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Innovation Policy in Canada

Strategy and Realities

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itps SWEDISH INSTITUTE FOR GROWTH POLICY STUDIES

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Foreword

In the quest for sustainable growth, scholars and policy makers increasingly give attention to innovation and benchmarking on innovation-related issues is becoming an important industry policy tool.

For Sweden, having recently formulated and launched an innovation strategy, it is important to study and learn from the experiences of other countries. Canada has shown a significant motivation to develop its innovation capability. A number of efforts to improve the innovation climate including the development of a national Innovation Strategy, with very clear strategic goals, have appeared during the last five years. New measures are being taken almost every year and innovation policy matters are very visible in the Canadian political debate.

The study aims to create an understanding of how Canada acts to develop and improve its capability for knowledge-related innovation. It also explores areas for potential future cooperation between Canada and Sweden.

Four policy paths have been chosen as underlying themes for the study. The *balance between national and regional goals and effects* in Canada is found to be partly depending on the nature of the province or community where measures from different levels of government meet. *Formulating useful SME measures* is a difficult task since they often seem complex from the program maker's point of view – e.g. integrated business-technology advice, which implies a network of people with different competences but easily accessible through a low number of entry points. The Industry Research Assistance Program, IRAP, of the National Research Council, NRC, offers a successful example of this approach. The *efficiency in the use of public R&D resources* is related to the approach to commercialization of science and research in universities and research institutes that are publicly funded or owned. In international comparison, Canada seems to offer a fairly high degree of pull-oriented schemes. As for *international cooperation*, Canada is actively seeking to balance its natural strong links with the US through close involvement and cooperation in i.a. the EU RTD Framework Program.

The major part of this study was carried out during March–July 2004 by Thomas Liljemark, PhD, ITPS and partially Vinnova (The Swedish Agency for Innovation Systems), during an assignment to the ITPS office in Washington DC. The report has been edited by Sara Modig, Vinnova.

We hope that this study will work as inspiration as well as a policy learning tool for people involved in shaping the Swedish innovation system and that references will be useful for further studies or contacts.

Östersund April 2005

Suzanne Håkansson
Avdelningschef

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Author's notes

Canada is interesting for Sweden and other countries to learn from and cooperate with. Canada has a significant motivation to develop its innovation capability. A number of efforts to improve the innovation climate including the development of a national Innovation Strategy, with very clear strategic goals, have appeared during the last five years. New measures are being taken almost every year; innovation policy matters are very visible in the Canadian political debate.

Sweden has recently (July 2004) launched an Innovation Strategy. It is interesting for Sweden to reflect on the Canadian experiences of innovation policy implementation, and for Canada to reflect on the different paths taken in Sweden. Although there are major dissimilarities between the administrations in the two countries, interests in common are many, and from dissimilarities one can also learn.

The major part of the study was carried out March–July 2004, by Thomas Liljemark, PhD, ITPS and partially Vinnova (The Swedish Agency for Innovation Systems), during an assignment to the ITPS office in Washington DC.

It has not been possible to carry out this study without excellent interest and help from several devoted Canadians, who were very helpful in arranging meetings and providing material and who actively participated in many conversations during this period, primarily in 2004. Key persons here include: Dr Denys Cooper and Cathy Bakker in NRC (National Research Council) in Ottawa and Marie Savostianik, NRC/IRAP in Saskatoon, Kevin Fitzgibbons and Jack Smith in the staff of the National Science Advisor to the Prime Minister, Marie Tobin and Marshall Moffat in Industry Canada (the Ottawa office). Roland Kilpatrick, NRC/IRAP, spent four months in the year 2002 with Vinnova in Stockholm and played a special very important early role.

A special thanks is also given to Diane Palmintera, Innovation Associates, Washington DC (Reston Virginia), for very valuable comments during the study and writing.

Some of the Swedish persons who have been very helpful in the shaping of this report are Göran Marklund and Jennie Granat Thorslund, Vinnova, Lars Bager–Sjögren , Magnus Karlsson and Anna Nilsson, ITPS, Sven Sjögren, Ministry of Industry, Employment and Communication, Charles Edquist, Professor, Lund University and Åsa Ivarsson, the Swedish Defence Research Institutes. Other important persons dealt with in different meetings in Canada are mentioned in the text.

These persons are not in any way responsible for the text. The report is a mixture of facts (numbers and authorised texts in documents and homepages) and reflections, understandings and conclusions of the author, who is of course fully responsible for mistakes and misunderstandings still in the text.

Executive Summary

In the quest for sustainable growth, scholars and policy makers increasingly give attention to innovation. Innovation strategies are being designed in more and more countries. Benchmarking on innovation-related issues is becoming an important industry policy tool.

For Sweden, having recently formulated and launched an innovation strategy, it is important to study and learn from the experience of other countries. Canada offers a useful comparison, since it shows interesting similarities as well as differences to Sweden. Both countries face a growth challenge – Sweden needs to increase both the number of start-ups and growing companies while Canada's economic strength seems to lag behind the strength of the US, its foremost competitor as well as export market. The economic structure of Sweden and Canada respectively differs in respect to i.a. industry structure, where the Canadian industry is characterized by SMEs while Sweden's industry is dominated by a tenfold of very large and international companies. This structural difference has a very strong impact on national innovation policies and strategies, leading to different solutions offering valuable lessons.

The study aims to create an understanding of how Canada acts to develop and improve its capability for knowledge-related innovation. It also explores areas for potential future cooperation between Canada and Sweden.

Four policy paths were chosen as underlying themes for the study. The *balance between national and regional goals and effects* in Canada is found to be partly depending on the nature of the province or community where measures from different levels of government meet. There are examples of both correlation as well as competition between initiatives from different policy levels. The Canadian experience underlines the importance as well as the difficulties of taking the regional and local aspects into consideration when developing and implementing an innovation strategy. The *importance for SMEs* of a measure corresponds with the correlation between the function of the measure and the circumstances for the target group. SMEs often need measures that may seem complex from the program maker's point of view – e.g. integrated business-technology advice, which implies a network of people with different competences but easily accessible through a low number of entry points. The Industry Research Assistance Program, IRAP, of the National Research Council, NRC, offers a successful example of this approach. The *efficiency in the use of public R&D resources* is related to the approach to commercialisation of science and research in universities and research institutes that are publicly funded or owned. This is often handled by initiatives taking a push approach, while a market-pull approach may be more fruitful. In international comparison, Canada seems to offer a fairly high degree of pull-oriented schemes. As for *international cooperation*, Canada is actively seeking to balance its natural strong links with the US through close involvement and cooperation in i.a. the EU RTD Framework Program.

Canada's efforts in innovation policy were made possible through a major governmental cut in public expenditures, turning the federal budget deficit into the only budgetary surplus among the G-7 countries. The improved macro-economic situation has made possible i.a. strategic tax reductions, large increases in public R&D, strengthened the Venture Capital sector and measures to increase highly qualified labour through support for graduate university studies and improvements to Canada's immigration policies

In a major policy exercise, Canada's innovation strategy was published in 2002. The strategy was developed in two parts: one part related to education policy and one part related to mainly industry and R&D policy. The study focuses on the latter, which includes four areas: Canada's knowledge performance, skills, the innovation environment, and the need for strengthening the innovation capacity of communities The strategy enunciated a broad range of targets for the Canadian innovation policy efforts for the coming ten years, i.a. the doubling of federal investments on R&D. The innovation strategy has increased the policy focus on innovation issues. It has also led to a higher legitimacy for innovation-related issues in policy making.

There are many areas of common interest for the two countries. The increased understanding of how to use market pull approaches in the commercialization of knowledge produced in public research organisations; the exploration of different roles and relations between categories of public R&D players – government-owned institutes or universities; the discussion of approaches such as cluster programs, incubators, or foresight are examples of issues where both Canada and Sweden can benefit from a strengthened dialogue and cooperation.

1 Introduction and Framework

In Sweden, innovation has received growing attention from policy makers for a number of years. One of the first innovation agencies in the world was established in Sweden in 2001. It was not until 2004, however, that an innovation strategy was formulated and innovation policy thereby given a more formalised position in politics. In the implementation and further development of the innovation strategy, the experience and solutions of other countries offer lessons and perspectives of great value. In this chapter, it is argued that Canada is an interesting example for Swedish innovation policy makers to learn from. The purpose, scope and method of the study are presented.

1.1 Why Canada?

Canada has for long shown high ambitions in seeking to create more effective innovation systems. Innovation has become a leading concept in Canadian politics and a number of new measures and programs have been introduced during the last ten years. One of the measures is the Innovation Strategy, launched in November 2002 as an important policy action and a confirming document for reference and harmonization in policy efforts.

Canada is a successful country. It has a high standard of living, and for a number of years has had a higher growth rate than many other countries. The Prime Minister's reply to the Speech from the Throne in October 2004[1] stated that:

- Canada's growth in living standard: first among the countries of the G-7.
- Canada's job growth: fastest among the countries of the G-7.
- Canada's budgetary surplus: alone among the countries of G-7.

However, the income gap relative to the U.S. seems to be widening. This is one of the reasons why the Government of Canada seeks to develop innovation policy, as innovation is a major factor for growth. Productivity has grown significantly over the last number of years, but it has grown even more rapidly in the U.S. Compared to a number of other countries Canada's innovation performance is good, even if it should be noted that the country started from a low level. Canada seems to be moving in the right direction but still the government considers the country to be moving too slowly. For all these reasons, Canada has developed a national Innovation Strategy that was launched in 2002.[2]

There is great potential for mutual learning through cooperation and dialogues between Canada and Sweden. Both countries have good reasons to strengthen their innovation capacity. Canada needs i.a. to decrease the gap between itself and the U.S., while Sweden faces the long-term growth problem that growth in the SME category, in terms of both the number of new companies and the growth of existing

[1] *www.pm.gc.ca*

[2] *Observations on the Canadian Innovation System have been made by Technopolis in January 2003 (Arnold et al.); the conclusion i.a. being a need for focus and stringency.*

ones, is insufficient to compensate for the decreasing growth rate in Sweden of the Swedish global companies. Canada shares this challenge in part, in that companies are started in Canada to a reasonable extent, but without growing to the extent expected.

There are a number of circumstances that make relations between Canada and Sweden easy to develop, i.a. the fact that both Canada and Sweden are located in geographical fringe areas with economically strong central forces. It is also easy to find concrete areas for cooperation. The EU system (Canada pays much attention to relations with and participation in EU's framework program for RTD), SMEs and clusters programs as well as research programs primarily within biotechnology and telecommunications are examples of areas of mutual interest.

Swedish companies find Canada interesting for investments and establishments, since it offers a rich knowledge climate and a generous business climate, i.a. due to a client-oriented bureaucracy. There are several examples of such establishments, as well as cooperative research efforts, for instance in Biotechnology.

There are many similarities between the two countries (Liljemark et al. 2003):

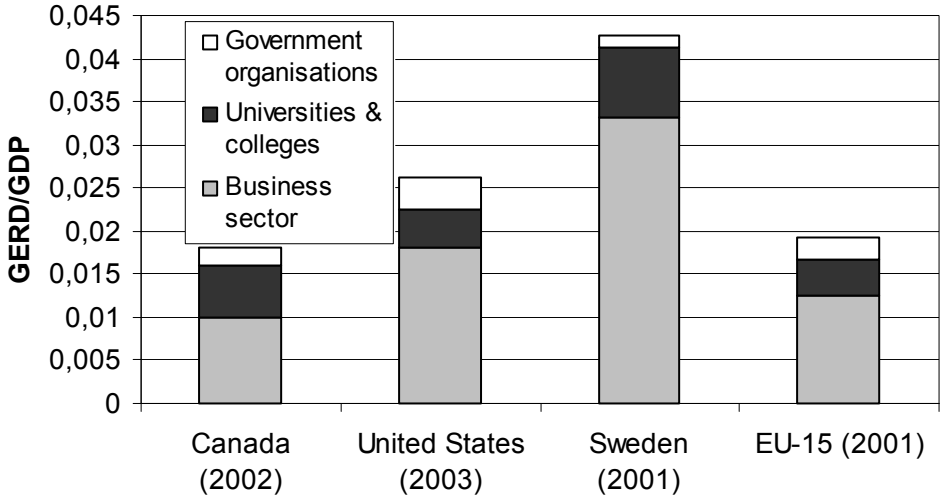
- High average level of education.
- High standard of living (environment, health and high length of life).
- Dependence on exporting.
- Long distances – need for good infrastructure (Canada has 31 millions inhabitants dispersed in an area that is larger than that of the USA).
- Demographic obstacles for increase of GDP – increase demands high increase in productivity and competence immigration.
- High IT density.
- Privatization and deregulation of the public sector and Government owned companies have been carried out.
- Publicly owned universities.

However, there are also differences: structures of industry and R&D as well as the fact that Canada is a confederation while Sweden has a centralised administrative system. These differences make comparisons and mutual learning possible, interesting and challenging.

The most important difference between the countries as far as innovation systems is concerned is the extreme dominance of ca 10 very large and international companies in Sweden compared to a typical small and middle-sized companies structure and culture in Canada. This structural difference has a very strong impact on national innovation policies and strategies.

The Canadian economy has traditionally been based on natural resources within the forest, mineral and energy sectors and suppliers and subcontractors to larger companies e.g. the car industry in the US.

Diagram 1 R&D expenditure in relation to GDP



Source: OECD MSTI

Due to its economic structure, Canada has historically spent relatively little resources on R&D, in total about half the amount spent in Sweden in relation to the GDP. In 2002, Canada's gross expenditure on R&D (GERD) as share of GDP amounted to 1,82 %, a decrease from 1,91% in 2001.

The main reason for the low total R&D expenditures is the low R&D expenditure of the private sector. As for public R&D expenditures, Canada is among the five leading countries in the world. Its gross expenditure on R&D (GERD) in 2002 was 20,7 BCAD, equivalent to ca 112 BSEK[3], of which ca 54 % were spent in the business sector, ca 34 % in the universities and ca 12 % in the government institute.

1.2 Purpose

The purpose of the study is to understand how Canada acts to develop and improve its capability for knowledge related innovation. The focus is not only on *what* Canadians do – this study is not primarily a survey – but also *how* they do it. The study aims to try to put measures taken in Canada in a context of modern innovation theory. Good and representative measures will be described, analysed and reflected upon, sometimes with a look at corresponding similar measures in Sweden or other countries. Part of the purpose of the study is to find out in what areas Canada and Sweden could increase cooperation for mutual learning.

During the last ten years (1994–2004), many innovation-oriented phenomena have been developed in Canada. This study aims to relate the story on the Canadian Innovation policy development during this period. Several political initiatives have been taken and a more formal Innovation Strategy was launched (2002). To give the reader a chance to understand how the Canadian system has developed, some of the measures and programs are described in detail with a short summary of their history.

[3] *1 Canadian dollars equals 5.40 Swedish krona.*

Canada's effort in innovation is of interest to many organisations in all sectors of the Swedish society. Some primary receivers of this study are:

- The Secretariat for Implementation of the Swedish Innovation Strategy[4], launched in July 2004.
- The Ministry of Industry, Employment and Communications.
- The Ministry for Science and Education.
- The Swedish Institute for Growth Studies, ITPS .
- The Swedish Agency for Innovation Systems, Vinnova.

There are also several organisations in Canada that show interest in these kinds of comparisons of experiences for learning and cooperation. This became evident e.g. at the TCI (The Competitiveness Institute) conferences in Gothenburg September 2003 and in Ottawa in September 2004.

1.3 Definition of scope

The focus in this study is knowledge-based innovation and its policies, as a broader and more relevant concept for economic development than e.g. research policy, education policy or entrepreneurship policy in themselves. As innovation and R&D are closely related it is impossible (and would be unproductive) to try to make any exact borderlines between the two concepts.

There are a number of paths along which public interventions in innovation systems can be characterized. These underlying paths can be found in more or less every version of innovation policy established so far. It is interesting for policy makers to make their consideration along such lines, depending on the circumstances in the region or nation, given that most measures take aim at improved growth in the economy by knowledge based innovation. For this study, the following paths have been chosen:

- Balance between national and regional goals and effects – correlation between initiatives from different policy levels in the community structure.
- Importance for SMEs – what are the circumstances that would facilitate sustained growth in SMEs in general and in technology-based SMEs in particular?
- Efficiency in the use of public R&D resources; commercialisation of science and research in universities and research institutes that are publicly funded or owned.
- International cooperation.

The selection has been made according to the time and resources available for the work as well as in line with the nature of the author's mission. The present report therefore focuses on the parts of the Canadian innovation policy related to industry

[4] *"Innovativa Sverige – En strategi för tillväxt genom förnyelse", Regeringskansliet 2004-07-07 (in Swedish).*

policy and research policy (see more on this in chapter 3 below). It has not been possible to include the parts related to education policy. For this reason, the reader should bear in mind that the references in this report to "Canada's innovation system" exclude education policy.

1.4 Method

The method of work is a combination of desk studies and interviews with key persons, primarily during two trips in Canada in April and June/July 2004, but also earlier experiences in Canada. It has not been possible to visit all the Canadian provinces; the resulting selection is based on what has been practically feasible and must not be understood as any kind of interest ranking. Places visited during those trips are Ottawa, Toronto, Calgary, Saskatoon and Winnipeg, and most of the provincial examples in this report emanate for natural reasons from those places.

2 Conceptual Framework

This chapter briefly recapitulates the concepts and theoretical discussions concerning innovation and innovation systems. A presentation of the arguments for paying special attention to the needs of SMEs in innovation policy is also made.

The focus of this study is on *innovation* and the context in which innovation arises. Innovation is here understood as:

> *New goods and services, new business models or markets, new processes or organisation of production, new competences or input sources.*[5]

Innovation is a commercial activity and the concept expresses a change that is introduced. It always takes place in an environment more or less conducive to innovation, an entrepreneurial climate. Co-action between the individual entrepreneur or the innovating company or group of companies and a variety of surrounding functions in organisations or other companies, that are accessible in the individual case, is the key element in innovation.

In general, continuous learning, flexibility, dynamism and change flourish in such environments by cooperation between different organisations. Geographical proximity is important in such cooperation as it facilitates the development of personal networks, trust and mobility. Education, research, venture capital, consultants, customers, suppliers, legal advisors, accountants, competitors and public measures etc. are present. Furthermore, strong such dynamic environments are characterised by openness and a rich contact network also outside the near environment, nationally as well as internationally. The importance of tacit knowledge as opposed to only codified knowledge, as a key to innovation, requires close social interactions. The local environment thus becomes more and more important for the competitive power of the individual company, at the same time as markets and resources internationalize rapidly. The reason is that the innovative capability of a company in a rapidly changing world is dependant on cooperation with other companies and other organisations.

During the last fifteen years a more rigid *systemic view* on innovation courses and success of innovating bodies thus has appeared and grown (Freeman 1987, Lundvall 1992, Edquist 1997). The concept of *innovation system* can be used in different structures. The concept of Innovation Systems is here understood as:

[5] *This is basically in line with the broad definition of innovation suggested by Schumpeter in 1934 and the focus of most innovation related research and analysis since then (from Marklund et al. 2004)*

> *The network of organisations, individuals and institutions which determine and shape the generation, diffusion and use of technology and other knowledge, which in turn, explain the pattern, pace and rate of innovation and economic success of innovation.*[6]

A *national innovation system* can be described in terms of important players, e.g. large and small companies, universities, and institutes, together with framework aspects such as access to risk capital and the design of some legislation and regulation. The government plays an important role in the national innovation system, both as source of funding and as legislator. The concepts of sectoral and regional innovation systems are used to describe networks of agents and framework conditions that are significant for a certain sector, e.g. a technology, or a region. Examples on factors that are unique for a certain place or region can be the existence of specialised knowledge, local social networks and trust or share values between parts concerned, the *place bound competence* (Deiaco, Giertz, Reitberger 2002). The concept of *communities and community-based innovation*, commonly used in Canada, belongs in this context.

Innovation systems can be considered as looking at and describing the innovators in their infrastructures for innovation with complex patterns of relations in a *Triple Helix structure* (Etzkowitz 2002), partially built on patterns of *Partnerships* between organisations in the public, profit oriented and university sectors. Some researchers (e.g. Chaiton, Rosenberg) speak about *4th pillar organisations* leading to *Quadruple helix* structures. *4th pillar organisations* are independent, not-for-profit, member-based organisations which combines funding from the government and the private sector. This kind of organisation is common in Canada. They are considered to be important players in the Canadian innovation systems as they work in the border areas of and create links between Triple Helix organisations[7].

Innovation systems never reach equilibrium, as innovation processes are evolutionary (Edquist et al. 2004–2005). Key individuals and entrepreneurs often break established systems and structures and create new ones. Edquist calls those factors that influence the development, diffusion and use of innovation "activities".[8] The

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[6] This is basically in line with the different variations of innovation system definitions adopted by different researchers and the OECD. However, it explicitly contains individuals and it explicitly includes the economic impact of innovation systems. None of these aspects is generally explicitly included in innovation system definitions used in the research literature. A more action-oriented innovation system concept is used by Vinnova as a tool for innovation policy programs where the aim is to promote efficient interplay between different agents in innovation systems. Innovation systems is then understood as: "Agents within research, business and politics who in interplay generate, exchange and use new technology and new knowledge for sustainable economic growth through new goods, services and processes." (from Marklund, Nilsson, Sandgren, Granat Thorslund, Ullström: "The Swedish National Innovation System 1970-2003", Vinnova ANALYSIS VA 2004:1)

[7] OCRI, see chapter 5, CANARIE, see chapter 3.6 and Precarn (www.precarn.ca) are examples on Canadian 4th pillar organisations

[8] Examples of such activities are "Provision of Research and Development creating new knowledge, primarily in engineering, medicine and the natural sciences" and "Formation of new product markets".

concept of activities is a structuring device for studies of Innovation Systems. Organisations (and individuals) are the actors that actually carry out the activities and they do so within a framework of institutions, which constitute incentives or obstacles to them.

Dynamic Clusters (Porter 1990) play a crucial role in the development of communities and functional regions (the sum of all relations developed in a community, not necessarily bound by administrative borders) and develop the innovation system by qualified demand for competence and other kinds of resources. Porter observed that cooperation for commercialisation of research and for innovation mostly takes place on distances less than 100 km. Communities and cluster policy thus become more and more important for the innovation capacity of a country, region or province.

The approach in this study is to focus on *innovation policy*. In the Canadian context this means a focus on what directions and with what strategies public policy measures for improving the innovation system are developed.

Innovation is closely linked to *entrepreneurship* and its policies. There seems to be a widely spread opinion that, in well-balanced developments of innovation systems, special efforts directed towards new and existing small companies and their technological upgrading are needed. The reasons for this are i.a. that SMEs find it difficult to capture enough market volumes over the long term to motivate large enough investments in innovation. Due to size, SMEs also are extremely risk exposed, since they often are dependent on very few products. This means that failures of just one or two products can be disastrous.

Furthermore, SMEs often have difficulties assessing technologies and support structures for partnerships in their development, since major deliverers of technological services like universities and institutes normally tend to "productify" their offers for larger business. This challenge is partly related to the SMEs' need for integrated technology-business advice – a network development effort – meaning that technology offers must most often be integrated with advice on e.g. business or investment plans, organisation changes and IPR. This implies that SMEs normally need a team (a "micro innovation system") to cooperate with for management capacity development.

Efforts represented in this category are important elements in the innovation policies of most countries and regions.

3 Innovation policy in Canada

In this chapter, we take a closer look on how innovation became one of six priority areas within the Canadian Government, as the development of Canada's innovation policy and the Canadian innovation strategy are looked into.

3.1 From Productivity Focus to Innovation Orientation

Canada's innovation policy grew out of an acknowledgement that as productivity was a major weakness in Canada, particularly as compared to the US. Around 1995, policy makers started to think about the factors that make some nations "winners". It was a process of learning, and with increased understanding comparisons became possible. The European countries were studied carefully, in particular UK and Sweden, as well as the R&D and innovation systems of the EU. Commercialization or commercial use of research results was found to be small in Canada; there was an analytical problem to understand why. Investments in R&D became a key question for the national government. Initially, the work focussed on the universities and technology transfer. The scope has since then broadened to include also tax incentives, legislation and the use of IPR.

The more formal Innovation Strategy was launched in 2002, see below, but key processes in transforming Canada into a more knowledge-based economy went on both before and in parallel with the development of the strategy.

In short Canada, through its government, has done a number of things since 1997 to advance innovation. The program review exercise of 1994–1998 reduced government expenditures in order to eliminate the federal deficit. The favourable macro-economic environment that this exercise resulted in permitted the government to implement tax reductions and to make investments in innovation. The government has i.a.:

- improved the business marketplace environment by reducing corporate, personal and capital taxes, and by steadily improving the regulatory environment. The new "Smart Regulations exercise" has the objective of making further progress in this area
- invested in R&D in the university, business and government sectors with the emphasis on new programs to support university research and the SR&ED tax incentive for businesses
- made commercialization a current priority which has been facilitated by stimulating collaborative research links between the research and business sectors (e.g. the Networks of Centres of Excellence Program (see appendix), the Sustainable Development Technology Fund, and NRC's Innovation Clusters (see below)) and by the new initiatives in the Budget 2004 to increase seed-stage venture capital funding and build commercialization capacity in the university and government research sectors

- acted to increase the availability of highly qualified people through support for graduate university studies and improvements to Canada's immigration policies to help attract and integrate highly qualified immigrants. In the Speech From the Throne9 in October 2004, it was said that the federal government aimed to work with the provinces and business to improve workplace skills training.

3.2 Towards an Innovation Strategy

The more formal development of an innovation policy started with the publication of a series of policy documents emanating from both the Department of Finance ("A New Framework for Economic Policy") and the Department of Industry ("Building a More Innovative Economy") in 1994.

In 1996, a Science & Technology Strategy was enunciated. In 1998, Industry Canada10 was asked by the Cabinet to formulate an innovation framework for Canada. The budgets of 1998 and 1999 contained several new measures to foster innovation in Canada but the real impetus came in 2 000 when, in a speech at the Board of Trade in Toronto, the Minister of Finance11 stated that Canada should seek to move from 15th to 5th country in Governmental Expenditure on R&D as share of the Gross Domestic Product until 2010. This implied tripled research investments in Canada in 10 years.

It is interesting to note that the statement from the Minister of Finance was a surprise for the staff of Industry Canada, who was put in charge of developing one major part of the strategy for reaching this target. In January 2001, the target was mentioned again in the Speech from the Throne, and in his response the Prime Minister added a further commitment to double federal investment in research and development by 2010, which implied a 7 % increase per year.

Industry Canada initiated work to document the necessary indicators, including the investments necessary to increase Business R&D, University R&D and Government R&D in order to reach the target. It was found that where the most catch-up was needed vis-à-vis other countries was in the level of business expenditures in R&D, (BERD). Canada's BERD was 1.01 % in 1998, ranking 13th in the OECD and well behind the 5th place of 1.93 %. After the initial economic studies, the Minister of Industry decided that a full innovation strategy was required in the country and sought his cabinet colleagues' approval to produce such a strategy and to lead consultations on this topic.

Due to the administrative system in Canada – education policy is the responsibility of the provinces –, the work with the Innovation strategy had to be divided into two parts. Industry Canada became responsible for the design and production of

[9] "The Speech From the Throne", held by the Governor General, and the Prime Minister's reply to it, sets out the government's broad goals and directions. It corresponds to the Swedish "Regeringsförklaring" held by the Prime Minister at the yearly opening of the new session of the Parliament.
[10] Industry Canada, the Ministry for Industry etc., corresponds with important exceptions to the Swedish Ministry for Industry, Employment and Communications
[11] Paul Martin, later the Prime Minister of Canada (2003)

"Achieving Excellence[12]", a document focussed on research, highly qualified personnel, business environment and communities, while the Minister of Human Resources published another document "Knowledge Matters[13]" which covered all facets of learning.

As already noted above, the present report deals only with issues and organisations that are linked to the part of the strategy handled by Industry Canada.

3.3 Development and Coordination of the Innovation Strategy

Industry Canada carried out its work in cooperation with "The Conference Board of Canada", a private organisation of think-tank-character. The Innovation Strategy secretariat in Industry Canada employed 15 people.

Initially, the scope was rather fragmented with a strong focus on the universities. Soon, however, it took a more system-oriented view and was broadened to include industry related issues like tax credits and other relieves as well as IPR and competition legislation. It should be noted that there were issues included in the work that were not under Industry Canada jurisdiction, e.g. skills, that falls under the jurisdiction of the provinces.

Both parts of the Innovation Strategy were released in February 2002 and were consulted on broadly throughout that year, culminating in November in the high-level meeting "The National Summit on Innovation and Learning", in Toronto under the authority of the Prime Minister.

In the process of developing the strategy leading to the National Summit over 10 000 individuals from all sectors of society and 249 policy sectors were involved, 34 major events were arranged; all in all an enormous consultation process. During the consultations ca 400 documents were received, most of them were laid out on the web. "Canadians speak on innovations" (a communication in TV of the kind "letter-to-the-editor") attracted ca 10 000 Canadian viewers during the two years period of work with the document. The total cost has been estimated to ca 14 MCAD[14].

All documents and other information related to the Innovation Strategy can be found on the web, www.innovation.gc.ca.

In public sectors like environment and schools the concept of innovation has grown stronger during the process. The Minister of Industry at that time, Alan Rock, had a strong position, which probably contributed to this.

[12] *www.innovation.gc.ca/gol/innovation/site.nsf/vDownload/Page_PDF/$file/summary_e.pdf*
[13] *www11.sdc.gc.ca/sl-ca/doc/toc.shtml*
[14] *1 CAD equals ca 5.40 SEK.*

3.4 Canada's "Achieving Excellence"

The strategy was developed along what came to be four main themes:

- knowledge performance – addressing issues concerning
- university research (i.a. commercialisation including partnerships with private sector)
- policy making based on science and technology, and
- private sector innovation (commercialization programs in certain areas such as biotech and ICT, mining and forestry, support to SMEs capability to assess and access global technology i.a. through international alliances and ventures, increased supply of venture capital).
- Skills – initiatives addressing the need for an increase in the number of graduates as well as immigration of skilled workers.
- Innovation environment – with initiatives concerning i.a. taxation and inward investment as well as attitudes to and reliance for science, research and innovation.
- Strengthening Communities – supporting globally competitive industrial clusters and the development of innovation strategies for smaller communities.

"Achieving Excellence" restated the 5th place target and the commitment to at least double federal investments on R&D. A broad range of other targets was added, including:

- Ranking among world leaders in share of private sector sales attributable to new innovations.
- Raising venture capital investments per capita to US levels.
- Increasing graduate student admissions by an average of 5 % per year.
- Improving recruitment of foreign talent.
- Increasing the number of adults pursuing learning opportunities by 1 million.
- Regulatory reform.
- Competitive business taxation regime.
- Development of at least 10 internationally recognized technology clusters.
- Improved innovation performance of communities.
- High-speed broadband access widely available to Canadian communities.

It invited public discussion of all the goals and commitments from all parts of the economy (provincial governments, universities, private sector) and also secured commitment on university research (double university research performance and triple commercialization performance by 2010).

3.5 Implementation of the Innovation Strategy

The launch of the Innovation Strategy in 2002 was an important innovation policy event, but the implementation of the strategy is an ongoing process. The Innovation Strategy has become a kind of reference document in this process that makes it easier for officials to make their efforts legitimate.

Key priorities in the implementation of the strategy are defined in the yearly budget process where major funding assignments are made. As part of this process, Innovation Canada makes a number of innovation strategy based proposals to the Minister of Finance. The fiscal year runs from April 1.

An important tool for the evaluation of Canada's performance and for benchmarking it towards the targets of the Innovation Strategy is the yearly report on S&T strategy implementation. This report contains written summaries on the progress towards the goals set in the strategy from public servants, senior officials and ministers.

The major players in the implementation of innovation policy and the Innovation Strategy are described in the appendix.

3.6 Results of the Innovation Policy

Among leading policymakers in Ottawa there is definitely a trust in Canada's innovation ambitions, based more or less on the process of the Innovation Strategy[15]. The strategy has created a common context for old and new efforts and generated a stronger political visibility and support for innovation policy.

The envisaged reinforcements of the governmental R&D budget have been realised. Since 1998, the federal government has invested more than 13 BCAD (ca 70 BSEK) in research and innovation. The transformation of the Medical Research Council to the Canadian Institutes for Health Research was a major initiative that has resulted in more than a doubling of funding in health research since 1997.

Special organisations have appeared, e.g.:

- Canada Foundation for Innovation, CFI.
- Genome Canada (grants Genome research).
- CANARIE (grants broadband research and installation).
- Sustainable Development Technologies Canada (grants for environmental technologies and green house mitigations).

The current Prime Minister Paul Martin, in his capacity as Minister of Finance, helped launch CFI and Canada Research Chairs (see appendix). He also contributed to making the Networks of Centres of Excellence (see appendix), NCE, permanent.

[15] *Kevin Fitzgibbons,* Office of the National Science Advisor

There are currently 12 similar organisations. Since they are given the function of foundations, only one fiscal allocation decision is required to fund them is needed, i.e. they load only one fiscal year and by that only one budget. The major part of these foundations were initiated by the Parliament, even if some existed already before the Parliament involvement. There are also a few that emerge from other sources. The Parliament prefers to create them itself, since this strengthens the influence of the Parliament.

As a result of the innovation-driven tax reforms made both before and as suggested by the innovation strategy, Canada today has lower company taxes than the US.

During 2005 there will be a particular emphasis on the "Commercialization of Research" issue. This was reiterated by the Minister of Industry in a speech to the Canadian Chamber of Commerce in September 2004, in which he stated "it is essential that research outcomes do not remain trapped beyond the reach of private sector enterprises that can commercialize them and deliver benefits to Canada". In the Speech from the Throne of October 5 2004 commercialisation was again stressed with a special emphasis on the Business Development Bank of Canada.

In the Prime Minister's October 2004 reply to the Speech from the Throne a new initiative was announced to give the Canadian Academies of Science a mandate to "create a national alliance of leading scientific and engineering societies, one that will operate at arm's length from government and receive operational funding of 35 MCAD over the next 10 years". The most recent budgetary results are

- Commercialization of research in Universities, 50 MCAD, and government laboratories 25 MCAD. These actions will get an Advisory Committee composed by members from the private sector.
- 90 MCAD to the Granting Councils plus resources for covering indirect costs.

During 2005, there will be a "high level policy-advice" from the Advisory Council, ACST (see appendix) on issues on commercialization, community/regional development and on methods for assessing research impacts.

Even if the majority of people working with innovation-related issues seem to be in support of the strategy, there are some critical voices heard too. One point made is that the strategy tends to give too much attention to research and that this makes the whole framework too static.

It is also questioned whether the strategy is possible to implement in places other than the largest cities, as resources in other parts of the country often are scarce and not available as matching funds. Many leading policy makers in the provinces mean that the strategy tends to neglect things happening outside Ottawa.

3.7 Future developments of Canada's innovation policy

The innovation strategy provides a framework that continually leads to new ideas and measures. Issues that are discussed as important for future development are i.a.

- The need to stretch goals further.
- Weakness in business spending on R&D.
- Government's role, and integration of S&T.
- The need to strengthen the demand side in the process of commercialization of research.

Canada also needs to further develop:

- *A long-term view on Big Science and big picture on needs for S&T.* Big Science here refers to major projects and infrastructure investments, e. g. The Canadian Light Source, see chapter 5.5. How is the non-linear need oriented model that might constitute innovation, compatible with academic fundamental long-term scientific research? Scientific research in relation to "Benefit for Canada", is heavily striking in the Canadian policy debate on innovation and research.
- *The immigration system.* Even if advanced by international standards[16], there is an acknowledgement in Canada that the growing deficit of skilled labour – the need for engineers has e.g. been estimated to exceed the output of the domestic education system by 80–100 000 persons – needs further development of immigration legislation and policy. This ambition is confirmed in the Prime Minister's reply to the Speech from the throne.
- *Performance indicators for innovation.* Statistics Canada works on indicators to compare with the US and do benchmarking with Europe, especially in terms of the Lisbon goals. In Statistics Canada's work, external researchers have the possibility to join cooperative benchmarking projects for an entry fee of 10 000 CAD.

3.8 Lessons from ten years of innovation policy

In looking back, Innovation Canada mentions several lessons that can be drawn from Canada's experience in innovation policy-making over the past decade.

1. Effective policy making starts with sound economic research and analysis at the international and national levels, and increasingly at the firm and community levels.
2. Having a clear idea of where you want to go and a sense of priority in terms of what is most important is also critical. Setting goals and intermediate targets for attaining these goals do help. Goals and targets also help to build consensus and work through partnerships.

[16] *Canada has high ambitions within competence immigration; e.g. a detailed "self evaluation" questionnaire is available on Internet for highly educated individuals with interest to immigrate to Canada.*

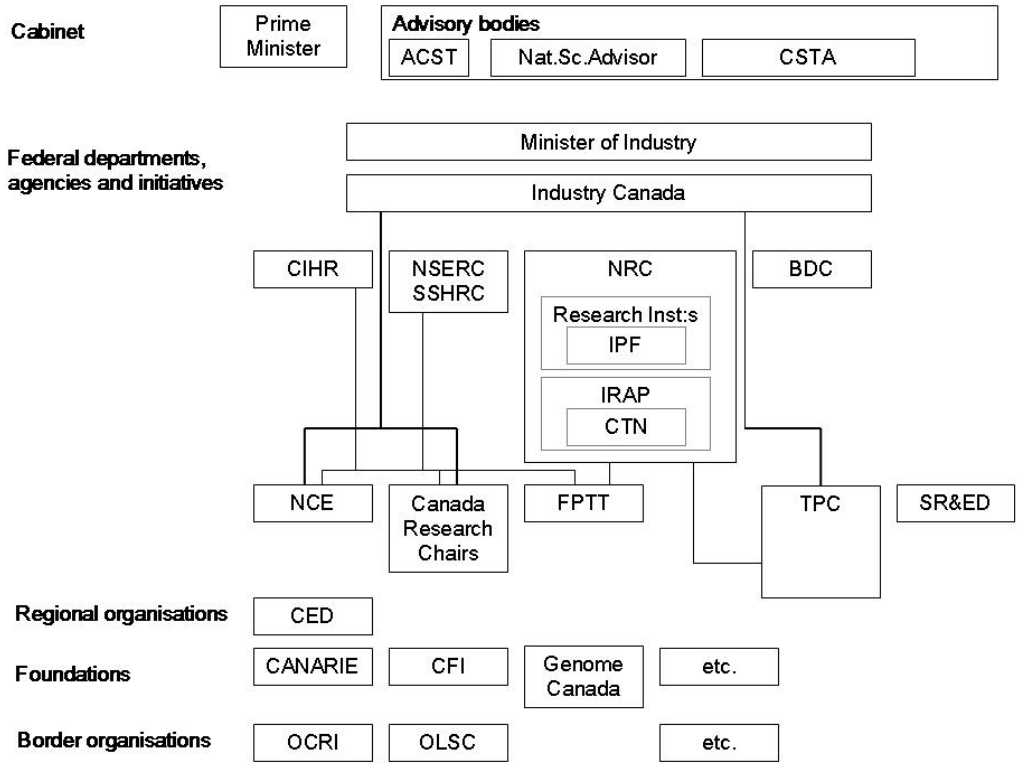
3. Effective policy is results-oriented. The only way to know if policy is having the desired effects is to find better ways to benchmark outcomes.
4. The policy mix matters as different objectives may require different instruments; and while this means a mix of indirect and direct policy tools, as much as possible policy should strive to be pro-market and pro-adjustment.
5. Finally, it is important to be flexible in tactics, but you have to stay the course as it takes time to generate tangible results.

4 Key Public Organisations in the Canadian Innovation System

In the first part of this chapter, a brief overview of the key public organisations and initiatives in the industry and research policy part of the Canadian innovation system on federal level is provided. More elaborate descriptions of the bodies are found in appendix. Following this presentation is a case study on the National Research Council of Canada, NRC.

4.1 Overview of organisations and initiatives

Figure 1 *Major organisations and programs in Canada's innovation system on federal level*



Genome Canada and CANARIE are treated above (see chapter 3.6). OCRI and OLSC are examples of 4th pillar organisations discussed in chapter 2, and are further discussed below in chapter 5.

On ministerial level, the Prime Minister's *Advisory Council on Science and Technology (ACST),* the *National Science Advisor,* and the *Council of Science and Technology Advisors (CSTA)* that provides strategic advise to the government on science, technology and innovation related issues.

Industry Canada (IC), led by the Minister of Industry, is the government department responsible for the Industry Portfolio, including innovation and SME related issues. Included in the Industry Portfolio are i.a.:

- *National Research Council of Canada (NRC).*
- *Two of the granting research councils – N*atural Sciences and Engineering Research Council of Canada (NSERC) and Social Sciences and Humanities Research Council of Canada (SSHRC). The third granting research council, Canadian Institutes of Health Research (CIHR), falls under the responsibility of Health Canada, the government department for health policy.
- Business development bank of Canada (BDC).
- Canada Economic Development for Quebec Regions (CED).
- Canada Foundation for Innovation (CFI).

Some of the major innovation policy related programs and initiatives run by these organisations are (further information is found in appendix):

- IC:

Networks of Centres of Excellence, NCE (in collaboration with the granting research councils) – partnerships among universities, industry, government and not-for-profit organizations.
Canada Research Chairs (in collaboration with the granting research councils) – a large-scale program to increase the quality of Canada's academic research through i.a. attracting world-leading scientists.
Technology Partnerships Canada, TPC, (in collaboration with NRC) –provides companies risk financing, not least to large companies like IBM and Ericsson.

- NRC:

Federal Partners in Technology Transfer, FPTT (a partnership of 16 federal organisations, e.g. NRC and the Granting Councils.) – with the aim to achieve better use of results and demand oriented effects of Canada's ca 360 research establishments
Canadian Technology Network, CTN (integrated in NRC's IRAP, but run by a large number of members including NRC-IRAP and IC) – offers everywhere "just-in-time" information for SMEs.

- NSERC:

I2I, "Ideas to Innovation", that provides funding to university researchers for research and development activities leading to technology transfer to a new or established Canadian company.
POP (proof of concept) program (in collaboration with CIHR)

NRC's *Research Institutes, Industrial Partnership Facilities (IPF)* and *Industrial Research Assistance Program (IRAP)* are described in the case study below and in chapter 5.

Canada Revenue Agency, the government agency in charge of the tax system, runs the *Scientific Research and Experimental Development (SR&ED) Program*, that is largest single source of federal government support for industrial research and development.

4.2 Case study – the National Research Council of Canada, NRC

The National Research Council of Canada, NRC[17], is, in spite of its name, not a research granting council, but predominantly an R&D performer and an implementing organisation. The goals of NRC can be said to be the same as those of the Swedish agency for Innovation Systems, Vinnova, even if the ways of implementation are very different. NRC is composed of 24 different institutes and runs a number of national programs that span a wide variety of disciplines and offer a broad array of services. It is present in every province in Canada and plays a major role in stimulating community-based innovation.

In 1978 the NRC's role as granting council for the universities ceased with the creation of the Natural Sciences and Engineering Council, the Medical Research Council and the Social Sciences and Humanities Research Council. This initially caused competition between NRC and the new bodies. Over time, more and more cooperation has developed, as described in the following sections.

NRC is the Government of Canada's largest S&T agency with 4500 employees and 1200 guest researchers. It reports to the Parliament, through the Minister of Industry. In 2003, its budget amounted to 800 MCAD (4,320 MSEK[18]).

NRC has regularly received increased budgets earmarked for special efforts. The funding for research fields already established have however remained at the same level for several years, even if costs to maintain facilities and equipment have increased.

The dominating two pillars of NRC are the research institutes and the IRAP program for SMEs. Even if many of the research institutes are located in Ottawa, more than half of them are located outside Ottawa in locations across Canada. IRAP is, through the programme's ca 260 Industrial Technology Advisors, ITAs, located in 90 communities in universities, agencies, institutes etc.; all together approximately 100 organisations. There are some interesting examples of coordination between NRC's different functions. In Winnipeg, Manitoba (see below), there is good cooperation between the NRC Institute for Biodiagnostics, with its IPF, Industrial Partnership Facility (Incubator) and IRAP.

NRC institutes and programs are organized into three key areas:

- Physical Sciences and Engineering.
- Life Sciences and Information Technology.
- Technology and Industry Support.

[17] *www.nrc.ca*
[18] *1 CAD equals 5.40 SEK.*

The Physical Sciences and Engineering Sector includes research institutes in areas of aerospace, astrophysics, construction, fuel cells, chemical processes and environmental technology, manufacturing technology, industrial materials and ocean technology.

The Life Sciences and Information Technology Sector includes research institutes that conduct research in biotechnology, biosciences, biodiagnostics, molecular sciences, nanotechnology, metrology, microstructural sciences and information technology Technology and Industry Support includes a number of industry-facing services, such as NRC-CISTI[19] (Canada Institute for Scientific and Technical Information) and the NRC-IRAP (Industrial Research Assistance Program), which focuses on the needs of small and medium-sized businesses. In this sector are two technology centres, the Canadian Hydraulics Centre and the Centre for Surface Transportation Technology, both of which operate on a cost-recovery basis and provide unique expertise and facilities in hydraulics fields and vehicular engineering.

Foresight is an important task for NRC. Canada takes part in international cooperation within the field.

When looking back on the development of NRC during the period 1995–2003, Arthur J Carty[20], former President of NRC, stressed i.a. the fact that an evaluation had shown that IRAP was one of the best SME programmes in the world as well as the fact that the budget of NRC currently was the largest in its history. He also highlighted the fact that there now were NRC institutes in all provinces and he underlined the need for more of the "Industry Partnership Facilities", which are NRC incubators.

Dr Carty also developed a vision for NRC, in which he stressed the importance of being able to move from risk adversity to dynamics, focusing on R&D excellence in parallel with multidisciplinary integration. Quickness, risk willingness and creativity were judged to be important in an environment shaped by the recognition of the importance of teamwork as well as networking. The open laboratories where large parts of the staff are guest researchers will demonstrate this, as would the many partnerships with non-research organisations and the ambition to increase international cooperation.

NRC Institutes

NRC has 24 research institutes/labs with 4500 employees, 1200 guest researchers and a total yearly budget of 650 MCAD. Institutes get a base funding within NRC, called "core funding". In addition, they are encouraged to seek other sources of funds to augment their budgets and to help cover costs of salaries, facilities and equipment. An NRC institute cannot apply for government money from the granting

[19] *CISTI, the Canada Institute for Scientific and Technical Information, is one of the world's major sources of information in all areas of science, technology, engineering and medicine.*

[20] *Presentation by Dr Carty at the "NRC- IRAP" Reunion 2003 (the first conference with all the 260 ITAs gathered). Dr Carty was in April 2004 given the position as the National Science Advisor to the Prime Minister*

councils, as it is a part of government. Joint applications led by a university with NRC institute participation are acceptable.

There are institutes in all provinces. The amount of relations with universities, industry and public organisations have increased dramatically since the mid 90's[21].

NRC has a central unit of about 20 people to assist the institutes in commercialization of their research results; three of whom work strictly with new companies, about 40 per year.

All institutes have "Business Development Centres", dealing with relations to cooperation partners. An entrepreneurship program was started 1994. In the beginning of this program all of the entrepreneurs were researchers from within the institutes themselves. With the burst of the economic bubble, a tougher climate developed. As a result, entrepreneurs participating in the program today are experienced businessmen and women from outside the institutes.

Further descriptions of some three of NRC's 24 institutes can be found below in chapter 5.

4.2.1 The Industrial Research Assistance Program, IRAP

IRAP is described by NRC as

> *The National Research Council's Industrial Research Assistance Program" (NRC-IRAP) is Canada's premier innovation assistance program for Canadian small and medium-sized enterprises (SMEs). It is a vital component of the NRC, a cornerstone in Canada's innovation system, regarded worldwide as one of the best programs of its kind.*
>
> *As a key enabler within Canada's innovation system, NRC-IRAP provides Canadian SMEs with value-added technological and business advice, financial assistance and a range of other innovation assistance. NRC-IRAP helps SMEs realize their full potential, turning knowledge and innovation into strategic opportunities, jobs and prosperity for all Canadians.*[22]

IRAP has operated for fifty years. It funds highly innovative technology with a market pull and a high degree of risk. It is sometimes described as a kind of national "Angel" network with public funding. It is a national effort with a regional focus that continuously has to find partners for regional and local activities.

Major tasks for IRAP are:

- To expand Canada's innovation system internationally, the most important challenge for the future.
- To understand the needs and the situation of the clients as well as how to introduce systems behaviour.

[21] *"The National Research Council and the Canadian Innovation System", Cathy Bakker,* NRC, *September 2002*
[22] *http://www.nrc.ca/irap/*

- To develop networks, electronic and others, ITAs phone conferences, customer relation systems, intranet, site visits.

The IRAP budget is ca 150 MCAD per year. According to the Innovation Strategy the resources should be doubled. Whether this will come true and when is not decided on. International efforts are to be given more attention in future budgets as that budget line is foreseen to increase by a factor of seven.

IRAP includes 260 Industrial Technology Advisors, ITAs, well distributed across the country. They offer technological assistance and financing for small and medium companies. The target group is innovative smaller companies (less than 500 employees). In order to minimise the risk of conflicts of interest between the client and the host organisation of the ITA, all ITAs are employed by and get all expenses covered by the NRC. Virtually all ITAs have come to IRAP with at least 10 years of industry experience. In total, ITAs have around 12 000 clients each year, of which around 3 000 get financing. On average, the ITAs deliver 14 funded projects each to a total cost of approximately 400 000 CAD per year.

The core task of the ITAs is to implement IRAP, which means to reach companies, offer technical advice and financing, carry out market studies, and offer feasibility studies for "proof of concept". They signpost, form teams and reduces the risk level of the client's project and increases its chance for technical and commercial success. It becomes more and more important to find or develop embryonic, local clusters that offer a beneficial environment for SMEs. There were also a few central ITAs with certain specialities, but recently these have been devolved to the regions.

ITAs handle funding for small businesses according to the following categories:

- Contributions less than 15 000 CAD, decision within 10 days, at least two ITAs.
- Contributions less than 100 000 CAD, decision within 30 days, with a team plus Director, depends on the province.
- Contributions on more than 100 000 up to 500 000 CAD, decision within 90 days, more extensive team.
- Contributions more than 500 000 CAD, Director General.

Contributions do not exceed 50 % of the total project cost. There are no repayment terms.

In an evaluation of projects funded during 1996–2001, it was shown that IRAP has generated 11 BCAD in turnover and 73 BCAD as forecasted turnovers. During the period IRAP reached 37 000 client companies content.

There is pressure both from outside and inside the program itself for IRAP to go towards larger projects. Some officials want to have the breath and a small number of large projects.

IRAP has recently gone through a major reorganisation to strengthen the regional and local presence and to get clearer routes for reporting. What implications this will have is too early to say. After the reorganisation, IRAP has got one Executive

Director and 50 "administrators" (mainly) in Ottawa and five regional Executive Directors. One of the reasons for the restructuring of IRAP was that the head office was considered to be overhead with little value added. Overhead across the country had increased from 5 % to 12 % during five years, which was considered too much.

The Policy, Planning and Assessment Corporate Services in NRC carried out an extensive "Evaluation of the Industrial Research Assistance Program (IRAP)" during 2002[23]. Among the conclusions were the fact that IRAP in international comparison has the best distribution over the country and by that is closer to clients everywhere. It was also found to combine advice and funding in a unique way.

Among the proposals for improvements were:

- to raise the level of funding in individual cases to levels similar to some countries in Europe
- that IRAP should sharpen its service portfolio. As far as advice is concerned it should be better focused on technology
- for ITAs to focus more on relationship building to institutes and universities for their clients, rather than offering a more general standard set of services.[24] It is also suggested a small amount of money available for institutes that sign contracts with SMEs that are ITA clients.

In general, the evaluation was very positive and stated that the IRAP program is of great benefit for Canada. The support from IRAP gives confidence with investors in IRAP's client companies; independence and integrity are often expressed as properties of IRAP.

The Swedish gathering for SMEs' research based technology support that started in the year 2000, TUFF (TeknikUtbyte För Företagsutveckling), was created with IRAP as an important model for one of its branches, technology brokers. The other TUFF branch, company groups, was analogous with increasing efforts for ITAs to stimulate cluster development.

4.2.2 Clusters and incubators/Industrial Partnership Facilities, IPF

NRC has large and growing ambitions within the areas of clusters and incubators. These efforts are implemented as horizontal elements in the institute and IRAP programs.

Cluster development has become a major policy instrument within the NRC field of work. The small businesses and their interests and needs are put in focus since they constitute the lever for success. The NRC Clusters combines other concrete actions, one cornerstone being NCR's Industrial Partnership Facilities, IPF (see below). One of the goals in the Innovation Strategy is to create 10 new interna-

[23] *Evaluation of the Industrial Research Assistance Program (IRAP), NRC– CNRC, October 24, 2002.*

[24] *Still 55 % of ITAs have difficulties to attract research institutes and universities for cooperation with their client companies, in spite of the fact that more than half of the ITA's offices (68 %) are located in research institutes and universities.*

tionally competitive clusters. The provinces often contribute. NRC does not provide any regular directed budgets for these actions, but acts as motivator and broker and "offers" the competences of NRC institutes.

However, as an exception, in 1999 cluster activities in the Atlantic region was allocated 110 MCAD, and 230 MCAD was then allocated as a follow up to NRC for anyone of the NRC identified clusters. These original Cluster money allocations went to IRAP and NRC Institutes located in identified clusters. It takes a long time, though, to see results. An evaluation of the first cluster efforts (the Atlantic part) was initiated during 2004.

One of the targets in the national innovation strategy is to develop "at least 10 internationally recognized technology clusters".

IPF, Industrial Partnership Facility, is the NRC incubator category. They are normally located in institutes with access for the tenants to labs and skilled personnel. The tenants are expected to have advanced technology ambitions. The IPFs do not offer venture capital or any financing themselves, but some of them have links to VC firms. All NRC institutes today have IPFs.

4.2.3 International Cooperation

International cooperation is important for Canada, and makes for an increasing part of NRC's work as mentioned above. In a report from the Advisory Council on Science and Technology from 1999 the importance for Canada of international cooperation is stressed.

Canada is an associated member of the EU RTD program. NRC, through IRAP, seeks to increase this involvement, i.a. through striving to become a member of the IRC (Innovation Relay Centres) network. IRAP is a member of the EBN (European Business Network). Within the IST (Information Science and Technology) program there is IST–EC (Europe–Canada) as the framework for Europe–Canada relations.

With the new organisation of IRAP, efforts towards internationalisation are to increase, initially primarily with Asia.

NRC has long-standing Science and Technology agreements with France, Germany, Japan and the EU. Lately, NRC has instead chosen to signs Memorandums of Understanding. Currently, there are 11 of those, e.g. with UK, France, Germany, Spain, and the Czech republic in Europe. The relation with Spain has worked out extremely well and has had a turnover of ca 2 MCAD in the first round. So far, there are no formalized relations with the nordic countries.

5 Relations between federal, provincial and community efforts

This chapter provides an overview of the principles for the relations between research and innovation policy makers on different governmental levels. Examples of measures in the provinces are then presented. Even if they are federal organizations, the NRC institutes have been included in this presentation in order to show how measures from different policy levels meet in the communities.

5.1 General remarks

Federal and provincial ministers responsible for research and innovation meet generally twice a year to review common issues and to mandate collaborative policy analysis work by teams of federal, provincial and territorial officials. The ministers are supported by a committee of deputy ministers that meets three or four times a year as well as four to six working groups with representatives for the federal, provincial and territorial level that study common interests and coordination issues. Some of the provinces are quite active in implementing research and innovation policies and programs. In general, these programs are complementary and supportive of federal initiatives. Federal, provincial and territorial ministers have adopted a common set of broad principles to guide their collective efforts to promote research and innovation in Canada. There is, however, the recognition that the knowledge and the acceptance of the national Innovation Strategy varies between regions and provinces as the political environment is not always as strong for innovation as is the fact in the national government.

Industry Canada has large offices in the provinces. *Technology Partnerships Canada, TPC,* (see appendix) is handled in these offices. There are also four Canadian regional agents for economic development with large resources.

In the communities, all national, provincial and local programs and measures meet and the communities would gain from good correlation of offers. Industry Canada puts more and more interest in what happens in the communities and seeks to design a strategy for making best and coordinated use of the different governing levels.

An interesting initiative is a set of networks of researchers on innovation systems (ISRN, Innovation Systems Research Networks). The initiative was taken by David Wolfe, who also runs the secretariat in one of these networks, Program on Globalization and Regional Innovation Studies, PROGRIS. These networks work well with all local/provincial/federal organisations.

David Wolfe et al, 2003, discuss the Innovation Strategy in the context of "joined-up governance". The conclusion is that the design of the strategy is good, but classic hierarchical thinking and behaviour characterize the implementation. The authors question whether learning is built-in and integrated in the implementation process. They find that the three policy levels create confusion, not the least since an enormous amount of organisations are active.

5.2 Ottawa, Ontario

Even if there is the feeling that the province government is invisible in Ottawa[25], Ottawa City provides a number of good examples on good relations in the municipal innovation system.

Ottawa Centre for Research and Innovation, OCRI, was founded in 1984. In 1999, it integrated education and training matters. In 2001 OCRI fused with Ottawa Economic Development, OED.

OCRI currently runs about 150 projects. The turnover is about 14 MCAD[26], ca 2 MCAD from the city of Ottawa (the OCRI part is about 5–7 %, the OED part almost 100 %).

Approximately 65 % of OCRI's members are companies from the private sector, and 35 % are individuals; in total OCRI has 625 members. In later times, OCRI has got more clients in industry, service and tourism.

One of OCRI's projects is the "Commercialization Task Force". The composition of the Task Force of private, municipal, federal organisations is a typical Canadian example on multiorganisational cooperation and of Triple Helix in several dimensions. The members are one company (Orbit iQ[27]), NRC, Ottawa and Gatineau Universities as well as institutes and incubators. Telecom and IT are important foci.

The task force has initiated the "Business Accelerator", run by Orbit iQ on behalf of OCRI. This is a kind of investment fund that invests people instead of money. The Business accelerator works with companies after the incubation stage to help them accelerate their growth, e.g. by rapid internationalisation.

Ottawa Life Sciences Council, OLSC, is a member owned organisation with ca 160 members. It performs the tasks of:

- networking and conferences
- consortia building
- business development
- technology and market development
- human resources
- market campaigns
- the development of Industrial Partnership Facilities.

There are ca 5 000 people in its network, there are two ITAs and there are 7–10 people in the staff to run the day-to-day business.

[25] *Alf Chaiton,* City of Ottawa
[26] *1 CAD equals 5.40 SEK.*
[27] *Orbit iQ is a newly started company that has 40 employees across the world, 20 regional associates and 100 advisors after one year. The ambition is to triple this within the next five years. The CEO of Orbit iQ is on the board of OCRI as well as chairman of the Task force. Orbit iQ that is a private international company, represented in many countries including Sweden/Stockholm.*

The NRC *Institute for Microstructural Sciences* (IMS) is located in Ottawa. NRC describes it as

> *having the mission to provide leadership, in collaboration with Canadian industry and universities, in the development of the strategic base for information technology; that is, in the development of enabling technologies related to future hardware requirements for information processing, transmission acquisition and display.*
>
> *The transfer of information between people, countries, through distance and time will irrevocably change within the next decade. The role of the Institute for Microstructural Sciences is to help keep Canada at the leading edge of the technologies that enable this information revolution.*
>
> *Through the application of novel materials and components to solve problems posed by the need for advanced hardware, IMS has demonstrated its relevance and expertise.*

The programs in Materials / Processes, Components, and Technology Base include a high level of partnership and interaction with industry in areas crucial to the economic well-being of Canada[28].

IMS's vision has been formulated as follows:

- Leadership in collaboration with industry and universities.
- Emerging and enabling technologies for acquisition, processing, transmission.
- Converge of physical & biological sciences.

The institute employs 135 people. Its budget amounted to 24 MCAD. It receives 1 MCAD in royalties.

The institute has as its first priority to form new companies, but it also works with established companies who want to interact. The vehicles for commercialization are Canadian Photonic Fabrication Centre (below), Industry Partnership Facility and IRAP.

Canadian Photonics Fabrication Center (CPFC), at the Carleton University in Ottawa, will start in September 2004, representing 100 MCAD in total value of which 30 MCAD comes from the Federal and Ontario Governments.

Canada had, in 2000, 40 % of the world market in photonics. There are five photonics clusters in Canada: BC, Ontario, Quebec (two) and Ottawa[29].

5.3 Toronto, Ontario

Ontario Ministry of Economic Development and Trade, MEDT, funds and manages four centres of excellence, *"Ontario Centres of Excellence", OCE*.[30] These are virtual centers with the objective to stimulate "need oriented applied research,

[28] *http://www.nrc.ca/ims/*
[29] *Sylvain Charbonneau, Director,* IMS
[30] *Mark D. Garscadden, Manager, Commercialization and International R&D*

train researchers within fields of industrial interest, enhance technology transfer and can trace and "seed finance" ideas within emerging technologies". As virtual centres, they are networks, not buildings. There is a strong influence by industry.[31]

The provincial government funded the OCE activities with 32,4 MCAD during 2001–02, which was 45 % of the total turn over. The centres have worked with more than 1 000 Ontario companies and 350 researchers. They have been or are involved in 350 patents etc. A new center was opened late 2003 for "Electricity and Alternative Energy Technology". A reorganisation – effective as from April 2004 – has been undertaken so that the management of the centers was merged into one organisation.

5.4 Calgary, Alberta

Typically, because of the geographic position of Calgary and Alberta, it is stressed there that the country is very dispersed and that every community wants everything. In the province of Alberta, the two main cities, Calgary and Edmonton, are powerful. Alberta has the largest number of companies per capita in North America. There is a culture of commercialization in the university; many people there have been recruited from industry. "In Alberta people do everything they can to avoid Government, in Saskatchewan people always tend to ask Government for help" is a statement often heard in Alberta[32].

University Technologies International Inc., *UTI*[33] is a virtual incubator. UTI's working field is IPR, which in Alberta are arranged like in Sweden, so that the IPR rests with the individual, not the organisation. This is very unusual in Canada; only three other similar establishments exist. UTI gives service not only to university employees or students, but also to outside individuals. In 2003, UTI looked at proposals of which 70 % came from the university, 10 % from other university graduates and 20 % from industry. The same year the incubator was involved as partner in 38 start-ups and had equities in 15. The target group is tangible products, as UTI does not address service companies.

UTI's board of directors has a 50/50 representation of Business and Academia respectively. Even if it is a university owned company, it gets no funding from the university. It is a for-profit company, with the profit being donated to the university (900 000 CAD once and 300 000 CAD once). UTI started 1989 and currently employs 14 people.

TR labs[34] was originally started by the University of Alberta in Edmonton, Nortel and the Alberta Government. Now there are five labs, two in Alberta and three in Saskatchewan. In total, there are 56 partners, of which 12 large and ca 35 small companies. 260 people are involved, half of which are students. There is an IRAP-

[31] *Roger Pan, Senior Advisor, Science and Technology*
[32] *Most of the general statements in this chapter are related to a visit to Calgary in June 2004 and is the author's understanding of conversations in the area coordinated by Robin Black, IRAP (ITA)*
[33] *Don Morberg, UTI. See also www.uti.ca*
[34] David Morley, Director, Business Development Inc., Calgary and Andrew Kostiuk, Saskatoon. See also www.trlabs.ca

ITA in the office in Calgary. TR labs funding comes from industry (45 %), from governments[35] (45 %) and from universities in kind (10 %). The fee for SMEs amount to 7 000 CAD per year, 50 % cash, 50 % in kind. This is well-spent money, since SMEs involved in TR have shown to be more successful than those who are not. Total leverage has been calculated to 30:1. CANARIE (see chapter 4) links the research on Internet nationally. There is a "Technobridge – Singapore", and a Test bed in Calgary.

TR labs show a slow and steady growth. For the future, there is a potential for TR labs to develop its commercialization activities through its subsidiary, TR Tech.

5.5 Saskatoon, Saskatchewan[36]

For *TR labs* see chapter 5.4**.**

Important strategic areas for Saskatchewan are:

- advanced Technology: ICT, Environment, Bio Science
- value added: mineral, energy and forest
- manufacturing
- innovation and export
- agriculture.

There is a Regional Economic Development Agency, a public/private construction, for the three prairie provinces. AgWest Bio is a membership body that coordinates the work of different agencies. There is an IRAP initiative, *Wellness West*, which aim to build a cluster in West Canada on "Natural Health Products".[37]

Saskatchewan Research Council, SRC[38] is one of four regional research councils left – there used to be research councils in all provinces. It is owned by the Province and funded with 25–30 % in a core grant from the Provincial Government and 70–75 % from contracts. In total that makes 25 MCAD per year. There are 250 employees.

The NRC *Plant Biotechnology Institute, PBI,* is located in Saskatoon. NRC describes it as follows:

> *NRC's Plant Biotechnology Institute is dedicated to plant and crop research.*
>
> *PBI is a leader in the metabolic modification of oilseeds to increase oil content and to create specialty plant oils for new markets. Similar research is altering wheat starch for novel uses and to meet new international markets. Investi-*

[35] *Western Economic Diversification Canada is a federal supporter to develop Western Canada*
[36] *Most of the general statements in this chapter are related to a visit to Saskatoon in June 2004 and is the author's understanding of conversations in the area coordinated by Marie Savostianik, Community Innovation facilitator, c/o NRC- IRAP*
[37] *Dale Botting, Danya Kordan, and David Katz,* Industry and Resources, *Saskatchewan*
[38] *David Grier,* Saskatoon Research Center. *See also www.src.sk.ca*

gation of metabolic pathways has also led to a significant reduction in anti-nutritional compounds in common commercial crops.[39]

The institute has existed since 1983. The Parliamentary appropriations or core funding pays for the basic research. Sometimes the institute does work in the applied R&D phase; companies might participate with their own labs. The Government covers the Institute budget to 30 %.

PBI was the third NRC institute to establish an IPF. It is important that the cooperation between the institute and SMEs allows the latter to preserve cash flow.

Many of the scientists are adjunct professors at universities and several students are involved.

Canadian Light Source[40] is a huge investment to attract companies and researchers from all over the world to develop activities in Saskatoon. There are 18 different sources of funding for the investment.

5.6 Winnipeg, Manitoba

Winnipeg, the capital of Manitoba, has ca 680 000 inhabitants and the next largest town has a population of 50 000. The province of Manitoba has ca 1 M inhabitants. Today, there are 57 biotech companies in Manitoba with a total of 400 MCAD export. This has grown from almost nothing five years ago.

In 1991 Manitoba got its Innovation Strategy. In 1990 a study on how to transform traditional industry to innovation based was performed. In 1994, the Economic and Technical Advisory Council was established to improve the circumstances for people to interact. The *Ministry for Energy, Science and Technology, Government of Manitoba*[41] works with the following issues:

- education and training
- enhancing research capabilities, balance between research and business development
- existing companies to become receptors, not only start-ups
- connecting people together; broadband
- business environment, competitive regulation, taxes (Manitoba is not a low tax area)
- the government itself, demography: how do you recruit and save the knowledge that leaves with retirement
- specific measures towards innovation:

– clusters in aerospace, inf.- tech, biotech, culture; new media.

[39] *http://www.nrc.ca/pbi/*
[40] *Rob Slinger,* Canadian Light Source Inc.. *See also www.lightsource.ca*
[41] *John Clarkson, Deputy Minister for Energy, Science and Technology,* Government of Manitoba

- advanced manufacturing (14 % of GDP), productivity and innovation, industry arranges training themselves.
- energy to create a fossil free province – an Energy Capital.

The *NRC Institute for Biodiagnostics* is described by NRC itself as follows:

> *Established in 1992, the National Research Council's Institute for Biodiagnostics (IBD) develops noninvasive medical devices and techniques to increase prospects for prevention, earlier diagnosis, improved treatment and prognosis of diseases*
>
> *Employing over 200 people, the Institute for Biodiagnostics generates significant economic benefits. For instance, IBD has established five spin-off companies since its inception, with total sales to date reaching $15 million. From its headquarters in Winnipeg, IBD's research network now reaches worldwide, combining collaboration and expertise with opportunities to establish affordable and accurate diagnoses for diseases that touch us all.*[42]

In 1986 the present institute building was built predominantly for political reasons. The first direction was manufacturing. In the late 90's the transformation started, 20 persons were relocated from Ottawa. Manufacturing did not work, as it was impossible to build necessary relations with industry that was not very large and had its major development in other places. The institute now employs ca 200 people (some shared with the university). The base funding is 8 MCAD per year. In total 15 MCAD is spent, mostly on salaries. Through the relation with the university, it had been possible to achieve many grants. The institute takes equity, for five years, and this remains somewhat of a challenge.

The very close connection between the institute and IRAP is unique. It is good for firms to work with ITAs and also with the Business Development Centre that give advice on patents, licensing etc. A "Commercialization centre" will be established in the area by NRC and the Government of Manitoba in 2005. 90 % of the firms there will be IRAP clients.[43]

[42] *http://www.nrc.ca/ibd/*

[43] *William Smith, Deputy Director General of* NRC/IRAP*, Vivian Sullivan, Regional Director, Travis Takeuchi,* IRAP-ITA *and Roxanne Deslauriers, Director, Research,* Institute of Biodiagnostics

6 Conclusions

The conclusions are presented as reflections on the policy paths referred to in chapter 1 as they appear in Canada, and as reflections on areas where Canada and Sweden could exercise mutual learning from the different experiences in the two countries

6.1 Reflections on Innovation Policy Paths in Canada

When looking at the **balance between national and regional goals and effects** in Canada, it is possible to find both measures totally independent of federal measures (and more or less without any knowledge of them) and measures developed to complement measures from other levels and in coordination with each other. Depending on the circumstances competition might be fruitful or a waste of resources. The Industrial Research Assistance Program, IRAP, of the National Research Council, NRC, being a national program with a regional focus through its network of Industral Technology Advisors, many times is the glue locally between measures initiated from different levels of government. The Canadian experience underlines the importance as well as the difficulties of taking the regional and local aspects into consideration when developing and implementing an innovation strategy.

In trying to understand what makes public measures **important for small and medium-sized enterprises, SMEs**, it is interesting to note that the NRC evaluation of the IRAP program stresses that IRAP in international comparison has the best distribution over the country and by that is closer to clients everywhere. It also combines advice and funding in a unique way.

Regarding the issue of **efficiency in the use of public R&D resources** the conclusion is that commercialization actions in Canada to some degree, even if low in comparisons with other countries, are executed from the supply side[44] rather than from the demand/receptor side, or in dialogues. One interesting exception from this is the cluster policy, which takes its point of departure in the needs of SMEs. Another exception is the part of IRAP that aims to stimulate SMEs to make better use of research-based knowledge in institutes and universities, and to train SMEs, the receptors, to express a demand for such knowledge. More must be learned on relations between knowledge produced in public research organisations, and on how to package such knowledge, and business development in SMEs, as these processes still seems to be too much stimulated by pure push approaches.

The Canadian example shows that increased **international cooperation** is an important ambition in Innovation Policy. Canada strives to balance its naturally strong relations with the US through efforts to strengthen links both eastward and westward.

[44] *See for example the references to I2I, POP, NCE in Appendix*

6.2 Reflections on mutual learning between Canada and Sweden

The innovation systems in Canada and Sweden[45] respectively are different, and because of those differences and consequently the different approaches, many chances for topics of mutual learning appear. A number of tentative theses on differences and maybe challenges are indicated below.

The Canadian experience shows that an innovation strategy helps to focus on innovation issues. It aims to ensure that innovation gets a higher legitimacy in policy making. In Sweden there has been a tendency to consider innovation problems as research problems instead of a broader spectrum of growth creation measures. Without a comprehensive strategy innovation issues tend to be regarded by economic policy makers as research issues.

A point that arises from the two countries' experiences of innovation strategy formulation is the importance of clear and measurable targets. The Swedish strategy does not formulate any targets, while the Canadian strategy hosts a large number of ambitious ones as shown above. How strong is the correlation between political and legitimating power of a strategy and the existence of measurable targets?

The overall strategic approach differs between the two countries. While Canada looks for weaknesses in the innovation system and tries to eliminate them, Sweden tends to strengthen functions and structures that are already strong. In general, the Canadian approach seems to be more open to change; more experimental and prepared to work with new things, but at the same time doing so with patience and durability.

A major weakness in Canada is the low R&D investments in industry. In order to strengthen private sector R&D, Canada has a number of programs for direct funding or financing in companies: IRAP for smaller businesses, Technology Partnerships Canada, TPC, for small as well as large companies, and a tax incentives program, Scientific Research and Experimental Development program, SR&ED, from which around 2 BCAD (ca 11 BSEK) is claimed each year. Such measures do not exist in Sweden.

Sweden's strengths are its large number of global industrial companies and its universities. The Swedish public research and technology policy[46] has made the circumstances for the global companies good, with higher education playing a very important role. Strong universities and technology institutes have been given high priority, and research in these institutions has primarily been there to support the coursework at undergraduate and graduate levels for students primarily interested in later employment in the larger industries. Education, supported by research, has been oriented towards employment and work in larger organisations rather than towards innovation and entrepreneurship. The public research institute sector is small. The cooperative research institutes are limited companies that are majority owned collectively by industry. Normally, they carry out research of collective in-

[45] *The public organisations in the Swedish innovation system are described in the country reports for Sweden of the "Trend Chart on Innovation in Europe" action (http://trendchart.cordis.lu/).*
[46] *Innovation policy was formally introduced in Sweden in July 2004*

terest for their owner companies, which often are large companies. There are exceptions; a few institutes are based on excellence in certain fields of technology.

It is claimed in chapter 3 of this report that special measures for SMEs are important in innovation policy. In this field Sweden and Canada have very different experiences. More must be learned on relations between knowledge produced in public research organisations and how to package it for SMEs in general. These processes appear to still be highly dependent upon science and technology push approaches that rely upon public funding incentives, in Canada mainly from the federal level. This area is of great interest in both countries.

There is currently no Swedish program corresponding to IRAP. IRAP's success is largely dependent on durability and a strong regional prescience. This takes into account the fact that working with SMEs is very much about hands-on-work, person-to-person building of long-term relationships that creates trust. IRAP's combination of advice and funding makes it a complex program. It is worth discussing the level of complexity when designing programs for SME support – what seems complex from the program managers' point of view may make it less complex for clients to navigate the support system since i.a. integrating technological advice and funding can reduce the number of entry points.

Sweden has normally, at least during the last 10 years, tended to launch programs based on the idea that companies in consortia, local and other groups, or other types of networks, strengthen each other as "buyers" in the public research system. Such consortia or groups might as well have large companies as members, if that is found important for the small businesses. The experiences are good, but still Sweden has not been able to act with sustainability, most of these approaches have lasted five years or less. A "relative" in Canada seems to be the cluster efforts[47] that to date mostly seem to be based on institutes and their Industrial Partnerships Facilities, IPF, and their relations to SMEs.

Funding in early stages in technology-based SMEs in Canada is primarily a result of IPF and IRAP efforts. Such funding has been rare in the Swedish system so far. In 2005, Sweden through Vinnova will introduce a program similar to the US Small Business Innovation Research program, SBIR, which will offer such resources. The Canadian experiences of SME funding offer interesting aspects for Sweden to take into account in the design of the program.

Most government research funding in Sweden goes to universities, a part of that funding goes to VINN Centres of Excellence.[48] A challenge for Sweden in research is to find new roles, particularly for the institutes and to stimulate them to break new ground and find more pro-active roles. In this area Canadian experiences from

[47] *"Clusters" has in Canada become an investment tool that comprises anything that improves circumstances for commercialization, which currently is a field of large policy interest in Canada. Clusters comprise different concrete actions, particularly IPFs and other efforts in institutes and IRAP. It takes long time though to establish such efforts and even longer for results to show. These things are in many places in Canada relatively new.*

[48] *See www.vinnova.se or trendchart.cordis.lu*

government-owned institutes and their positions in relation to universities provide interesting lessons for Sweden.

Sweden runs an incubator program that is a continuation of an older Technopole program. Incubators in Sweden are primarily linked with the universities; there are no such equivalents in the institutes. The incubators work together and exchange experiences in a network that meets once or twice a year. Industrial Partnership Facilities in Canada, a more recent effort than the corresponding incubator effort in Sweden, seem to be more closely linked to institutes and their respective cluster efforts.

Commercialization of research results and knowledge resulting from research is a matter of concern in both countries. Incubators, seed financing[49] and the SBIR effort are all examples of increasing Swedish ambitions to improve commercialization. Commercialization happens in markets and by better information and visualizations of markets (e.g. through roadmaps or foresights), entrepreneurs can do more commercialization of research results by using such information for business. Universities can do their best to develop and package the knowledge they offer, and to handle Intellectual Property Rights etc., but the key is for countries to have good conditions for market developments. Incubators, SBIR and IRAP are examples of such key activities. Cluster efforts in Canada and the Swedish Vinnova VINNVÄXT initiative are initiatives that aim to improve circumstances for commercialization for innovation by building better local or regional systems for local coactions. Much more could be done though to improve the coverage and impact of these programs, and mutual learning between countries is an important part of such efforts.

Performance indicators are of very high interest for both countries as well as research on innovation systems. Statistics Canada seems to be more research oriented than its colleagues in Europe, and has been relatively proactive in developing new measures for assessing innovation practise of companies.

Technology roadmaps[50] as offered by Industry Canada are an established tool, easily accessible, for Canadian industries. Technology Roadmapping is a planning process driven by the projected needs of tomorrow's markets. It helps companies to identify, select, and develop technology options to satisfy future service, product or operational needs. Sweden can learn from these experiences, especially regarding the way companies access the tool.

Foresight is a task of growing interest in Canada and NRC is a forerunner in the field; this has been extended and repositioned as a partnership between NRC and the Office of the National Science Advisor as part of Central agency and policy integration. Sweden also is advancing its foresight interests as a partner in the European context. Canada has been invited to join in EU fora on foresight. There may be opportunities for actual joint project collaboration in the future.

[49] *There will be an increase of public funding for seed-financing in Sweden during 2005. This will be accompanied by a strengthening of the public system for seed capital.*
[50] *http://www.cbsc.org/english/search/display.cfm?code=2096&Coll=FE_FEDSBIS_E*

Both countries are advanced middle-sized countries for which international cooperation is of great importance. Canada tries to participate as much as possible in the European systems for cooperation There is also a fast growing Canadian interest for Asia, shown i.a. in the special effort towards Asia for SMEs that IRAP has developed. International policy learning institutions, e.g. the Association For Technology Implementation in Europe, TAFTIE, are interesting for both countries. The two countries can learn from each other's methods and contact networks.

All these fields are of mutual interest. As Canada strives to increase international cooperation, there are currently large opportunities for Sweden to strengthen the links with Canada and for both countries to jointly explore challenges as well as possibilities for an innovation policy for the future.

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Appendix

Innovation Policy-related Governmental Bodies in Canada

Industry Canada (www.ic.gc.ca)

Industry Canada is the Canadian government department in charge of industry and research. The Minister of Industry leads its operations. Industry Canada is in charge of the so-called *Industry Portfolio*, a number of agencies that work with industry- and research-related issues. The department has 5 000 employees all over the country, including some that in Sweden would have been employed by Government Agencies.

Advisory Council on Science and Technology, ACST (www.acst-ccst.gc.ca)

The *Advisory Council on Science and Technology, ACST,* is appointed by and reports to the Prime Minister and the Cabinet. ACST operates on a high political level and in large policy decisions. ACST has more and more become a committee for innovation," Advisory Council on Innovation". It has a secretariat of five people in IC. The topics it deals with are tasks given directly by the Prime Minister, the Minister of Industry or by the Cabinet and includes research commercialization, skills, innovation framework legislation and communities. ACST is independent, but the ministries formulate questions. It has 13 members: 7 from the business sector, big (4) and small (3) companies, and 6 from the research society. It is a group of the Prime minister, but run by the Minister of Industry. The Prime minister chairs when he is there (which is seldom). The Minister of Industry normally chairs, commissioned by the Prime minister. It meets normally six times a year and has about six round tables. The ACST has round tables of two types:

- Thinkers from all over the world
- Doers, ca 25.

There were five round tables last year.

The National Science Advisor

The *National Science Advisor* to the Prime Minister was appointed in December 2003 with the mandate to provide sound, independent, non-partisan advice on the government's directions and priorities for science and technology. Core among his priorities are to address the commercialization gap in Canada in partnership with the Minister of Industry. The National Science Advisor began his mandate in April 2004, and is located within the Privy Council Office (the department of the Prime Minister).

Council of Science and Technology Advisors (www.csta-cest.ca)

The *Council of Science and Technology Advisors, CSTA,* is made-up by members of boards and councils to the Science Based Departments and Agencies, chaired by the Secretary of State for Science, Research and Development, whose mandate is to

advise on broad horizontal management issues related to the science performed by government laboratories.

Granting Research Councils – Natural Sciences and Engineering Research Council of Canada, NSERC (www.nserc.ca)

There are three granting research councils in Canada: *Canadian Institutes of Health Research (CIHR)*, *Natural Sciences and Engineering Research Council of Canada (NSERC)*, and *Social Sciences and Humanities Research Council of Canada (SSHRC)*. They all came into existence in 1978. University-based research had previously been supported through the National Research Council; a report of the Senate Special Committee on Science Policy led to the creation of the new granting research councils.

NSERC has grown from a budget of 112 MCAD in 1978, to a budget of 771 MCAD in 2004.

NSERC fulfils its mission by awarding scholarships, research chairs and grants through peer–reviewed competition, and by building partnerships among universities, colleges, governments and the private sector. The Intellectual Property Management program, IPM, provides funding in partnership with universities to support activities related to managing intellectual property and interacting with industry. Universities apply singly or in groups for support of initiatives to improve the effectiveness of technology transfer to Canadian industry.

NSERC itself is committed to institutional innovation in achieving its mission.

NRC-IRAP has developed a link with NSERC to facilitate international partnerships that involve an SME (with IRAP funding), and a university researcher (NSERC funding via its Collaborative Research and Development element).

NSERC's closest analogue in Sweden is the Swedish Research Council, but there are also very close similarities with Vinnova's need oriented research, e.g. the VINN Centres of Excellence program.

NSERC runs a program, I2I, "Ideas to Innovation", that provides funding to university researchers for research and development activities leading to technology transfer to a new or established Canadian company. There are two distinct funding phases; these phases are limited in time and the direct costs of research in the first phase will be entirely supported by NSERC while those of the second phase will be shared with a private partner in a three phase program:

- phase 1, 200 000 CAD, business partner not necessary
- phase 2, 200 000 CAD, VC, SME or both necessary
- phase 3, 275 000 CAD.

There is a special agreement between NRC and CIHR, Canadian Institutes of health research, that concerns CIHR's POP (proof of concept) program, that offers

- phase 1**,** Up to $150,000 per application from CIHR

- phase 2**,** Up to $250,000 per application from CIHR. An investor must match CIHR funds at a 2:1 ratio (investor: CIHR).

The agreement says that IRAP is given a lead in phase two. This construction gives a very good pattern for funding both the academic and business work.

Networks of Centres of Excellence, NCE (www.nce.gc.ca)

The Canadian granting research councils and Industry Canada combine their efforts to support and oversee the *Networks of Centres of Excellence, NCE,* initiative.

The NCE program has been operating for fifteen years. In February 1997, the government established the NCE as a permanent program. Two years later, it increased the program's budget by 30 MCAD bringing it to 77.4 MCAD per year.

Networks of Centres of Excellence are partnerships among universities, industry, government and not-for-profit organizations aimed at turning Canadian research and entrepreneurial talent into economic and social benefits for all Canadians. An integral part of the federal government's Innovation Strategy, these nation-wide, multidisciplinary and multisectorial research partnerships connect excellent research with industrial know-how and strategic investment. In 2002–2003, 756 companies, 213 provincial and federal government departments and agencies, 48 hospitals, 153 universities, and more than 280 other organizations from Canada and abroad were involved in the NCE program. The active involvement of Canadian industry provides stimulating training environments and employment opportunities for students. In fact, about 82.7 percent of network graduates are successful at finding jobs. In 2002–2003 the networks stimulated outside investments on more 69 MCAD, including more than 33 MCAD by participating private-sector companies.

Ca 20 NCEs are currently active. Together, the Centres are capable of achieving more than the sum of their individual efforts.

They work with knowledge and competence, not exclusively with technology, within "Mode 2"; they "do not separate research and its exploitation". Mobility is important and includes students and experienced personnel from different sectors of society. There are virtual institutes. 10 % of university spin-offs emerge from the NCE system. In total results at the level of 21 BCAD have been achieved. Multisectoral research is encouraged.

The program involves all sorts of stakeholders. "We like the French model: universities, industry and public organisations are all welcome, in Canada it is just the universities"[51]. 20 % of the students are foreign. NRC institutes are not eligible for funding as they also belong to the national Government, but they can still participate in the work in a center.

Canada Research Chairs (www.chairs.gc.ca)

In 2000, the Government of Canada provided $900 million to support the establishment of 2 000 research professorships – *Canada Research Chairs* – in universities across the country. The ambition is to "strengthen research excellence in

[51] *Jean Claude Gavrel, Director,* NCE

Canada and increase Canada's research capacity by attracting and retaining the best researchers".

Canadian universities both nominate Canada Research Chairs and administer their funds. The granting councils run the program together with IC.

There are two types of Canada Research Chairs:

- Tier 1 Chairs, tenable for seven years and renewable, are for outstanding researchers acknowledged by their peers as world leaders in their fields. For each Tier 1 Chair, the university receives 200, CAD annually for seven years.
- Tier 2 Chairs, tenable for five years and renewable once, are for exceptional emerging researchers, acknowledged by their peers as having the potential to lead in their field. For each Tier 2 Chair, the university receives 100 000 CAD annually for five years.

In individual cases there may be matching funds; but the quality of the person and how it matches the strategy of the University are more important. Chairholders are also eligible for infrastructure support from the Canada Foundation for Innovation (CFI) to help acquire state-of-the-art equipment essential to their work.

The concept of 2 000 Canada Research chairs was developed within IC as a proposal to the Cabinet for the year 2000 as a symbol for the new millennium. The basic idea came from a university president to the Deputy Minister of IC. It was initially estimated to run for five years, which means 400 new chairs each year. That showed to be too fast, which is why the time horizon changed to a 7–8 years perspective.[52]

Federal Partners in Technology Transfer, FPTT (www.fptt-pftt.gc.ca)

Federal partners in Technology Transfer, FPTT, is a partnership of 16 federal research- and technology-interested organisations, e.g. NRC and the Granting Councils. NRC hosts the office and heavily supports FPTT. FPTT forms a system of "multiple single entry points". There are regional chapters in Alberta and Quebec.

The goal is to achieve better use of results and demand oriented effects in the ca 360 research establishments there are in Canada. This will be attained by the development of an infrastructure and by the distribution of knowledge.

The work model is conferences, training, networks, legal advice/IPR and good practises. The processes can deal with inventions, copyright, business secrets, know-how, design, copyright, samples, biological material, technical information etc., all optimised from the point of view of the end user. FPTT gives legal advice to interpret the legal system.

[52] *The author's understanding of the story told in IC*

Technology Partnerships Canada, TPC (tpc.ic.gc.ca)

Technology Partnerships Canada, TPC, provides companies risk financing, up to a third of the project cost, with repayment at success, large amounts, not least to large companies like IBM and Ericsson.[53]

The Canadian governments have always given subsidies to companies, primarily for physical investments with a high substance value. In 1996 a major reconstruction of TPC was done to replace in part the Defence Industry Productivity Program (DIPP), which was cancelled in 1995. TPC has four focus areas: aerospace, defence, environment and enabling technologies like advanced manufacturing and materials, IT and Biotechnology.

The repayment should be related to sales that may result from the funding. For smaller companies that are based on only one product the repayment is related to the total sales of the company. More and more, this has become the general rule since it is easier to measure and reduces problems with attribution.

As most Canadian companies are export companies, WTO intervened in a key aircraft case and claimed export subsidies. TPC then changed policy to support "Technology platforms" rather than products. Product innovation is thus not funded by TPC anymore.

TPC is funded with ca 300 MCAD per year. The total investment volume is higher depending of the success of earlier projects, and the total volume. Repayments lag behind; just ca 20 % of prognosticated money comes in.

IRAP manages the SME-relations of TPC for companies with less than 200 employees. IRAP-TPC funding can be combined with other IRAP funding. The grants are given for pre-commercialization activities (after normal IRAP), according to WTO rules, which implies that they are repayable.

IRAP has created more projects than IC that handles the contracts for big companies in regional offices led by "Innovation Officers", a new system that is on its way to find its role. IRAP grants are normally less than 1,0 MCAD. TPC grants are, in general, larger than 10 MCAD; thus, there is a gap in funding possibilities. IRAP-TPC funds only SMEs, while TPC funds larger projects from both SMEs and larger firms – with the predominance of aerospace in the funding, the majority of the money goes to large firms.

Canada Foundation for Innovation, CFI (www.innovation.ca)

Canada Foundation for Innovation, CFI, is an independent corporation created in 1997 by the Government of Canada to fund research infrastructure. CFI provides matching funds up to 40 % for modernizing of the environments for research within natural sciences, engineering sciences and medical sciences in universities and research hospitals. Research infrastructure consists of the state-of-the-art equipment, buildings, laboratories and databases required to conduct research.

[53] *Phone conversation with Maureen Lofthouse, TPC, 031017 and http://tpc.ic.gc.ca/*

The basic capital 1997 was 800 MCAD to make use of during five years. CFI has after that already in 1999 been refilled with 200 MCAD and then 2000 with another 900 MCAD. Government grants to the CFI now total to 3,65 BCAD.

In 2003 CFI's mandate was revised by the Parliament to permit Canadians to participate in large international projects.

Business Development Bank Canada (www.bdc.ca)

Business Development Bank Canada, BDC, is wholly owned by the government of Canada. Its objective is to deliver financial, investment and consulting services to Canadian small business, with a particular focus on the technology and export sectors of the economy.

The availability of risk capital for pre-seed, seed and second phase funding is one important element and the government has recognised this by measures in the budget – 250 MCAD to the BDC – to augment capital for innovative start-ups and early stage companies.

By many experts the BDC is considered to be like a regular commercial bank.

Canada Economic Development for Quebec Regions, CED (www.dec-ced.gc.ca)

Canada Economic Development for Quebec Regions, CED, is one of four Canadian regional agents for economic development. (In addition to CED there are: "Atlantic Canada Opportunities Agency", "Western Economic Diversification Canada" and "Federal Economic Development Initiative for Northern Ontario".) With Swedish glasses these organisations seem to be similar to a combination of ALMI[54] and IUC[55], probably though with stronger ambitions with technology.

CED in Quebec has 14 offices in the province. Unique for CED in relation to the other regional development agents is the ambition to develop relations to French speaking countries, France and Belgium primarily. It focuses on manufacturing and high technology; the turnover is 240 MCAD (2002).

The Regional Strategic Initiatives, RSI is a CED-administered program tailor-made for remote and sparsely populated areas. Infrastructure is important. Methods are diagnosis, consultancy, development of centres, network activities, training and direct investments.

Scientific Research and Experimental Development (SR&ED) Program (www.cra-arc.gc.ca/taxcredit/sred/menu-e.html)

The *Scientific Research and Experimental Development (SR&ED) Program* is the largest single source of federal government support for industrial research and development. The program is a federal tax incentive program to encourage Canadian businesses of all sizes and in all sectors to conduct research and development (R&D) in Canada that will lead to new, improved, or technologically advanced

[54] *www.almi.se*
[55] *www.iuc.se*

products or processes. Claimants can apply for SR&ED investment tax credits for expenditures such as wages, materials, machinery, equipment, some overhead, and SR&ED contracts. Generally, Canadian-controlled private corporations with less than 200 000 CAD in taxable income can receive a refundable investment tax credit (ITC) of 35 % of qualifying SR&ED expenditures, to a maximum of 2 MCAD of expenditures. Most other Canadian corporations, proprietorships, partnerships, and trusts can receive an investment tax credit of 20 % of qualifying SR&ED expenditures. Around 2 BCAD is claimed each year, 1,5 at the federal level and 0,5 at the provincial level.

With combinations of funding from Technology Partnerships/IRAP and Tax Credits it is in fact possible for companies to get 75 % of development costs covered by Government.

Canadian Technology Network, CTN (ctn-rct.nrc-cnrc.gc.ca)

Canadian Technology Network, CTN, offers everywhere ”just-in-time" information for SMEs. CTN has 360 advisors and has partners in several countries. Examples on common topics that clients order are to fill competence holes and to design training for SMEs. Security Clusters Canada is such a topic discussed below.

CTN works driven by 180 members (IRAP, IC e.g.) and 670 connected laboratories. IRAP’s funding of CTN is about 4,5 MCAD/year. There are also foreign members.

CTN is now completely integrated in IRAP.

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