council plays a vital role in developing and implementing the country's national research strategy, and it has three roles: a government advisory role, a research funding role and a co-ordinating or integrating role. The Research Council comprises three research divisions (Science, Innovation and Strategic Priorities), one division for administrative affairs and one international unit organised directly under the Director General. The Executive Board of the Research Council consists of seven members and two deputy members and is responsible for the Council's policy at the national level. Three research boards, one for each research division, advise and report to the Executive Board.

- Innovation Norway came into operation on 1 January 2004 as a replacement for the four previous innovation policy agencies: The Norwegian Government Consultative Office for Inventors (*Statens veiledningskontor for oppfinnere*, SVO), the Norwegian Trade Council (*Norges Eksportråd*), the Norwegian Industrial and Regional Development Fund (*Statens nærings- og distriktsutviklingsfond*, SND) and the Norwegian Tourist Board (*Norges Turistråd*). The reorganisation took place against the background of a parliamentary bill stressing the need for the policy instrument system to be better coordinated and directed to the common goal of contributing to increased innovation nationwide.
- SIVA, the Industrial Development Corporation of Norway (*Selskapet for industrivekst*), is to contribute to the development of strong regional and local industrial environments by providing investment capital, competence and networks for small and medium-sized companies. As co-owner of science and research parks, incubators, business gardens and investment companies all over the country, SIVA is a network organisation offering an infrastructure for entrepreneurship and innovation nationwide. SIVA was established in 1968 and is based in Trondheim. The parliamentary bill proposing the establishment of Innovation Norway (see above) opened up for the incorporation of SIVA into this new innovation policy agency. A subsequent white paper on SIVA's future operations maintained that the company should remain independent, but that it should cooperate closely with both Innovation Norway and the Research Council of Norway. The white paper furthermore recommended that user groups should get access to SIVA's services through Innovation Norway's network of regional offices.

Sweden

Sweden is often named a Global leader in expenditures on research and development (R & D). About 4 % of GDP is spent on R & D, which is more then any other OECD country (but lower than Israel). But the structure of the Swedish science and innovation system in many ways differs from the other Nordic ones. Sweden has a large spending on R & D in the defence sector and without the defence research the Swedish expenditures on R&D as percentage of GNP is just a little bit higher then the EU average.

Sweden relies a lot on the larger companies R & D spending and the politicians focus much of their discussion on basic research at the universities. Even though, Sweden in many ways has leaded the way in national innovation policy (i.e. through VINNOVA) Sweden has separate policies for the industry and for research and education. Thus, in 2004 the government made a first innovation strategy where the focus is on how Sweden can get more growth out of the research spending. This strat-

egy has had some influence on the latest research bill, but still, focus in Sweden is more on research then development.
Sweden has a research system with various financing bodies, most of them with a focus on basic research.

The Swedish Research Council (Vetenskapsrådet - VR) is an agency under the Ministry of Education. The council has a budget of about 2 700 M SEK and is the largest financing body for external financing of basic research at the universities. Researchers from all scientific disciplines can compete for these grants. The council emphasis of high quality research and has a goal to support Sweden to be a lending nation in scientific research. The research council has a board where the scientific community elects eight members and four are appointed by the government. The board is responsible for policy and strategy. The Research Council has three Scientific Councils: one for Humanities and Social Sciences, one for Medicine and one for Natural and Engineering Sciences. It also includes a Committee for Educational Science and a Committee for Research Infrastructures. The overall framework for the council is decided by the parliament in the research bill.

The objective of Swedish Foundation for Strategic Research, SFF, is to support research and postgraduate studies in science, engineering and medicine in order to strengthen research environments of the highest scientific quality in an international perspective for the purpose of strengthening Sweden's future competitiveness. SSF is lead by a Governing Board of 11 members appointed by the Swedish government. The secretariat consists of about 15 persons and is headed by an executive director. Examples of programmes run by SSF are Strategic research centres, Strategic framework grants, and Individual grants.

The Swedish agency for innovation systems, VINNOVA, has the task of promoting sustainable growth by financing developing effective innovation systems. VINNOVA integrates research and development in technology, transport and working life. The agency has about 150 employees and is headed by a Director General. VINNOVA promotes the development of national, regional and sectorial innovation systems through different programmes. Example of programmes are knowledge platforms, competence centers, excellent institutes, centers of excellence etc.

The task for the Swedish Energy Agency is to work towards transforming the Swedish energy system into an ecological and economically sustainable system through guiding state capital towards the area of energy. The agency promotes new energy techniques and energy production and maintains comprehensive research funding in order to make energy use more effective, not least within industry. The Swedish Energy Agency maintains comprehensive research funding in order to make energy use more effective, not least within industry. Besides programmes for basic and applied research, there are also a programme for demonstration and commercialisation.
The Swedish energy agency was the main partner (together with IVA) in the energy foresight (2002).

Formas, The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning is an agency under the ministry of sustainable development. Formas also gets financial allocations from the ministry of agriculture. Formas is supposed to encourage and support scientifically significant research related to sustainable development. This means e.g. the areas of the environment, agricultural sciences, forestry and spatial planning, including building sciences and community systems. The projects supported cover a wide range of approaches from basic research to more applied efforts. The research of Formas is divided into three principal areas:

1) Environment and Nature, 2) Agricultural Sciences, Animals and Food, and 3) Spatial Planning.

Nordic level

The research and innovation managing system on the Nordic level consists primarily in the three institutions under the Nordic Council of Ministers: NordForsk, Nordic Innovation Centre (NICe) and Nordic Energy Research (NER).

Science oriented funding institutions:

- NordForsk is an independent institution operating under the Nordic Council of Ministers for Education and Research. The institution is responsible for Nordic cooperation within research and research training. In addition, NordForsk handles cooperation and coordination with Nordic InnovationsCenter, NICe. NordForsk was established in 2005 and replaced the Nordic Science Policy Council and Nordic Academi for Advanced Study, NorFA. The national research councils, other research-funding agencies and the universities are central players in NordForsk. It is the intention that the cooperation activities of NordForsk shall focus on the areas within research where the Nordic countries are strong scientifically and perhaps also world leaders. The aim is to promote research of supreme international quality. Together, the Nordic countries should thereby obtain a stronger position in the competition for European research funding than each country would have individually.

Application and innovation oriented funding institutions:

- Nordic Innovation Centre (NICe**)** is an instrument for the Nordic Council of Ministers for promoting an innovative and knowledge-intensive Nordic business sector. It is the basic assumption that each of the Nordic countries possesses knowledge, which through increased co-operation significantly will improve innovation capabilities and competitiveness for Nordic businesses. It is the understanding that building common Nordic knowledge markets are vital to all Nordic business life, enabling us to compete in a global market which is becoming more and more knowledge driven. Nordic Innovation Centre was established in 2004. It can be seen as a successor of the former Nordic Industrial Fund.

- Nordic Energy Research was established as an independent institution 1999 designed to further support and develop the Nordic market's energy sector. The goal of Nordic Energy Research's Mission is more specifically to contribute to maintaining a high level of energy efficiency and sustainability in the Nordic energy system and to sustaining the Nordic Region as a world leader within some areas of renewable energy technology research and development. Thereby it contributes to the development of research networks and important knowledge in the field of energy. Nordic Energy Research makes action plans for four years periods. This corresponds to the four years periods after which the activities of the programme are structured. The newest strategy plan is the plan for 2007 – 2010. Currently the following areas are in focus: Integration of the energy market, Renewable energy sources, Energy efficiency, The hydrogen society, Consequences of climatic change on the energy sphere.

Conclusions across the Nordic countries

Three conclusions can be drawn across all five Nordic countries:

- Major reorganising of the research and innovation funding and advisory system in all five countries and on Nordic level has taken place during the latest 5 – 7 years
- The changes have resulted in a clearer distinction between independent research on the one side and strategic research and innovation on the other hand.
- The changes has resulted in increased focus on innovation oriented activities

Table 9. Overview of the research and innovation council systems in the Nordic countries.

	Denmark	Finland	Iceland	Norway	Sweden	Nordic
Standging Governing	• ?	• S&T Policy Council of Finland • Committee for the Future	• Science Committee • Technology Committee	• ?	• ?	• ?
Science oriented	• Council for independent Research • National Research foundation	• Academy of Finland	• RANNIS o Research Fund o Instrument Fund o Graduate training Fund	• Research Council of Norway	• Research Council (VR)	• Nordforsk
Strategic and innovation oriented	• Council for Strategic Research • High Technology Foundation • Council for Technology and Innovation • Programmes under sectoral ministries (Energy, Enviroment, Agriculture, etc).	• TEKES • SITRA	• RANNIS o Technology Development Fund	• Innovation Norway • SIVA	• Foundation for strategic research • VINNOVA • Programmes under sectoral ministries (Energy Agency, Formas)	• Nordic Innovation Centre • Nordic Energy Research

The use of foresight and similar approaches

A considerable amount of other strategy development activities appear in the research and innovation council systems. Some of these have similarities to foresight for example concerning creation of visions about future developments, communication between actors, and identification of important areas to support. The role and functions of the other strategy activities are important to understand when assessing the potentials for foresight.

Other strategic tools:

- Identification of core areas
- Visionary areas
- Innovation accelerating platforms
- Dialog meetings
- Analyses-based discussion
- Coordination networks

- Strategy panels (stakeholder panels?)
- Competitive application procedures within specified but broadly-based areas
- Identification of white-spots

Future needs for foresight in research and councils

For Denmark the study can conclude that the research and innovation councils on a general level clearly have a need for foresight activities. A considerable number councils and parts hereof employ strategic and visionary analysis processes in their activities. Most of the Danish councils establish specific processes or projects in support of the strategy development and for dialogue and interaction concerning definitions of important areas and priorities in research and technology initiatives. Most respondents express it as a need for improved and broader communication in the strategy processes. Prioritization directly of funding decisions is usually not seen as a task for foresight. Foresight is rather considered as something that can constitute part of the background for making prioritizations. Finally, the future orientation is important. Although, most units addressed in the analysis in general express a need for foresight it cannot be concluded that the different units can all use the same foresight exercises.

Finland differs in one way from other Nordic countries by having a very tight cooperation between the actors in the innovation system. Finland is a forerunner in the field of innovation policy and foresights seem to be a part in their strategy process. According to Finnish Foresight Forum, in most foresight exercises the purpose seems to be "*to create and maintain a reliable picture about the probable technological and societal trends, the developments of world and national economies, the values of people, environmental issues, and many other relevant topics*". Finland does not seem to need more foresights then they are doing today. Instead, a better coordination between the various foresight exercises, improved methodologies and formal tools, as well as more conscious and transparent utilisation of foresight knowledge would be welcome.

In Iceland the future need of Foresight has been under discussion in the Icelandic Research Council System. The present policy for research and development and innovation made by the Science and Technology Policy Council does start with the necessity of applying Foresight. According to the Director of the Science Office at the Ministry of Education and Science there is a clear interest to include Foresight in the policy and the policy making process of research and development and innovation. The members of the system do want to get to know the working methods, organization, working methods and how to apply these methods. At this moment the Research Council System is waiting for the Finnish "FinnSight" programme to be published which is expected in fall of 2006.

The Research Council of Norway in 2005 held a conference on the experience of the foresight programme, the five projects. Among the conclusions were that multidisciplinary cooperation will be much more important in the future and that there is an essential interplay between research and society. Consequently, foresight is needed when it comes to design new initiatives such as the Research Councils large initiatives. This has to be done in cooperation with actors from the various fields and industries in order to optimize the selection. It is anticipated that linking to regional development is suitable. Also regarding the design of foresight initiative an early warning mechanism should be embedded. Furthermore, it is concluded, that layman should have a stronger role in the future and laymen are also expected to contribute with creativity that is not necessary expected from experts.

In Sweden, the latest governmental research bill referred to the latest technology foresight, and VINNOVA has used the foresight results in their strategy process. The choice of certain industries, that the government has had dialogues with about future research and development, has also been influenced by the foresights. Also the organisations that fund research without any priorities to certain areas mean that the foresights contribute to smaller projects in new areas, even if the foresights don't influence their main work processes. In the coming years it is probable that there will be a new larger technology foresight and many foresights with a more focused purpose, e.g. to make strategies or road maps in certain areas. All these activities might not be called foresights but will have many of the same characteristics.

At Nordic level (Nordic Innovation Centre, Nordic Energy Research, NordForsk) foresight can play an important role in the definition and development of the Nordic Research and Innovation Area, NORIA, which is a central element in the policy of the Nordic Council of Ministers. Despite the limited use of foresight at Nordic level directly as basis for funding decisions and prioritizations, there is identified considerable need for foresight and similar strategic intelligence activities in the Nordic research and innovation management system. Foresight is considered an important activity type for the analysis of Nordic collaboration opportunities within research and innovation. Foresight exercises can moreover constitute central elements in the investigation of added values of cross-national and Nordic activities. Future Nordic level Foresight activities are by the Nordic actors anticipated to appear in the shape of preparatory background analyses guiding further strategy processes rather than as direct basis for funding decisions.

The analysis confirms generally that there is a need for foresight in the Nordic research and innovation council systems.

The needs expressed vary considerably between the different parts and units of the national Nordic research and innovation council systems. The variation concerns main issues like type of subjects for foresight exercises; who are going to be involved; and who are the results going to be communicated to. This diversity in needs can make it hard to find common ground for one, general foresight activity in the research and innovation council systems. A few units of the systems express that they do not need foresight.

The need or objective for foresight is not directly as a tool of prioritization and funding decisions. Instead, foresight and similar strategic intelligence approaches are expected to be useful as background analysis tools that inform and support decision making. Hence, the role for foresight is rather to produce not-binding guidance and advice than to directly take part in the decision making. Despite this, it might in some cases, on specific and delimited areas of research or innovation, be feasible and fruitful to carry out foresight exercises that lead to recommendations directly used for specific prioritizations.

On the Nordic level there is also identified need for foresight. Foresight or similar activities can contribute significantly to investigation of Nordic strength areas and network creation between the countries. Moreover foresight exercises have the important function of increasing the visibility of Nordic research and innovation outside the Nordic countries, in the European Union as well as broader internationally.

Appendices

a. References and web sources

- Aagaard, K. and K. Siune (eds.). 2001. Science Policy - Setting the Agenda for Research. Analyseinstitut for Forskning, Rapport 2001/8.
- Aagaard, Kaare 2000: Dansk forskningspolitik. Organisation, virkemidler og indsatsområder, (Danish research policy. Organization, means, and efforts), Århus: Analyseinstitut for Forskning
- Barré, R, M. Gibbons, J. Maddox, B. Martin & P. Papon 1997: Science in tomorrow's Europe, Paris: Economica International
- Borrás, Susana (ed.) 2004a: Special issue on a European system of innovation, Science and Public Policy, vol. 31, no. 6, December 2004, Guildford, UK: Beech Tree Publishing
- Brown, Nik, Brian Rappert & Andrew Webster (eds.) 2000: Contested Futures. A sociology of prospective techno-science, Asgate
- CFA 2004: Forskning og udviklingsarbejde i den offentlige sektor, Forskningsstatistik 2004
- CFA 2005: Indikatorer for dansk forskning og innovation 2005, Århus: Dansk Center for Forskningsanalyse
- CTI 2006: Årsberetning 2005 (Annual Report), Copenhagen: Council for Technology and Innovation, Danish Agency for Science, Technology and Innovation, www.fist.dk
- *Dannemand Andersen, P.; Borup, M.,* Strategy processes and foresight in research councils and national research programmes. In: Proceedings (cd-rom). 2. International Seville seminar on future-oriented technology analysis (FTA): Impact on policy and decision-making, Sevilla (ES), 28-29 Sep 2006. (JRC-IPTS, [s.l.], 2006) 16 p
- DCIR 2006: Action Plan 2006-2007, The Danish Councils for Independent Research, Copenhagen: Danish Agency for Science, Technology and Innovation, www.fist.dk
- DCRP 2006a: Forskningspolitiske udfordringer - Identifikation af kernefelter for dansk forskning, Copenhagen: Danish Council for Research Policy, Danish Agency for Science, Technology and Innovation, www.fist.dk
- DCRP 2006b: Et værktøj til vurdering af forskningens kvalitet og relevans, Copenhagen: Danish Council for Research Policy, Danish Agency for Science, Technology and Innovation, www.fist.dk
- DRA 2006: Figures for Research 2005, Copenhagen: Danish Research Agency
- Eerola, Annele & Birte Holst Jørgensen (2002): Technology Foresight in the Nordic Countries, Nordic Industrial Fund, Risø Roskilde: Risø-R-1362
- Eibl, G., The Swedish Research System at a Glance – Key characteristics of a success story, unpublished paper
- Etzkowitz, Henry & Loet Leydesdorff (Eds.) (1997). Universities and the Global Knowledge Economy: A Triple Helix of University-Industry-Government Relations. London: Cassell Academic

- Gergils (2006), Dynamiska innovationssystem i Norden?, SNS förlag 2006
- Gibbons Michael, Limoges, Nowotny, Schwartzman, Scott & Trow (1994): The new production of knowledge. The dynamics of science and research in contemporary societies, London: Sage
- Granberg, A. and S. Jacobsson (2006) Myths or realicy – a scrutiny of dominant beliefs in the Swedish science policy debate, Science and Public Policy, Vol. 33, no. 5, pp321-240.
- Grønbæk, David 2001a: Mellem politik og videnskab – Reform af det danske forskningsrådssystem 1994-1997, (Between policy and science – reform of the Danish research coucil system 1994-1997), Københavns Universitet: Institut for Statskundskab
- Guston, David H. 2000: Between politics and science. Assuring the Integrity and Productivity of Research, Cambridge University Press
- IVA (2003), *Energiframsyn i Europa – Syntes och sammanfattning*, 2003
- Knorr-Cetina, Karen 1999: Epistemic Cultures. The Culture of Knowledge Societies, Cambridge: Harvard University Press
- Mejlgaard, N., K. Siune and K. Aagaard (2005). The use of expert knowledge and scientific advice - Survey amongst Danish MPs. The Danish Centre for Studies in Research and Research Policy, Note 2005/5.
- Meulen, Barend van der (ed.) 2002: Institutional Innovation and Europenization of Research, special issue of Innovation: The European Journal of Social Science Research, vol. 15, no. 4, pp. 261-398, UK: Carfax Publishing
- Ministry of Education (2005), *Research in Finland*
- Nowotny, Helga, Peter Scott & Michael Gibbons 2001: Re-Thinking Science, Cambridge: Polity Press
- Salo, A. and J. Liesiö (forthcoming), A Case Study in Participatory Priority-setting for a Scandinavian Research Program, Forthcoming in Intl. J. of Information Technology & Decision Making.
- Salo. A., P. Mild, T. Pentikäinen (2006), Exploring causal relationships in an Innovation program with Portfolio Modeling, Technological Forecasting and Social Change, vol. 73, pp1028-1044.
- Salo, A., J.-P. Salmenkaita (2002), Embedded Foresight in RTD programs, Int. J. Technology, Policy and Management, Vol 2, No 2, 2002.
- Salo, A., R. Gustafsson, I. Kaakkolammi, T. Gustafsson (2006), Participatory Development of Future-Oriented Policy Configurations for Climate Change and Mobil Gaming. In: Proceedings (cd-rom). 2. International Seville seminar on future-oriented technology analysis (FTA): Impact on policy and decision-making, Sevilla (ES), 28-29 Sep 2006. (JRC-IPTS, [s.l.], 2006)
- Teknisk Framsyn (2004), *Choosing Strategies for Sweden. A synthesis report from Swedish Technology Foresight.*
- TemaNord (2005), Statlige bevilgninger til FoU i de nordiske landene. Utviklingen i perioden 2000-2005 – metodebeskrivelser. Nordisk Ministerråd, Copenhagen. ISBN 92-893-1188-6. http://www.norden.org/pub/uddannelse/forskning_hojereudd/sk/TN2005551.pdf

b. Web resources

Denmark

Agency for Science, Technology and Innovation (FIST) www.fist.dk
Technology Foresight programme http://www.teknologiskfremsyn.dk

Finland

The Academy of Finland	www.aka.fi
The committee for the future, Finland	www.parliament.fi/FutureCommittee
Finnish Foresight Forum	www.ennakointifoorumi.fi
Ministry of education, Finland	www.minedu.fi
SITRA	www.SITRA.fi
TEKES	www.TEKES.fi
VTT	www.vtt.fi

Sweden

Formas	www.formas.se
SSF	www.stratresearch.se
Swedish Energy Agency	www.stem.se
Research.se	www.forskning.se
Swedish Research Council	www.vr.se
Swedish State Audit Institution	www.riksrevisionen.se
Swedish Technology Foresight	www.tekniskframsyn.nu
VINNOVA	www.vinnova.se
The Wallenberg Foundation	www.wallenberg.org

Nordic

Nordic Energy Research	http://www.nordicenergy.net
Nordic Innovation Centre	http://www.nordicinnovation.net
Norden (Research)	www.norden.org/forskning
Nordforsk	www.nordforsk.org

b. Interviews

Denmark

- Carsten Gaarn-Larsen, High Technology Foundation
- Lars Mikkelgaard-Jensen, Chair, Council for Technology and Innovation
- Hanne Haarup Thomsen, Ministry of Science Technology and Innovation
- Ole Fejerskov, Director, The Danish National Research Foundation
- Nina Smith, Professor, Chair, The Independent Research Council
- David Budz Petersen (and Vibeke Hein Olesen), Strategic Research Council, Danish Research Agency
- Anne Løkke, the Independent Research Council for Culture and Communication

Finland

- Paula Tiihonen, The committee for the future
- Annele Eerola, VTT
- Pirjo Kyläkoski, Academy of Finland

Iceland

- Vilhjalmur Ludviksson, Director, Science Office of the Ministry of Education and Science
- Eirikur Baldursson, Department Manager, Science Office of the Ministry of Education and Science.
- Edda Lilja Sveinsdóttir Department Manager for the Science office of the Ministry of Education and Science.
- Sveinn Thorgrimsson, Director, Industry and Innovation Office, Ministry of Industry and Trade.
- Hans Gudmundsson, General Director, RANNIS the Icelandic Center for Research.

Norway

- Tone Vislie, Spesialrådgiver, Divisjon for store satsinger Stab, Store Satsinger
- Olov Bardalen, Analysis and evaluation, Innovation Norway
- Jon Rogne chief economist Innovation Norway
- Lars Ødegård, Research Council of Norway
- Jan Dietz Research, Council of Norway

Sweden

- Sture Blomgren, Formas
- Leif Eriksson, Swedish Research Council
- Olof Lindgren, SSF
- Göran Pages-Fick, VINNOVA

Nordic level

- Liisa Hakamies-Blomqvist, Director, NordForsk
- Birte Holst Jørgensen, Managing Director, Nordic Energy Research

Risø's research is aimed at solving concrete problems in the society.

Research targets are set through continuous dialogue with business, the political system and researchers.

The effects of our research are sustainable energy supply and new technology for the health sector.