ESTIMATES

Natural Sciences and Engineering Research Council of Canada

Performance Report

For the period ending
March 31, 1999

Canada

Improved Reporting to Parliament
Pilot Document

The Estimates of the Government of Canada are structured in several parts. Beginning with an overview of total government spending in Part I, the documents become increasingly more specific. Part II outlines spending according to departments, agencies and programs and contains the proposed wording of the conditions governing spending which Parliament will be asked to approve.

The *Report on Plans and Priorities* provides additional detail on each department and its programs primarily in terms of more strategically oriented planning and results information with a focus on outcomes.

The *Departmental Performance Report* provides a focus on results-based accountability by reporting on accomplishments achieved against the performance expectations and results commitments as set out in the spring *Report on Plans and Priorities.*

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Foreword

On April 24, 1997, the House of Commons passed a motion dividing on a pilot basis what was known as the annual *Part III of the Estimates* document for each department or agency into two documents, a *Report on Plans and Priorities* and a *Departmental Performance Report.*

This initiative is intended to fulfil the government's commitments to improve the expenditure management information provided to Parliament. This involves sharpening the focus on results, increasing the transparency of information and modernizing its preparation.

This year, the Fall Performance Package is comprised of 82 Departmental Performance Reports and the government's report *Managing for Results* - Volumes 1 and 2.

This ***Departmental Performance Report,*** covering the period ending March 31, 1999, provides a focus on results-based accountability by reporting on accomplishments achieved against the performance expectations and results commitments as set out in the department's pilot *Report on Plans and Priorities* for 1998-99. The key result commitments for all departments and agencies are also included in Volume 2 of *Managing for Results.*

Results-based management emphasizes specifying expected program results, developing meaningful indicators to demonstrate performance, perfecting the capacity to generate information and reporting on achievements in a balanced manner. Accounting and managing for results involve sustained work across government.

The government continues to refine and develop both managing for and reporting of results. The refinement comes from acquired experience as users make their information needs more precisely known. The performance reports and their use will continue to be monitored to make sure that they respond to Parliament's ongoing and evolving needs.

This report is accessible electronically from the Treasury Board Secretariat Internet site: http://www.tbs-sct.gc.ca/tb/key.html

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Investing in people, discovery and innovation

Departmental Performance Report

for the period ending March 31, 1999

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John Manley,
Minister of Industry

Executive Summary

The challenge

The next millennium will see a continued expansion of the global knowledge based economy. Canada's prosperity depends upon knowledge and innovation, especially in science and technology, as we transform our economy from one based on commodities to one based on value-added products in all sectors. Science and technology will also continue to enhance our quality of life by helping us improve the management of our resources, the environment, public education, and our health system.

Who we are

NSERC (the Natural Sciences and Engineering Research Council of Canada) is the national instrument for making strategic investments in Canada's capabilities in science and technology. NSERC functions at arm's length from the federal government, is funded directly by Parliament, and reports to it through the Minister of Industry.

What we do

Our mission is to invest in people, discovery, and innovation to build a strong Canadian economy and to improve the quality of life for all Canadians. NSERC advances government-wide priorities of building a stronger Canada, creating opportunities for young Canadians, and investing in knowledge and creativity.

NSERC supports world-class research and the training of Canada's brightest young people. As a result, Canada has access to leading-edge science and technology from around the world and highly qualified people expert in it. Students trained with the help of NSERC support acquire the skills needed to generate knowledge and pursue rewarding careers in all sectors of society. These investments in Canada's knowledge base lead to innovations in industry and advances in setting policy, standards and regulations, and in solving problems, thus strengthening our economy and improving the quality of life for all Canadians (See Figure 1.)

Some of our accomplishments

In recent years, NSERC has been successful in:

- maintaining a strong presence in world science and engineering research by supporting annually nearly 9,000 of the most creative and productive Canadian researchers;
- training more than 50,000 master's and doctoral students, and young research professionals since 1978, who have had little trouble finding well-paying jobs and who are contributing to Canada's knowledge-based economic sectors;
- supporting the development of new processes and products, some leading to the formation of new companies, all of which contribute significantly to the national economy;
- encouraging Canadian industry to invest more than $500 million since 1978 in university research and training activities.

Figure 1: Chart of Key Results Commitments

NSERC (The Natural Sciences and Engineering Research Council of Canada) is in business

to provide Canadians with:	**to be demonstrated by:**	**achievement reported in:**
Economic and social benefits arising from the provision of a highly skilled workforce and knowledge transfer of Canadian discoveries in the natural sciences and engineering from universities to other sectors	a highly skilled workforce, with a base of expertise across the natural sciences and engineering fields ➢ trends in employment and career status of former scholars and fellows	DPR Section 3.3.2
	an advanced knowledge base which is vital as a source of economic and societal benefits for Canada, in the short and long term ➢ high quality research results, as assessed by internationally-accepted standards	DPR Section 3.3.1
.	application of knowledge leading to new policies, standards and/or regulations ➢ incidence and impact of contributions of researchers and/or their research results to the formulation of public policies, regulations and standards	DPR Section 3.3.1
	creative and productive use of knowledge for new products and services, leading to new jobs and businesses ➢ trends in the numbers of collaborative partnerships supported by NSERC, between the university and private/public sector	DPR Section 3.3.1
	➢ economic impact of NSERC-supported research	DPR Section 3.3.1

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List of Abbreviations

AUCC	Association of Universities and Colleges of Canada
CFI	Canada Foundation for Innovation
CMC	Canadian Microelectronics Corporation
CRD	Collaborative Research and Development Grant
CRF	Consolidated Revenue Fund
DPR	Departmental Performance Report
IPM	Intellectual Property Management Program
IRF	Industrial Research Fellowship
MRC	Medical Research Council of Canada
NCE	Networks of Centres of Excellence
NSE	Natural Sciences and Engineering
NSERC	Natural Sciences and Engineering Research Council of Canada
OECD	Organization for Economic Co-Operation and Development
P	Preliminary
R&D	Research and Development
S&T	Science and Technology
SSHRC	Social Sciences and Humanities Research Council of Canada
TPP	Technology Partnerships Projects Program
USRA	Undergraduate Student Research Award

1. Messages

1.1 Minister's Portfolio Message

At the dawn of the new millennium, Canada, with its strong and dynamic economy, is well positioned to take a lead role in the global knowledge-based economy and to realize its benefits for all Canadians. The new global economy is fundamentally different from the one we have known for most of this century: its key building blocks are knowledge, information, innovation and technology, and it is changing at an unprecedented pace. Today, it is important for businesses and individuals to be connected to the Information Highway, but tomorrow it will be essential. Electronic communications are breaking the barriers of time and distance, and the effects are being felt everywhere in Canada, from the largest cities to remote areas where the Information Highway is the only highway.

The Industry Portfolio is …

Atlantic Canada Opportunities Agency
Business Development Bank of Canada*
Canadian Space Agency
Competition Tribunal
Copyright Board Canada
Canada Economic Development for Quebec Regions
Industry Canada
National Research Council Canada
Natural Sciences and Engineering Research Council of Canada
Social Sciences and Humanities Research Council of Canada
Standards Council of Canada*
Statistics Canada
Western Economic Diversification Canada

** Not required to submit Performance Reports*

To keep Canada in the vanguard of this global economy, the government is investing heavily in knowledge, innovation, and connectedness, in order to generate well-paying jobs and a higher standard of living for Canadians. As Minister of Industry, I am responsible for a Portfolio which brings together most of the federal departments and agencies responsible for promoting innovation through science and technology and advancing knowledge. With over 40% of federal spending on S&T, a wide range of programs to help businesses -- especially small- and medium-sized businesses -- in every region of the country, a world-leading electronic commerce framework, and flexible support for exporters, the Industry Portfolio represents a powerful toolkit to help Canada make the transition to the knowledge-based economy and society of the 21st century.

The trend towards globalization also poses other challenges to Canada, which has one of the most open economies in the world. The Industry Portfolio is working with partners in the public and private sector and in academia to help Canadian companies respond and adapt to these challenges, so they can become and remain competitive in the global market. The government's agenda is based on seizing the opportunities presented by the global economy to create jobs and wealth for Canadians, and the Industry Portfolio has a key role in delivering this agenda.

I am pleased to present this Performance Report for NSERC. This report shows the contribution that NSERC is making to the government's agenda by setting out the commitments that NSERC has made and measuring its success in meeting these commitments over the 1998-1999 fiscal year.

In 1998-99, NSERC invested $478 million in university-based research and training in all the natural sciences and engineering. Thanks to NSERC's investments on behalf of the Government of Canada, Canadian researchers gain access to leading-edge knowledge from around the world. Armed with this knowledge, and working increasingly in partnership with industry, they help fuel Canada's innovation system. The students, trained with the help of NSERC, acquire the skills needed to pursue rewarding careers in all sectors of the economy and become tomorrow's leaders. These investments in Canada's knowledge base lead to innovations in industry, and help set policy, standards and regulations. In so doing, they strengthen our economy and improve the quality of life for all Canadians.

I am proud of the contribution the Industry Portfolio makes toward the government's priorities of building a stronger Canada, creating opportunities for Canadians, and investing in knowledge and innovation.

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The Honourable John Manley

1.2 Message from the Secretary of State (Science, Research and Development)

Science and technology are key building blocks in Canada's transformation to a knowledge-based economy and society. The raw materials of the economy of the 21st century will be knowledge, information, innovation and a workforce with the skills to apply them, and increasingly the knowledge and the innovations we need will come from science and technology. Our future success depends on our ability to innovate as individuals, as communities, and as a nation.

The Industry Portfolio plays an important role in the search for knowledge and promoting innovation in Canada. The Portfolio accounts for over 40% of federal spending on S&T, with a wide range of programs spanning the continuum from basic research, right through to the commercialization of new technologies and bringing their benefits to Canadians. The breadth of the Portfolio's involvement is also significant, since it touches on many facets of our lives, including health and social sciences, space research, biotechnology and information technology, to name just some of the areas in which the Portfolio is active. This investment in knowledge and innovation is essential to creating jobs and growth, and improving our quality of life by making our economy more productive. The government is a key player in this effort, but we also place a high importance on working with other key players in the public and private sectors and in academia.

This Performance Report for 1998-99 illustrates how NSERC is playing its part in advancing Science and Technology in Canada. Initiatives such as these are helping to translate the promise of science and technology into real opportunities for our future.

The Honourable Gilbert Normand

2. Departmental Overview

2.1 Mandate, Mission, and Objective

NSERC (the Natural Sciences and Engineering Research Council of Canada) is the national instrument for making strategic investments in Canada's capabilities in science and technology. NSERC functions at arm's length from the federal government, is funded directly by Parliament, and reports to Parliament through the Minister of Industry.

Mandate

Created in 1978, NSERC's legal mandate, its functions, and its powers are defined as follows:

> "*The functions of the Council are to promote and assist research in the natural sciences and engineering, other than the health sciences; and advise the Minister in respect of such matters relating to research as the Minister may refer to the Council for its consideration*" *(Natural Sciences and Engineering Research Council Act 1976-77, c24).*

Mission

In an effort to clearly define NSERC's purpose and the means by which its ends are achieved, in June 1999, the Council adopted the following mission statement:

> *NSERC invests in people, discovery, and innovation to build a strong Canadian economy and to improve the quality of life for all Canadians. It supports research in universities and colleges, research training of scientists and engineers, and research-based innovation. The Council promotes excellence in the creation and productive use of new knowledge, and seeks out new ways to increase Canada's capability to do that, both in terms of the skills and knowledge of individual Canadians and the number of Canadians with the necessary competencies. NSERC fulfils its mission by awarding scholarships and research grants through peer-reviewed competition, and by building partnerships among universities, colleges, governments and the private sector. NSERC itself is committed to institutional innovation in achieving its mission.*

NSERC focuses on the university sector and actively fosters partnerships with other sectors. Universities play a vital role in creating new knowledge and in putting this new knowledge to productive use, as well as in providing young people with the skills to contribute to these essential activities.

The federal science and technology strategy**, Science and Technology for the New Century** (March 1996), commits the federal government to three related goals for building a dynamic Canadian innovation system: sustainable job creation and economic growth; improved quality of life; and advancement of knowledge. NSERC is committed to these goals and to working towards them as laid out in the Industry Portfolio's Action Plan.

Objective

The Council's ultimate objective is to advance Canada's prosperity and high quality of life by supporting the creation and transfer of knowledge in the natural sciences and engineering (NSE) in Canada, and by ensuring people are trained to use and create that knowledge. To achieve this, NSERC supports research in Canadian universities that meets the highest international standards of excellence and it supports the education of young people in that research.

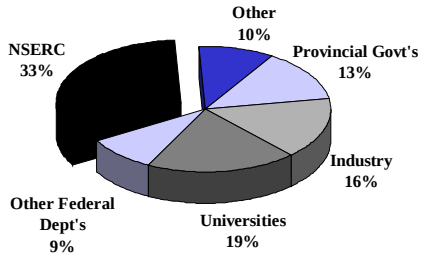
As a result, Canada has access to leading-edge science and technology from around the world and highly qualified people expert in it. Partnerships with industry connect researchers with those who can use the new knowledge productively and enhance Canada's capacity for innovation. Innovation contributes to wealth creation in the economy, which produces prosperity. New knowledge in NSE also enhances our quality of life through its impact on many policies, regulations, practices, and institutions.

2.2 Market Position, Clients and Partners

Universities

NSERC is the single most important funder of research and development (R&D) in the natural sciences and engineering in Canadian universities. $1.3 billion in R&D was carried out by Canadian universities in the natural sciences and engineering in 1998. NSERC directly provided one-third of the total funding. Since much of the other funding from universities, industries and governments is contingent upon NSERC funding, a reasonable estimate makes the Council directly and indirectly responsible for slightly more than half of the funding. Figure 2 gives a breakdown of the total funding by direct source. (See Section 6.4 for more statistics on the importance of Canadian university research.)

Figure 2: University R&D Funding in the Natural Sciences and Engineering, 1998



Total: $1.3 Billion

Source: Statistics Canada

More than 8,900 university researchers and nearly 13,000 university students and postdoctoral fellows are supported by NSERC. The Council also supports a considerable number of university technicians. Most Canadian universities benefit from NSERC programs, as do a growing number of industries and government departments. Figure 3 presents the details of NSERC's client support. Estimates of the share of the population funded or participating, for eligible individuals and organizations, and trends over the past ten years, are also included.

Figure 3: NSERC's Clients and Partners, 1998-99

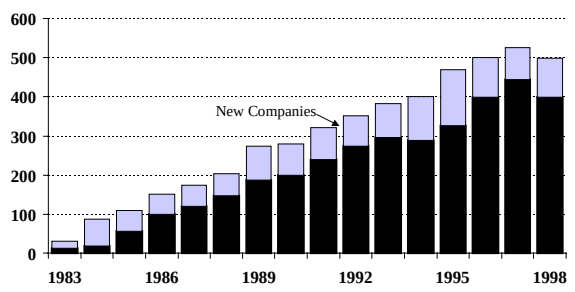
	Number Supported or Participating	Share of the Population	Trends in Share of the Population Over Past 10 Years
Clients:			
University Researchers	8,925	60% – 65%	Small Increase
Undergraduate Students	3,336	3%	Slight Decrease[1]
Master's/Doctoral Students	7,873	35% - 40%	Stable
Postdoctoral Fellows	1,547	40% - 50%	Stable
University Technicians	2,873	30% - 40%	Stable
Partner Organizations:			
Universities	60	75%	Stable
Companies Performing R&D	678	9% - 11%	More than doubled
Federal Science Departments/Agencies	11	65%	More than doubled
Provincial Science Departments/Agencies	8	25% - 40%	More than doubled

1. Large increase expected in 1999-2000 as a result of the 1998 and 1999 federal budgets.
Source: NSERC

Companies

Strong growth has taken place in the number of companies that have contributed to NSERC's collaborative university-industry research programs (see Figure 4). Since the inception of the university-industry research programs more than 1,200 firms have participated, rising from less than 50 companies in 1983 to nearly 500 businesses in 1998. On average, 100 new firms are working with NSERC every year.

Figure 4: Number of Companies Contributing to NSERC's University-Industry Programs



Source: NSERC

NSERC is well known to companies heavily involved in R&D. Thirty-seven of the top 50 Canadian R&D companies (as ranked by the Globe & Mail, 1998) have funded university research jointly with NSERC.

2.3 NSERC Operations

NSERC operates within a framework of:

(1) programs developed in consultation with the Canadian research community, in the context of the present and future challenges facing the Canadian university research system, and in light of Canada's needs and government priorities; and

(2) a rigorous process of peer review for awarding funding within the programs.

The peer review system ensures that funds go only to the best researchers and students, and the best research programs and projects. NSERC's involvement guarantees objective and fair review of applications for support. A more detailed description of the peer review process for research grants can be found in Section 6.6.

Applications for research funding are judged first and foremost on the merits of the proposed research and on the excellence of the research team; other criteria vary among the Council's programs, and include the level of commitment from industrial partners, the plans for interacting with the partners, and (especially for large projects) the design of the project and the proposed management structure.

Applications for direct student support, through NSERC's Scholarships and Fellowships programs, are judged on the student's academic qualifications, as well as his or her potential for research achievement, and an assessment of his or her leadership qualities. NSERC recognizes that success in graduate studies, and in a subsequent research career, is dependent on more than academic excellence; an enquiring mind, adaptability, and the ability to work well in a team are also essential. In addition, many other students receive NSERC support indirectly, through research grants awarded to their faculty supervisors.

2.4 Priorities and Challenges

Priorities

In the years to come, the global knowledge-based economy will continue to expand. Canada's prosperity and high quality of life will depend on our ability improve our productivity growth performance relative to the U.S. and other major trading partners. Success depends on investing in people and knowledge and the linkages between them.

Thanks to NSERC's investments on behalf of the Government of Canada, Canadian researchers gain access to leading-edge knowledge from around the world. Armed with this knowledge, and working increasingly in partnership with industry, they help fuel Canada's innovation system. The students, trained with the help of NSERC, acquire the skills needed to pursue rewarding careers in all sectors of the economy and become tomorrow's leaders. These investments in Canada's knowledge base lead to innovations in industry, and help set policy, standards and regulations. In so doing, they strengthen our economy and generally improve the quality of life for Canadians.

1. Young People

NSERC's investments in the training and development of graduate students, postdoctoral fellows and junior faculty are critical to our future capabilities in science and technology, and to Canada's long-term productivity.

These investments provide Canada with experts in the natural sciences and engineering and help satisfy Canada's demand for highly skilled people who will be able to pursue knowledge-intensive careers of many kinds within any sector of the economy. Over NSERC's 21-year history, more than 50,000 master's and doctoral students and young research professionals have benefited from NSERC training programs. (See page 30.)

2. Discovery

Basic university research continues to be an important source of high quality new knowledge. This knowledge, when adopted in industry, leads to product and process innovations, and creates economic activity that benefits future generations of Canadians. In fact, many of the "spin-off" companies discussed later (see page 23) come from basic research. To build a strong national system of innovation with the capacity for radical innovations, we must continue to advance our knowledge of the world around us.

Investing in basic research

By investing in basic university research and the people who seek out new knowledge, NSERC ensures that Canada generates new ideas for innovation. The Research Grants programs invest in the research activities of individuals and groups working in leading-edge science and engineering, as well as in the equipment and facilities necessary for this work. Combined, these two components provide a stimulating environment for research

training. A peer review process ensures that only the most promising proposals are funded. These investments contribute to Canada's capabilities across all areas of natural sciences and engineering on a national and international scale, enhancing our ability to access and use new knowledge from around the world.

Reallocating resources

NSERC has used international benchmarking to develop a Reallocations Exercise that helps set research priorities. Every four years, national and international experts review submissions from natural sciences and engineering disciplines to identify priorities for funding. The exercise shifts resources to strategic directions that are the most important to Canada. This will ultimately lead to better basic research in science and engineering in Canadian universities.

International collaboration

NSERC believes it is crucial to encourage international research collaborations that will significantly benefit Canadians. Two new NSERC programs, Collaborative Research Opportunities and the International Opportunity Fund, will help Canadian researchers establish collaborative projects with research groups or networks abroad, and enable them to access major international programs. The federal government's increased resources for NSERC in the 1998 and 1999 budgets made these programs possible.

3. Innovation

It is now widely understood that increasing Canada's productivity growth is key to our success in the global knowledge-based economy. NSERC fosters innovations in the natural sciences and engineering that add value to the goods and services we produce leading to productivity gains without losing jobs. As our economy becomes more knowledge-intensive, more innovations will be based on knowledge. That means that NSERC must continue to encourage the private sector to make better use of the excellent resource universities have to offer.

Partnerships

NSERC has successfully leveraged its investments by forming partnerships with the private sector, as well as in other sectors, including government departments and agencies, to help strengthen Canada's capacity in science and technology. These partnerships lead to university licensing agreements, patents, and new products and processes, as well as new policies, standards and regulations. Taking this one step further, this activity can expect to improve the productivity of existing companies and create new jobs and businesses, as well as to improve how government manages the advancement of knowledge.

Productive use of knowledge

Thanks to the 1998 budget increase to the Research Partnerships Program, NSERC will continue to play a significant role in helping industry turn research into commercial opportunities. As a result of the increase, NSERC satisfied more of the demand for university-industry projects, research agreements with other Federal departments and research networks. At the same time, it reinstated two important programs. The Technology Partnerships Program supports partnerships between universities and Canadian small- and medium-sized companies, enabling them to turn research into commercial applications. The Intellectual Property Management Program strengthens Canadian universities' ability to manage their intellectual property and to transfer the technology to industrial partners.

Challenges

New challenges have arisen from the interdependent pressures on the Canadian university research system, government and industry, within the global economy. These include:

1. The rising cost of research

The cost of performing leading-edge, world-class research is rising, creating greater dependence on NSERC funding. This is due to:

- *The dollar*: The exchange rate on the Canadian dollar makes it expensive to import scientific instruments and to conduct international research activities.
- *Inflation*: The prices for equipment, materials, and journals are going up much faster than the Consumer Price Index (CPI).
- *Expensive research methods*: To conduct world-class research, Canadian researchers must adopt modern research methods. These modern techniques are more expensive than traditional methods.
- *Indirect costs becoming direct*: Many services that used to be free now carry user fees that are paid out of NSERC grants.

2. Impact of the Canada Foundation for Innovation

Over the next five years, the federal investment of $1 billion for the creation of the Canada Foundation for Innovation (CFI) will translate into $2.5 billion in investment in much-needed infrastructure. However, while the CFI will strengthen the capacity of Canada's universities to conduct research, it will also create challenges for all sectors. NSERC, which funds the direct costs of research, anticipates a large increase (approximately $62.5 million per year) in demand for funding to operate the new facilities and laboratories.

3. Growing number of researchers to support

Despite static or even declining numbers of permanent faculty positions at most Canadian

universities, NSERC has to support a growing number of researchers. There are two reasons for this. First, all new faculty members are expected to conduct research; they must be supported at a critical time in their career even though those being replaced were not all active in research. Second, some early retirees who were active in research still remain as unpaid professors; they continue to win support in NSERC competitions. Both trends are good for Canada, but they create pressures on NSERC's budget.

4. The loss of leaders

Funding cuts to universities have had an impact on their staffing practices. While the debate over "brain drain" or "brain gain" may never be resolved, it is certain that Canadian universities are losing some highly qualified faculty and these tend to be the leaders. As highly paid senior professors retire or relocate, often outside Canada, universities have tended to replace them with junior faculty, or not at all.

5. The demand for highly skilled people

A key component of Canada's long-term productivity depends on skilled people that can contribute to a knowledge-based economy. However, some young talented people sometimes pursue careers south of the border attracted by higher salaries and research funding at leading-edge facilities. As a result, universities have difficulty attracting postdoctoral fellows and junior researchers. Moreover, many Canadian companies report that they cannot find highly skilled individuals in some fields, notably electrical engineering and computer science. If this trend continues, these companies and potential new firms may set up in the United States and elsewhere to ensure a sufficient supply of highly qualified people. NSERC must clearly encourage more young Canadians to pursue advanced studies in the natural sciences and engineering. More of Canada's young people need to be able to develop their talents fully to sustain and improve our ability to compete and innovate in a knowledge-based world.

6. Encouraging university-industry linkages

NSERC is the principal source of public support for research partnerships between universities and the private sector. After nearly two decades of working to bring the university and industry cultures together, the effort is bearing fruit in spectacular fashion. The achievements of these successful partnerships are creating wealth and high-quality jobs. By continuing to promote university-industry partnerships across the entire R&D spectrum, NSERC will help meet the growing demand for new partnerships.

7. Improving collaboration

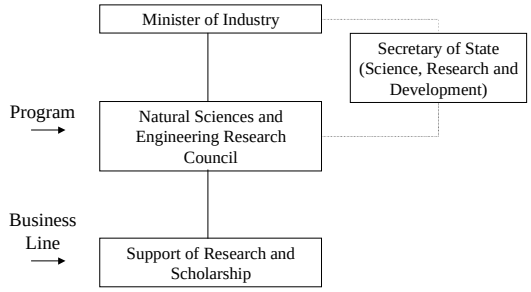
Information technology is partly responsible for the collapse of barriers between disciplines, institutions, sectors and nations. Groups of researchers with diverse disciplinary backgrounds and skills are now networking and sharing results. Often they work with industries, governments and international partners to solve small- and large-scale problems that benefit society. NSERC has participated in this evolution by

developing programs and review mechanisms that support multi-disciplinary research. Still, NSERC's experience continues to show that much remains to be done to break down the isolation of disciplines.

2.5 Departmental Organization

NSERC's sole business line is: Support of Research and Scholarship in the Natural Sciences and in Engineering. Figure 5 presents NSERC's organization structure.

Figure 5: Organization Structure



NSERC is governed by a Council (a Board of Directors) whose members are drawn from industry and the universities, as well as from the private non-profit sector, and appointed by the Governor-in-Council. Members serve part-time, and receive no remuneration for their participation. The President serves full-time, and functions as the Chair of the Board and the Chief Executive Officer of the Council. Council is advised on policy and programming matters by several committees. Figure 6 presents NSERC's committee structure.

Figure 6: Committee Structure

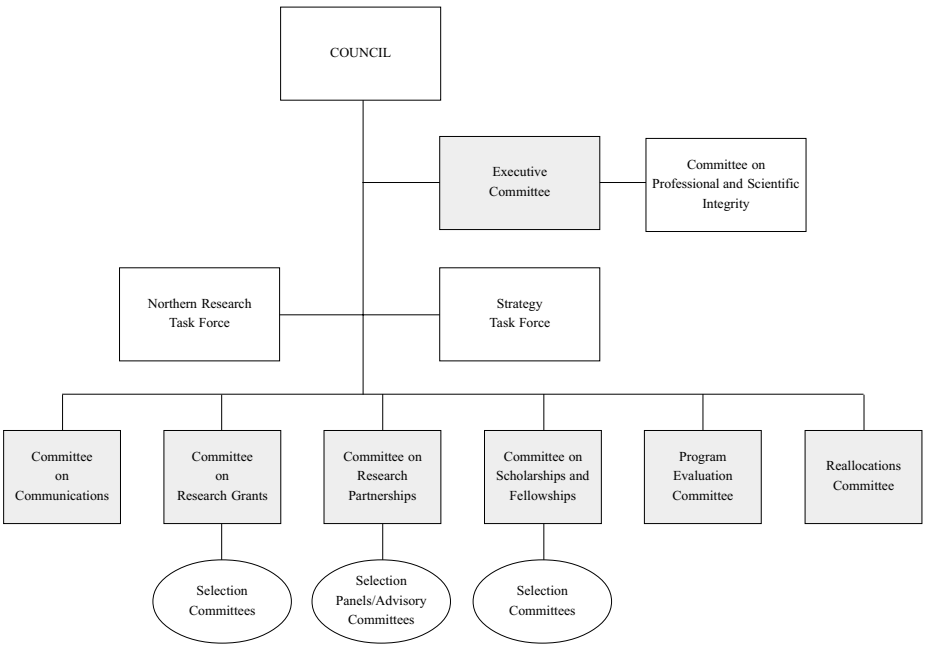
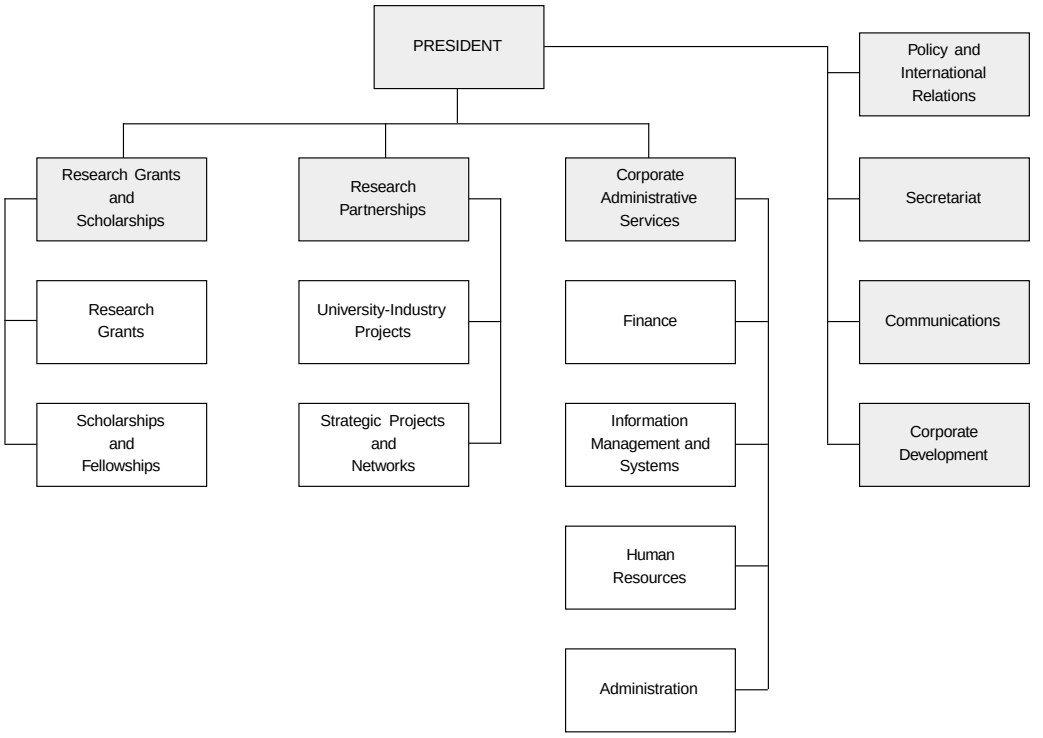


Figure 7 displays the corporate structure. NSERC is organized around two program directorates - Research Grants and Scholarships, and Research Partnerships. The Directors General of these directorates report directly to the President. There are also four corporate functions: Policy and International Relations, Corporate Development, Communications, and the Secretariat; the Directors of these units also report to the President. Finally, there is the Corporate Administrative Services Directorate. This directorate is shared with the Social Sciences and Humanities Research Council (SSHRC), and handles Human Resources, Information Management and Systems, Finance, and Administration for both Councils. Its Director General reports to the Presidents of both SSHRC and NSERC.

Figure 7: Corporate Structure



3. Departmental Performance

3.1 Performance Expectations

NSERC measures its performance by evaluating the programs of research and training support, their impact, cost effectiveness and continuing relevance. When reviewing performance indicators for assessing research support programs, it is important to remember that these investments take longer to bear fruit than most other government investments.

Performance expectations detailed below are taken from the Report on Plans and Priorities (1997-1998) and are summarized in the Chart of Key Results Commitments (p. iii). Highlights of performance expectations to **serve Canadians** include:

- high quality research capability maintained across all areas of natural sciences and engineering;
- enhanced ability to access and use new knowledge from around the world;
- knowledge base for developing policies and regulations, and making decisions, for government and industry;
- creation and productive use of knowledge in support of new products, processes, services, policies, standards and regulations in private and public sectors;
- highly qualified personnel to meet the needs of industry and the public sector;
- stronger economy based more on knowledge due to more technology transfer via highly trained employees in the public and private sectors, and through the creation of new businesses by trained individuals.

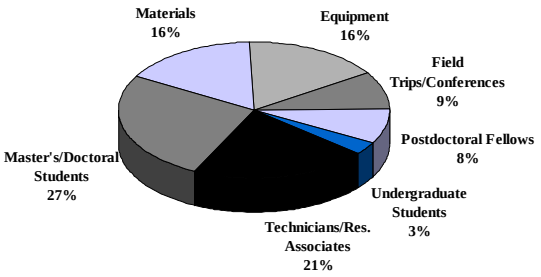
3.2 Resources

Figure 8 presents the resources devoted to NSERC's business line, Support of Research and Scholarship in the natural sciences and engineering. Spending in 1998-99 reached $498 million or 9 per cent of the federal government's expenditure on science and technology.

Figure 8: NSERC Expenditures, 1998-99

Business Line	Support of Research and Scholarship in the Natural Sciences and in Engineering
Planned Spending	$493,656,000
Total Authorities	$499,015,982
1998-99 Actuals	**$498,492,255**

Figure 9: NSERC Research and Training Expenditures, 1998-99



Total: $478 Million

Source: NSERC estimate based on 1997-98 expenditures.

The 1998-99 spending for goods and services purchased by Canadian university researchers with NSERC grant funds, together with NSERC's direct scholarship spending, is presented in Figure 9. Nearly 60% of NSERC research and training funds in 1998-99 were used to pay technicians, undergraduate and postgraduate students, and postdoctoral fellows. This creates and sustains more than 15,000 high technology jobs every year. Materials, scientific equipment, and travel expenses for field trips and conferences make up the other 41% of research and training expenditures. Spending on these goods and services indirectly creates or sustains roughly another 1,500 jobs per year. NSERC's administration expenses of $20 million (4% of total expenditures) brings the total for the year to $498 million. Additional financial information on NSERC program expenditures can be found in Section 6.5.

It should be noted that when a university researcher receives an NSERC grant, the funding can not be used for the researcher's personal income. It can only be used for the direct costs of research under a strictly defined set of rules and accountability procedures.

3.3 Performance Accomplishments

The impact of NSERC's investment in research and training in the NSE can only be fully assessed over the long term. As well, no one indicator can be considered a defining accomplishment; rather the whole suite of indicators presented should be taken into consideration. The performance indicators are presented within two categories: (1) research and development, and (2) training.

NSERC is also addressing performance issues in its administration activity, including quality service initiatives. The goal of the administration activity is to support and underpin the Council's function; performance issues therefore revolve around efficiency and quality service to both Council's staff and the research community. Performance in administration will be discussed in future Performance Reports, after performance baselines have been established. Current initiatives are described in 3.3.3.

3.3.1 Research and Development

Across all its programs NSERC invested $299 million in R&D in 1998-99. (This total excludes all expenditures on undergraduate/master's/doctoral students and postdoctoral fellows, which will be discussed in section 3.3.2.) The results of this and prior investments are described below under ten indicators:

1. Publications
2. Collaboration/Partnerships
3. Patents
4. Awards and Prizes
5. Licenses
6. Leveraging
7. Industrial Survey Results
8. Spin-Off Companies
9. New Products and Processes
10. Success Stories

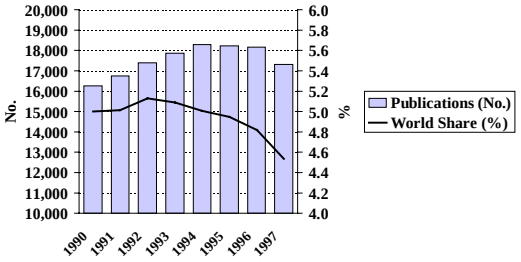
1. Publications

One of the first tangible outcomes of an investment in university R&D is a publication in a scientific or engineering journal. The worldwide culture of university research places a great deal of importance on publishing new discoveries and advances in widely circulated journals. Investment in this very public forum gives the country's researchers access to the latest international research and the ability to build on this research. The graphs on the following pages highlight some performance trends.

1. Publications (Cont'd)

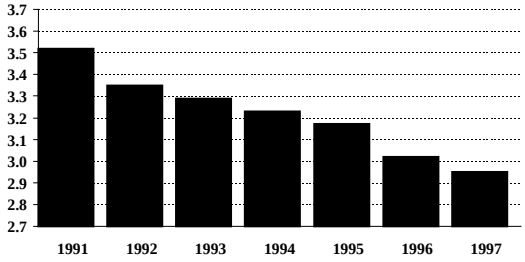
- Canadian researchers (all sectors) in the NSE publish roughly 18,000 journal articles per year, ranking Canada 6th overall in the world. This has represented a declining share of worldwide production, from 5% at the beginning of the decade to 4.5% in 1997 (see Figure 10). Most of Canada's and the world's scientific and engineering publications are produced by university researchers. The decline in Canada's share of university research spending in the OECD (Organization for Economic Co-Operation and Development, a good approximation for the world scene), as shown in Figure 11, follows roughly the same pattern as our world share of publications. However, Canada's world share of publications still exceeds Canada's share of university R&D expenditures.

Figure 10: Number of Canadian Publications in the NSE and World Share



Source: Observatoire des Sciences et des Technologies

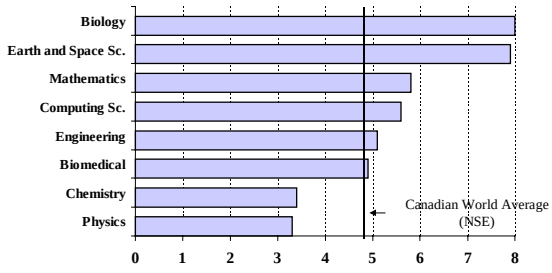
Figure 11: Canada's Share of University R&D Expenditures in the OECD (%)



Source: OECD

- One of the important objectives for NSERC is to maintain a significant world presence in all fields of the natural sciences and engineering. Figure 12 indicates that for the most part this is being accomplished.

Figure 12: Canada's Share of World Publications by Discipline in the NSE, 1990-97 (%)

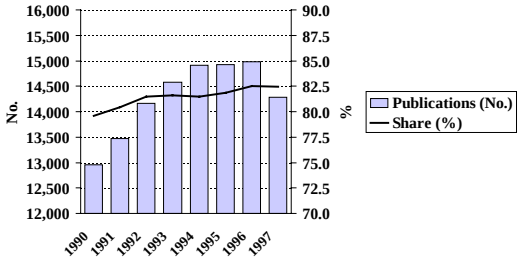


Source: Observatoire des Sciences et des Technologies

1. Publications (Cont'd)

- Most of Canada's NSE publications are produced by university researchers (see Figure 13). Of the average 15,000 university papers produced annually, over 80% can be attributed to NSERC-funded researchers.

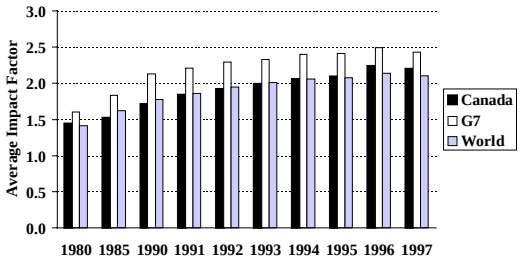
Figure 13: Number of Canadian Publications in the NSE by the University Sector, and Share of Canadian Papers



Source: Observatoire des Sciences et des Technologies

- Figure 14 provides an indication of the "impact" of Canadians papers in the NSE. Similar to common rating systems, in which a higher score indicates more viewers, listeners, or readers, the impact factor is a measure of the potential use of a researcher's work by fellow researchers. If a researcher's work is being referenced or cited more often by his/her peers, then there may be more intrinsic value to the work. Canada's impact factor in the NSE is slightly better than the world average and slightly below the G7 (although the gap is narrowing).

Figure 14: Average Impact Factor of Publications in the NSE

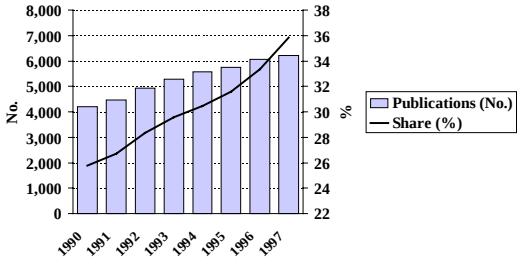


Source: Observatoire des Sciences et des Technologies

2. Collaboration/Partnerships

Increasingly Canadian researchers in the NSE are collaborating with international partners and benefiting from the globalization of R&D. Figure 15 shows the trend over the past seven years, culminating in one-third of Canadian papers in the NSE being written with international partners.

Figure 15: Number of Canadian Publications in the NSE Co-Authored with International Partners, and Share of Canadian Papers

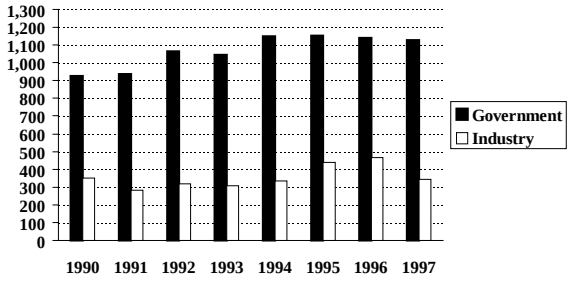


Source: Observatoire des Sciences et des Technologies

2. Collaboration/Partnerships (cont'd)

Canadian university researchers are also working closely with researchers in Canadian government laboratories and industry. Figure 16 indicates that over 1,000 university-government publications and over 300 university-industry publications are produced annually. This trend has been fairly steady over the past decade. A number of the university-government collaborations result in changes to government policy, as illustrated in the story below.

Figure 16: Number of University-Industry and University-Government Publications in the NSE



Source: Observatoire des Sciences et des Technologies

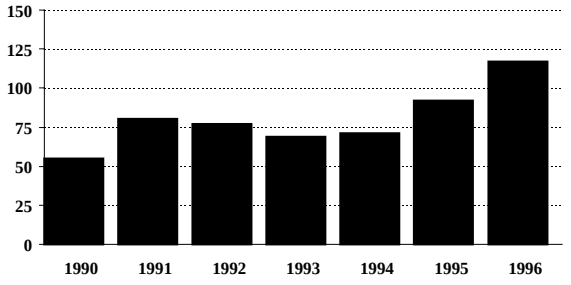
University-government collaboration leads to arrest of the world's most (un)wanted

Research conducted by Dr. Donald Mackay at the Environmental Modelling Centre of Trent University with Dr. Frank Wonia was influential in the 1998 decision to control or ban the manufacture of Persistant Organic Pollutants (POPs), a class of compounds that includes some of the most notorious chemicals: dioxins, DDT, and PCBs. In that year, Canada joined with the United States and Europe to sign the agreement, sponsored by the United Nations Environment Programme. Dr. Mackay and others have shown that POP chemicals aren't merely a problem for the country that manufactures them. Through environmental models, Dr. Mackay and his colleagues have shown that chemicals used in hot climates thousands of miles from the arctic evaporate into the atmosphere, drift and eventually condense and fall as precipitation in the cold climate ecosystem. The chemicals then enter the food chain. Abnormally high concentrations of some POPs have even been found in mother's milk in the far north. NSERC has supported Dr. Mackay's research for more than two decades. His study of contaminant interactions with snow and ice was jointly funded by NSERC and Environment Canada's Atmospheric Environment Services division. A global treaty for the control of POPs is expected in 2000.

3. Patents

A patent is issued when an invention is deemed to be new, useful, and nonobvious. Universities are paying closer attention to the potential value of R&D carried out on their campuses, and are seeking patent protection. A good measure of this activity is the number of U.S. patents being issued to Canadian universities. These have increased in the past two years (see Figure 17), but the 1996 level still falls behind the number of patents issued to U.S. universities by approximately 50% (after factoring in the different sizes of the countries).

Figure 17: Number of U.S. Patents Issued to Canadian Universities in the NSE

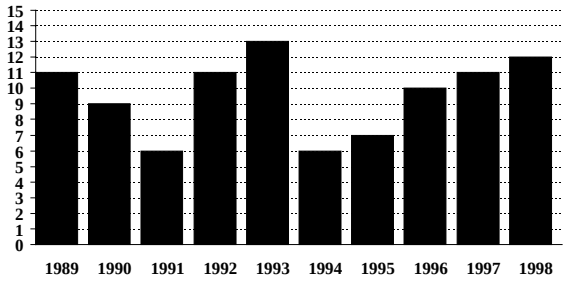


Source: Observatoire des Sciences et des Technologies

4. Awards and Prizes

Awards and prizes are a very common tribute to excellence in the research community. NSERC collected data on 191 international awards and prizes. Over the past ten years NSERC-funded researchers have received roughly 3% of the awards and prizes included in the analysis. (See Figure 18.)

Figure 18: Number of International Awards and Prizes Won by NSERC-Funded Researchers

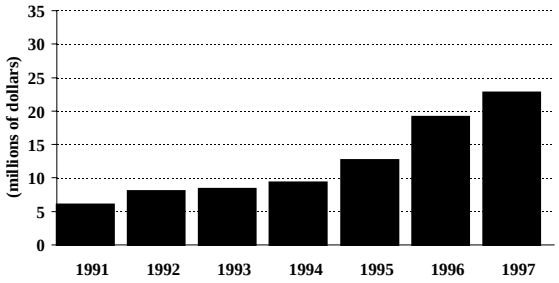


Source: NSERC

5. Licenses

One way university research is transferred to industry is through a license, giving the industrial buyer the right to commercialize the research. Commercial use of the licensed technology results in royalty income to the university and typically the researcher. The amount of licensing royalty revenues is another measure of the value of university research. Figure 19 presents an estimate of licensing revenues for Canadian universities. Most of these revenues can at least be partially attributed to funding from NSERC and the Medical Research Council (MRC). The trend in revenue growth is certainly a positive one and as universities strive to secure additional revenues it should continue to grow. But for now, Canadian university licensing revenues are far below U.S. university levels by a factor of at least two.

Figure 19: Canadian University Licensing Revenue (millions of dollars)



Source: NSERC estimate, Association of University Technology Managers..

Examples of licenses based on NSERC-funded research include:

- Novel compounds for the treatment of cancer have been licensed to a Canadian pharmaceutical company. University of British Columbia chemistry professor Chris Orvig developed the organovanadium compounds in collaboration with Angiotech, a Vancouver-based firm, which was granted a license in 1998.

5. Licenses (Cont'd)

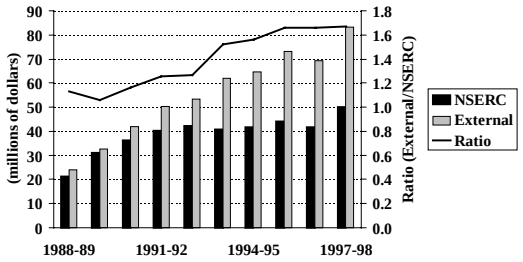
- Calgary-based Intermap licensed geoid mapping technology developed at the University of Calgary. Dr. Klaus Peter Schwarz developed the system in the Department of Geomatics Engineering. His technology brings precision to Digital Elevation Models, and is now being used by the US Government's National Image and Mapping Agency to map the Panama Canal Zone.

- Early this year, Roche Vitamins Inc. licensed a novel vaccine delivery system from the University of Guelph. Research on bacterial surfaces conducted by microbiologist Terry Beveridge and his team led to the development of the system, which should speed the development of affordable.

6. Leveraging

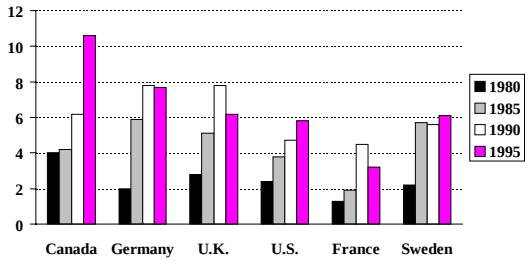
Many of NSERC's programs, and especially the university-industry programs, require a contribution from industry, universities, government departments and agencies. Over the past ten years, contributions from NSERC's partners have grown tremendously. (See Figure 20.) From just over $23 million in 1988-89, contributions in 1997-98 reached $83 million, for a growth rate of 260 per cent over the ten-year period. The total contribution from NSERC partners over the decade is an impressive $555 million. A comparison of NSERC funding to partner contributions is also presented in Figure 20. The ratio of partner contributions to NSERC funding has been steadily increasing over the 10 years. From a low of 1.13 in 1988-89, this ratio now stands at 1.7. Put another way, for every dollar NSERC puts on the table for a University-Industry research grant, our partners contribute $1.70, demonstrating the value they place on the R & D. The impact of NSERC's and MRC's partnership programs has been to increase the share of university research funding from industry to levels well beyond other industrialized nations. (See Figure 21.)

Figure 20: Contributions to NSERC's University-Industry R&D Programs



Source: NSERC

Figure 21: Share of University Research Funded by the Private Sector (%)



Source: OECD

7. Industrial Survey Results

NSERC's pilot study to measure the outcomes of the Collaborative Research and Development (CRD) program, a program that brings university researchers and industrial partners together. NSERC is continuing this work and a summary of the industrial participants' perceptions of their CRD experience and some short-term outcomes from the pilot study are described below:

- In 34 of the 44 projects studied, the industrial partners expected commercializable results. Such results were achieved in 31 projects. Of those, 26 reached the implementation stage, with positive effects on the companies' competitiveness. In 20 cases the industrial participants reported no difficulties in the implementation of the research results.

- 41% of the industrial collaborators interviewed stated that "new products, processes, standards or services" were created as a result of the projects. 57% mentioned "improvement of existing processes or products", 86% "updating knowledge" and 68% having "access to new ideas" through the CRD projects.

- In 26 cases (59%), CRD projects resulted in positive competitive effects on the industrial partners. The impact on the company's competitiveness was mostly in terms of "gains of productivity" (17 cases), "profit" (15 cases), "sales" (8 cases) and "market share" (7 cases).

- The return on investment (ROI) of the CRD projects, as reported by the industrial partners, was "excellent" in 14 cases, "good" in 10 cases, "fair" in 11 cases and "poor" in 5 cases. There was "no reply" in 4 cases.

- 37 out of 44 industry participants (84%) still maintain a research relationship with their university partners: "formal or informal networks" (19 cases), "consulting contracts" (10 cases) and "collaborative research" (12 cases).

8. Companies Linked to NSERC-Funded Research

The creation of a company remains one of NSERC's more tangible outcomes of university-funded research. The "spin-off" companies highlighted in this report have all been founded on results of research partially funded by NSERC. The 112 "spin-off" companies featured (see Figure 22 on the next page) are currently in business producing goods and services for Canadian and international markets. Combined, these companies employ 6,878 Canadians and generate nearly $1.3 billion in annual sales/revenue. Creating innovative goods and services using the latest technologies, these firms make an important contribution to Canada's economy. The potential for future growth of many of

Figure 22: Companies Linked to NSERC-Funded Research, 1969 to 1998
(Number of employees in Canada in 1998)

Alberta
Raylo Chemicals (175)
BIOMIRA (160)
Wi-LAN (65)
D.B. Robinson and Associates (56)
Harding Instrument Company (41)
Hycal Energy Research Laboratories (40)
Itres Research (35)
SemBioSys (22)
Cel-LOC (20)
Boreal Laser (5)

Saskatchewan
SED Systems (250)
Wavecom Electronics (155)
DEL-AIR Systems (100)
Sci-Tec (93)
Conservation Energy Systems (60)
Biostar (32)
Droycon Bioconcepts (8)

Quebec
BioChem Pharma (438)
Les entreprises GIRO (120)
Ad Opt Technologies (60)
Nexia Biotechnologies (38)
Hexavision (35)
Pyrovac (27)
Advitech Solutions (25)
Infolytica (24)
INRO Consultants (23)
Comlab Télécommunications (22)
Kemestrie (18)
Tekna Plasma Systèmes (18)
DephyTech (10)
Bios Inc. (10)
Mycota (10)
Real Numerix (6)
Cosem Neurostim (Confidential)

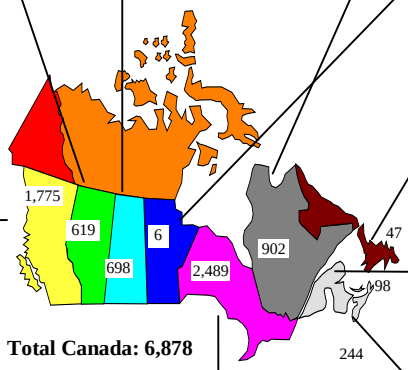
British Columbia
MacDonald Dettwiler and Associates (800)
NEC Moli Energy (350)
QLT PhotoTherapeutics (175)
Brooks Automation (Techware) (100)
CTF Systems (60)
Westport Innovations (55)
Forbes Medi-Tech (34)
Terragen Diversity (34)
TIR Systems (25)
Vortek Industries (25)
Phero Tech (22)
Credo (Kinetic Effects Research) (13)
IGT Pharma (13)
Barrodale Computing Services (11)
Wavemakers Research (9)
Kinetic Sciences (8)
Intertech Systems (8)
Assistive Listening Device Systems (7)
Mycologic (7)
Quantum Technology (6)
Albacore Research (6)
IDAQ (5)
Dewey McMillin & Associates (5)
Process Stimulations (5)
Microtek International (Confidential)
MicroXpress (Confidential)
Aurora Instruments (Confidential)

Manitoba
Sysmon (6)
Quantic Laboratories (Confidential)

Newfoundland
Guigné International (30)
AF Protein (10)
Northern Radar (7)

New Brunswick
Unisys (70)
EMR Technologies (28)

Nova Scotia
Focal Technologies (80)
Applied Microelectronics (50)
Satlantic (40)
Pictorius (30)
Ocean Nutrition Canada (29)
MathResources (8)
Thermo Dynamics (7)



Total Canada: 6,878

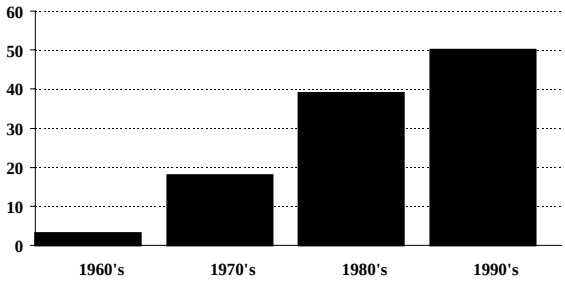
Ontario
Zenon Environmental (400)
MDS SCIEX (320)
Sybase Waterloo (240)
Dalsa (175)
Inverpower Controls (175)
Open Text (140)
Honeywell Hi-Spec (130)
Certicom (95)
Optech (90)
Stantec Consulting Ltd. (80)
Waterloo Maple (70)
Platform Computing (60)
Virtek Vision (52)
TRIAM Powerlasers (40)
Imaging Research (38)
Electrophotonics (36)
Diffracto (33)
Philips Analytical (31)
Innova Technologies (30)
Performance Plants Biotechnology (28)
Turbotak Technologies (22)
Legasys (21)
Dynacon Enterprises (20)
Ensyn Technologies (20)
ESG Seismology (18)
Polyphalt (15)
Hydromantis (14)
Millennium Biologix (12)
Hydrasil (10)
Estco Energy (9)
Biorem Technologies (7)
Apollo Environmental Systems (6)
Qubit (6)
EnviroMetal Technologies (5)
Gensel (5)
Ask Science Products (4)
Elstat (4)
New Orbit Technologies (3)

8. Companies Linked to NSERC-Funded Research (Cont'd)

these advanced technology companies, which are tomorrow's multi-nationals, is high. They range in size from new start-ups with only a few employees to well-established firms with hundreds of workers. The number of employees and annual sales/revenue figures by province are shown in Table 18 in Section 6.5.

The pace of "spin-off" company formation seems to be accelerating (see Figure 23). As more researchers embrace the entrepreneurial spirit to launch a company, NSERC expects more and better things to come in the future.

Figure 23: Number of NSERC-Related Spin-off Companies by Decade of Incorporation

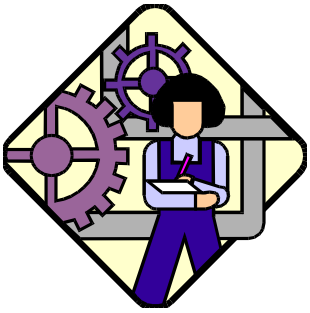
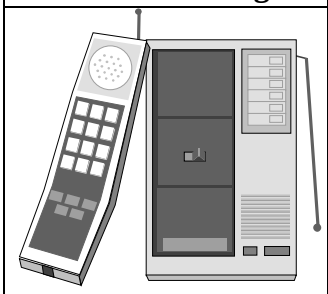
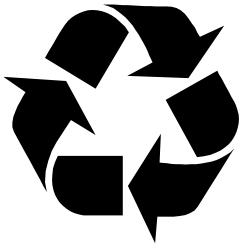


Source: NSERC

9. New Products and Processes

NSERC-funded researchers have created or developed many new products and processes, the value of which is easily in the billions (although it is very difficult to determine the exact amount). A sample of these new products and processes by economic sector is presented in Figure 24.

Figure 24: Examples of New Products and Processes Developed by NSERC-Funded Researchers by Sector

 **Natural Resources**	➢ Seismic monitoring systems for mine design, safety, and management ➢ PetroTag, a system for monitoring the mass, density and volume of fuel in storage tanks. ➢ Microwave systems for improving productivity in mining & heavy oil industries ➢ Soil cover system for mines, preventing acid rock drainage ➢ Ambrosia beetle control protecting forests ➢ Fibre Quality Analyzer (FQA) for the pulp and paper industry ➢ Natural insecticide for the protection of hemlock trees
 **Manufacturing**	➢ LaserEdge™ a vision system for composite material parts manufacturing in the Aerospace industry ➢ Electromagnetic stirring systems for improving quality and productivity in steel making ➢ Advanced software for shipbuilding ➢ DETECT/NDE, a non-destructive evaluation system for complex materials, such as the interior of the wing of an aircraft ➢ Robotics for equipment control in the manufacture of semiconductors ➢ Ultra-powerful arc lamps for the manufacture of integrated circuits and advanced materials ➢ Intelligent Robot Eye, smart image sensors for pattern recognition, quality control, and robot guidance ➢ Heat-resistant polymer for autoparts
 **Telecommunications**	➢ Fibre optic filters, components ➢ Hopper and Hopper Plus wireless modems ➢ Speech compression software ➢ SQL Anywhere Studio: mobile database technology ➢ CELLOCATE™ System pinpoints exact location of cell phone for safety reasons ➢ Digital Video Modulator for video-on-demand applications ➢ Self-healing and self-organizing networks
 **Environment**	➢ Turbotak Scubber for the efficient removal of solid, liquid and gaseous contaminants from process exhaust streams ➢ Clean treatment to prevent Dutch elm disease (a vaccine) ➢ Electrostatic spray technology to reduce pesticide use ➢ Rapid Thermal Processing, transforming waste into valuable chemicals and fuels ➢ BARTT biodetectors for monitoring water quality ➢ ECO-clear, a bio-herbicide ➢ Laser-based gas detectors for monitoring emissions of greenhouse gases ➢ Pyrocyclage™ a technique for recycling used tires, treating contaminated soils.

10. Success Stories

The following are some examples of NSERC-funded research projects that have improved the quality of life, health, or prosperity of Canadians or that have brought international prestige to Canada by significantly contributing to the advancement of knowledge. NSERC has collected hundreds of similar success stories and will present a selection of them in every performance report. This year's theme is: "How NSERC-funded research contributes to improved productivity and wealth generation."

Researcher gets computers to share

Investment in an NSERC Collaborative Research Project made it possible for Nortel to save millions of dollars through better use of both human and computer resources. University of Toronto Computer Science professor Songian Zhou designed a distributed computing system, joining many computers into a virtual supercomputer. The prototype of the Load Sharing Facility (LSF) was tested and applied successfully at Bell Northern Research under a NSERC Collaborative Research and Development Project. The LSF system ensures that no suitable computer will stay idle if there are jobs queued, and that a job would never be run on a slower computer if a faster one is available.

New methods worth a mint

Nineteenth century methods are still used in the mining and metals industries. Canadian university researchers are helping to bring twentieth century technologies to outdated practices, for cleaner and more productive operations. Through an NSERC collaborative research and development grant, University of Toronto's James Toguri and Queen's University's Chris Pickles helped the Royal Canadian Mint to clean up a commonly used 19th century gold purifying process known as the "Miller Process." The partnership resulted in a technique called "QTM" (named after the partners: Queen's, Toronto, Mint), which has vastly improved the Miller Process. The Mint has saved on costs, labour, and floorspace, while cutting pollution significantly. The Mint is now making the QTM process available for license.

10. Success Stories (Cont'd)

A collaboration that really took off

Productivity is soaring at Pratt and Whitney Canada, thanks to a research partnership with a professor at the University of British Columbia. Mechanical engineering professor Yusuf Altintas helped Pratt and Whitney Canada to save millions of dollars on the manufacture of components for jet engines. Dr. Altintas developed adaptive control software to optimize the machining process. The system enabled Pratt Whitney to cut waste and reduce shutdowns, improving their productivity by fifty percent. The technology is a result of the longstanding collaboration between PWC and Dr. Altintas, which has been supported through NSERC grants. Dr. Altintas' technology is now in demand by manufacturers around the world.

Work that runs on schedule and on budget

Keeping on budget and on schedule can be a challenge. Major airlines are turning to solutions developed by researchers at the Université de Montréal's École des hautes études commerciales and École Polytechnique. There, Drs. Jacques Desrosiers and François Soumis designed scheduling software for optimizing flight schedules, as well as the pilots and crews for the flights. Their system, known as GENCOL, uses mathematical scrutiny to determine the most cost-effective solutions, taking into account all constraints. For some clients, the system has resulted in savings of 15% of operating costs. This really adds up, when your operating budget is in the multi-billion dollar range.

Research produces concrete benefits

Researchers at Dalhousie University are having a solid success with their new material. Civil engineering professor Jean-François Trottier and his graduate student Michael Mahoney developed a synthetic fiber that increases the toughness and durability of concrete. The new fibers are easier to use, better performing and more resistant to corrosion. Locally, the new material has been used in the repair of the Halifax International Airport apron and the MacKay bridge piers. It has also been used in California for replacing steel fibers in tunnel linings. The material, developed under Dr. Trottier's research grant, is being distributed around the world by a major building supplies company.

Pheromone research a fruitful endeavor

At Simon Fraser University, researchers have discovered an environmentally friendly way to increase orchard productivity by up to 30%. Biological science professors Mark Winston and Keith Slessor synthesized a pheromone produced by the Queen bee. By using the pheromone, researchers are able to control the worker bees in much the same way as the Queen bee does. They can be induced to collect more pollen, "rear more brood", or put-off swarming or repro-duction. But what makes this development especially interesting and valuable is that the pheromone can help to increase the production of fruit. Bees are essential to fruit producers. Without their help, the flowers on fruit trees would not be pollinated and would not bear fruit. By spraying some crops with the pheromone during the flowering season, bees are more effective pollinators. The end result is up to 30% more fruit. The treatment is particularly effective for cranberries, pears, and blueberries.

3.3.2 Training

NSERC invested $179 million in 1998-99 to train the next generation of science and engineering graduates. This training support is provided in two ways: (1) directly through national competitions to selected individuals; and (2) through indirect support provided by an NSERC-funded researcher from his or her NSERC grant.

NSERC must be able to support enough graduate students in the natural sciences and engineering to meet the needs of the country, and the support must be at a high enough level to attract the best people. Without these long-term investments in young people Canada will experience a decline in its ability to compete and innovate in a knowledge-based world.

For a more detailed analysis of the impact on Canada's economy of supporting advanced training in the NSE, see Section 6.7.

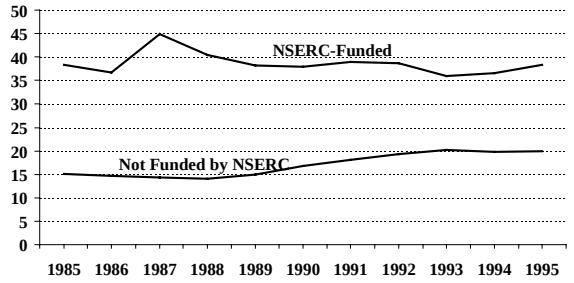
NSERC measures the impact of its training investments through four indicators:

1. Undergraduate Students Going on to Graduate School
2. Career Progression of Master's and Doctoral Students
3. Career Progression of Postdoctoral Fellows
4. Career Progression of Industrial Research Fellows

1. Undergraduate Students Going on to Graduate School

NSERC provides four-month jobs for undergraduate students in the natural sciences and engineering through our Undergraduate Student Research Awards (USRA) program (Note: NSERC-funded researchers also support undergraduate students through their NSERC research grants). NSERC has made an annual investment of $9 million to bring this experience to more than 2,000 students every year. The program's objective is to stimulate the interest of undergraduate students in research by providing them with valuable experience in a university or industrial laboratory, and to encourage these students to undertake graduate studies.

Figure 25: Percentage of Undergraduate Students Who Go On to Graduate School (%)



Source: NSERC estimates.

More than 30% of USRA winners pursue graduate studies; we know this because this number goes on to hold NSERC postgraduate awards. In fact, many more USRA winners probably go on to graduate school without direct NSERC support, but their numbers are unknown. However, reasonable estimates for this group and undergraduates that do not receive NSERC funding and that go on to graduate school can be made. Figure 25 indicates that NSERC-funded undergraduates are on average twice as likely to go on to graduate school as those not funded by NSERC.

2. Career Progression of Master's and Doctoral Students

NSERC provides scholarship support for Canadians to pursue a master's or doctoral degree in the natural sciences and engineering. This is done in two ways: (1) directly through national programs supporting more than 3,500 students annually at a cost of $53 million per year; and (2) indirectly through NSERC's research grants, which support more than 4,300 students (full-time equivalent), at roughly $75 million per year.

The career status of former NSERC-funded master's and doctoral students and the degree to which NSERC funding affects their ability to undertake or continue with their studies are important indicators of the impact of the scholarship support. Over the past four years NSERC has completed annual surveys of directly-funded master's and doctoral students. A total of 990 former NSERC-funded students have replied (a response rate of nearly 55%). Just under half (47%) of the respondents wrote remarks in the "Comments" section of the questionnaire. Most of the remarks were positive. (See side box).

NSERC-Funded Master's and Doctoral Students Comment on Their Awards

- "I feel that receiving an NSERC Scholarship is one of the most important factors in bringing me to my present position of employment."
- "They are an engine for research and they inspire a feeling of national pride in those who hold them."
- "NSERC scholarships: well administered. Amount was sufficient, but not extravagant. Extremely important to encourage good students!"
- "If I had not had the NSERC scholarship, I would not have received my master's degree, at least not without incurring a lot of debts...Further, the degree was essential to my current job."

The major findings of these surveys can be summarized as follows:

- The unemployment rate for respondents is estimated to be less than 2%.
- 82% of the respondents (employed or self-employed individuals in a full-time position in Canada) have an annual salary greater than $45,000.

2. Career Progression of Master's and Doctoral Students (Cont'd)

- A high percentage (65%) of respondents are active in a research and development capacity, using their training for one of the primary purposes of the scholarship programs.

- 70% of respondents feel that their graduate training was "critical" to their careers.

- 173 respondents (17% of the total) were living outside the country at the time of the survey. One-half of these respondents intend to return to Canada.

- 96% of the respondents completed the degree (master's or doctorate) for which they received NSERC funding.

- 90% of the respondents said that NSERC funding was moderately important to essential to undertake or continue with their studies.

3. Career Progression of Postdoctoral Fellows

After a doctoral degree it has become customary in certain fields to go through additional postdoctoral research training. NSERC directly funds postdoctoral fellows (PDFs) for up to two years to continue their research training. NSERC invests approximately $11 million per year to support roughly 400 Canadian PDF's per year. NSERC also provides this PDF support for more than 900 other individuals through NSERC research grants. Survey results from the first-ever survey of our previously funded postdoctoral fellows are coming in during the summer/fall of 1999. The survey is similar to the master's and doctoral students' surveys presented above. It is anticipated that the career results will be as positive as for the master's and doctoral population, since 60% of NSERC's postdoctoral fellows held an NSERC postgraduate scholarship.

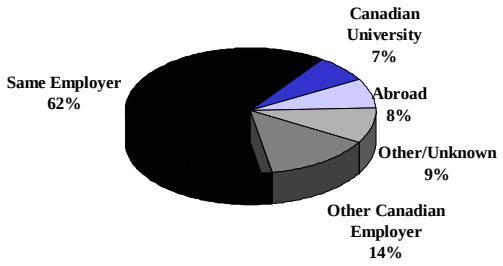
4. Career Progression of Industrial Research Fellows

Another route for doctoral graduates to gain additional research experience is through NSERC's Industrial Research Fellowships (IRF) program. This relatively small program invests approximately $3 million per year to help place 150 Canadian Ph.D.s annually in industrial laboratories. This investment has contributed significantly to the number of doctoral graduates working in Canadian industrial labs. More than 15% of Canadian industrial researchers with a Ph.D. have been funded by NSERC through the IRF program.

4. Career Progression of Industrial Research Fellows (Cont'd)

To determine if the program is staying on track, NSERC routinely monitors the employment situation of former IRF winners. Ideally IRF winners would continue to work as industrial researchers. Figure 26 shows the current employer for the 828 Fellows who finished their award from 1980 to 1998. Seventy-five per cent of former IRF winners are still working in Canadian industries. A small percentage have gone on to academic positions in Canadian universities, and a similar percentage have left the country.

Figure 26: NSERC's Industrial Research Fellows: Where Are They Now?



Total: 828

Source: NSERC Industrial Research Fellows from 1980 to 1998.

NSERC also surveys representatives of the company where the Fellows worked, or their supervisors. Surveys from over 100 companies involving 304 Fellows have been received to date. The reaction of the companies responding to the survey has been overwhelmingly positive:

- 98% of the firms said that the program was able to meet their requirements;
- 98% stated that the research project undertaken by the Fellow was "successful", and 95% believed it to be cost-effective.

Some of the comments received from company representatives are highlighted in the side box.

Company Representatives Comment on NSERC Industrial Research Fellows

- "Over the past decade, we have continued to make excellent use of the IRF program to attract young scientists. These talented individuals have, in turn, created very exciting programs with the potential for commercialization of new 'Made in Canada' products."
- "This is a useful program for companies in that they are given the privilege of working with fresh Ph.D. recipients who are open to new ideas and directions, and are very keen to apply their academic knowledge to practical systems."
- **"**The IRF provides the added leverage/ support to keep these people in Canada."
- "The program is exceptional. We welcome programs such as this as it gives small companies such as ours, the opportunity to recruit people with exceptional skills and knowledge."
- "I think that the actual program is very good and well-administered. The criteria are fair and the mode of selection is rigorous."

3.3.3 Service Delivery and Service Standards

NSERC is committed to improving the quality of its services and administrative efficiency by enhancing program delivery and improving access to information for all interested parties. Some of the service initiatives that have been completed or started in 1998-99 include:

- NSERC and SSHRC, in consultation with the research community, have agreed to review all existing grant policies and procedures to harmonize their respective sets of directives, wherever possible. Revised policies and procedures will take effect in 1999-2000.

- NSERC continues to increase public awareness of the natural sciences and engineering research sector. As part of its new Communications Policy, NSERC is reaching out to the general public and the business community, as well as maintaining its traditional contacts with researchers. During the year, NSERC promoted its twentieth anniversary to interest the press and the public in the work we support. There were also advertisements, a new publication, and major additions to NSERC's Web site.

- A Web-based version of the application for NSERC scholarships and fellowships was made available for the first time, and many students decided to try it out. In fact, 3,865 students were curious enough to access the new process, while 1,717 of them used it to complete their application. Specialized software isn't needed, since everything can be downloaded free of charge from the Internet.

- One of the most notable highlights of the year was the launch of a new breakfast series for M.P.s in collaboration with the Partnership Group for Science and Engineering (PAGSE). These events are designed to bring research advances to the attention of federal politicians.

- NSERC reviewed its own systems and databases for Y2K compliance. Efforts were made to bring to the attention of institutions and individuals who receive NSERC awards their responsibility for the scientific, administrative and financial aspects of the activities sponsored through those awards, and to alert them to possible Y2K problems that they might have to deal with.

- NSERC will continue to develop new ways of using web-technology to provide better access to information for users of NSERC programs, as well as to increase the awareness of the value of NSERC-funded research among the public, opinion leaders and the private sector. NSERC launched a re-designed web site in the spring of 1999 to better serve its clients. This included a web-based searchable database (www.nserc.ca/programs/result/database.htm) to permit anyone to run queries on NSERC-funded research.

4. Consolidating Reporting

4.1 Year 2000 Readiness

As of the end of July 1999, NSERC was in very good shape in terms of Y2K compliance and readiness. All departmental mission critical computer systems were redesigned or purchased in recent years, taking into account Y2K requirements. The most recent technical assessment by Treasury Board Secretariat rated NSERC technical readiness as 98%. NSERC is confident that it will achieve the 100% rating once all technical testing is completed in September.

Management contracted an independent auditor to assess the state of NSERC's Year 2000 readiness in February 1999. The audit confirmed that technical systems were compliant, but recommended that management should focus on issues related to due diligence such as Y2K project governance, technical testing, communications and business contingency planning.

As a direct response to these recommendations, NSERC immediately formed a joint Y2K steering committee with the Social Sciences and Humanities Research Council (SSHRC). This committee, which is constituted of senior managers of both councils, has met regularly since March 1999 to direct and review the work of Y2K project staff. Since SSHRC and NSERC share corporate administrative services, infrastructure and systems, they are collaborating on their Y2K responses.

Significant progress has been made in response to the audit recommendations. NSERC is completing a detailed technical testing project and has undertaken Y2K communications initiatives targeting research administrators in the universities. With respect to contingency planning, at the time of this writing NSERC had completed and received very positive feedback on two of the three reports required by the National Contingency Planning Group. The final report is expected to be submitted and approved in September.

5. Financial Performance

5.1 Financial Performance Overview

Tables 1, 2, 3, 7, and 9 in the next section present the required financial information for NSERC, while the other Financial Tables were not applicable to NSERC. There were no major differences between planned and actual spending levels for 1998-99.

5.2 Financial Summary Tables

The following tables represent the required financial information for NSERC.

Table 1: Summary of Voted Appropriations

Financial Requirements by Authority (millions of dollars)

		1998-99		
Vote		**Planned Spending**	**Total Authorities**	**Actual**
	Natural Sciences and Engineering Research Council Program			
85	Operating expenditures	16.0	19.1	**18.5**
90	Grants	475.8	478.0	**478.0**
(S)	Contributions to employee benefit plans	1.9	2.0	**2.0**
	Total Program	*493.7*	*499.0*	***498.5***
	Total Agency	**493.7**	**499.0**	**498.5**

Note: Total Authorities are Main Estimates plus Supplementary Estimates plus other authorities.
Due to rounding, figures may not add to totals shown.

Table 2: Comparison of Total Planned Spending to Actual Spending

NSERC Planned versus Actual Spending (millions of dollars)

Support of Research and Scholarship	1998-99 Planned Spending	1998-99 Total Authorities	1998-99 Actual
FTEs	197	197	200
Operating[1]	17.9	21.0	20.5
Capital	—	—	—
Voted Grants & Contributions	475.8	478.0	478.0
Subtotal: Gross Voted Expenditures	493.7	499.0	498.5
Statutory Grants and Contributions	—	—	—
Total Gross Expenditures	**493.7**	**499.0**	**498.5**
Less:			
Respendable Revenues[2]	—	—	—
Total Net Expenditures	**493.7**	**499.0**	**498.5**
Other Revenues and Expenditures			
Non-respendable Revenues[3]	—	—	(0.1)
Cost of Services provided by other Departments	1.7	1.7	1.9
Total Transfer Payments	**495.4**	**500.7**	**500.3**

1. Operating includes contributions to employee benefit plans.
2. These revenues were formerly called "Revenues Credited to the Vote".
3. These revenues were formerly called "Revenues Credited to the (CRF)".

Note: Total Authorities are Main Estimates plus Supplementary Estimates plus other authorities.

Table 3: Historical Comparison of Total Planned to Actual Spending

Historical Comparison of NSERC Planned versus Actual Spending (millions of dollars)

	Actual 1996-97	Actual 1997-98	1998-99 Planned Spending	1998-99 Total Authorities	1998-99 Actual
Natural Sciences and Engineering Research Council	451.6	435.4	493.7	499.0	**498.5**
Total	**451.6**	**435.4**	**493.7**	**499.0**	**498.5**

Note: Total Authorities are Main Estimates plus Supplementary Estimates plus other authorities.

Table 7: Non-respendable Revenues[1]

Non-respendable Revenues (thousands of dollars)

			1998-99		
	Actual 1996-97	**Actual 1997-98**	**Planned Revenues**	**Total Authorities**	**Actual**
Natural Sciences and Engineering Research Council	105	386	—	—	**115**
Total Non-respendable Revenues	**105**	**386**	**—**	**—**	**115**

1. These revenues were formerly called “Revenues Credited to the (CRF)”.

Table 9: Transfer Payments

Transfer Payments (millions of dollars)

			1998-99		
Support of Research and Scholarship	**Actual 1996-97**	**Actual 1997-98**	**Planned Spending**	**Total Authorities**	**Actual**
Grants	434.7	418.0	475.8	478.0	**478.0**
Contributions	—	—	—	—	**—**
Total Transfer Payments	**434.7**	**418.0**	**475.8**	**478.0**	**478.0**

Note: Total Authorities are Main Estimates plus Supplementary Estimates.

6. Supplementary Information

6.1 Contacts for Further Information and Web Sites

Our Web site is located at: www.nserc.ca

For further information about this report you can contact:

Mr. Steve Shugar
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Tel. (613) 995-6449
Fax (613) 947-5645
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or

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Tel. (613) 996-1079
Fax (613) 947-5645
E-Mail bjl@nserc.ca

6.2 Legislation Administered and Associated Regulations

NSERC does not administer any legislation.

NSERC was created by the *Natural Sciences and Engineering Research Council Act 1976-77, c. 24, s. 24*.

6.3 Other Departmental Reports

Copies of the following reports are available:

- Annual Report 1998-99
- Annual Report 1997-98, Networks of Centres of Excellence
- NSERC Facts and Figures 1997-98
- Postgraduate Surveys
- 1997-98 Estimates
- Longer-Term Performance Indicators for the Collaborative Research Development Program
- Performance Indicators for the Research Grants Program
- Report on Plans and Priorities 1999-2000

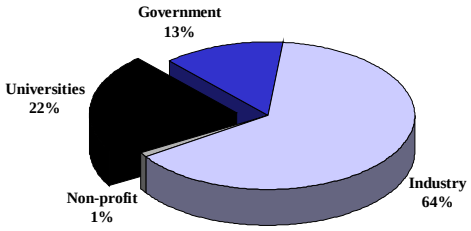
6.4 University Research in Canada

(Refer to Section 2.2)

The following statistics are presented to help the reader understand the position and relevance of Canadian university research.

1. University researchers conducted 22% of all Canadian research, as measured by expenditures, in 1998 (see Figure 27).
2. Of the $3 billion of direct and indirect investment in Canadian university research in 1998, 42% was allocated to the natural sciences and engineering (see Figure 28).
3. Figure 29 shows trends in the funding of Canadian university research in the NSE. Over the past ten years the Federal government's share has declined, while industry has contributed a greater portion.
4. Canadian university researchers perform 3% of the nearly $100 billion in university research in the OECD (see Figure 30). When measured as a percentage of gross domestic product, Canada conducts roughly the same amount of university research as most of its G7 competitors.

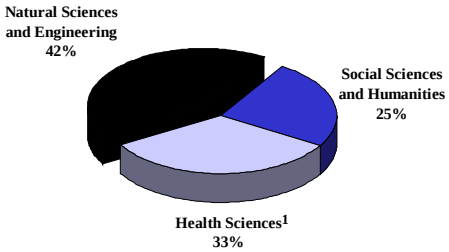
Figure 27: R&D Performance in Canada, 1998



Total: $13.9 Billion

Source: Statistics Canada

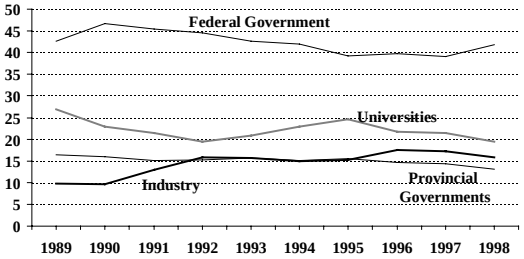
Figure 28: University R&D in Canada by Discipline, 1998



Total: $3.0 Billion

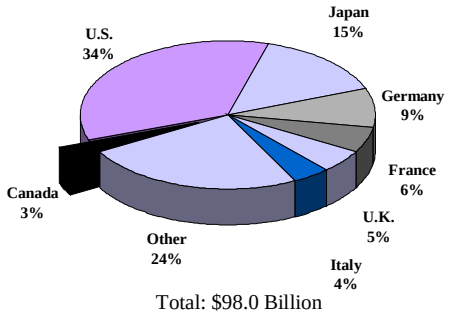
1. Excludes hospitals.
Source: Statistics Canada

Figure 29: Canadian University R&D Funding in the Natural Sciences and Engineering (%)



Source: Statistics Canada

Figure 30: University R&D Expenditures in the OECD, 1997



Total: $98.0 Billion

Source: OECD

6.5 Supplementary Tables

Table 17: NSERC Expenditures by Program (thousands of dollars)

	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99
Research Grants Programs	229,419	252,908	264,626	271,317	267,906	277,237	263,130	265,605	243,905	286,237
Research Partnerships	73,116	120,674	120,011	124,842	120,951	116,190	119,108	112,669	116,955	122,793
Training (Direct Support)	61,677	64,851	70,914	76,417	78,149	72,961	67,570	54,348	54,139	67,081
General Support	11,138	10,399	10,269	10,112	9,719	8,607	2,048	2,115	2,984	1,874
GRANTS AND SCHOLARSHIPS	375,350	448,832	465,820	482,688	476,725	474,995	451,856	434,737	417,984	477,986
Administration	16,645	17,410	16,292	16,560	18,138	17,613	17,019	16,905	17,464	20,506
TOTAL EXPENDITURES	391,995	466,242	482,112	499,248	494,863	492,608	468,875	451,642	435,448	498,492

Table 18: "Spin-off" Companies Linked to NSERC-Funded Research by Province

Province	Number of Companies	Number of Employees	Annual Sales/ Revenue (millions of $)
British Columbia	26	1,775	268
Alberta	10	619	73
Saskatchewan	7	698	94
Manitoba	2	6	0.2
Ontario	38	2,489	468
Quebec	17	902	341
New Brunswick	2	98	13
Nova Scotia	7	244	30
Newfoundland	3	47	6
TOTAL	112	6,878	1,293

Source: NSERC

6.6 Peer Review Explained

(Refer to Section 2.3)

Peer review is the assessment of research proposals or research contributions by impartial experts in the specific field. It is generally recognized as the best system available to perform such assessments - for example, the emerging economies in Eastern and Central Europe are establishing peer review systems based on principles similar to those in use in the U.S. and Canada.

NSERC's peer review process generally works as follows, with some variation from program to program:

1. An eligible faculty member submits an application for funding for a research project or program. The application includes information on:
   - the proposed research (proposed course of work, theoretical underpinnings, methodology, references to previous work, anticipated results, etc.)
   - the researcher or research team (training, qualifications, previous contributions to the field, etc.);
   - an itemized budget for the project or program;
   - details of other funding previously or currently held by the researcher or the team;
   - for the Research Partnerships program, an outline of the contribution to be made to the project from partners outside the university sector, and a plan for transferring the results of the research to the user sector;
   - for very large projects, a description of the management structure for the project.
2. The application is sent out for review by international experts in the field -- typically three to five experts are consulted per application. Experts from all sectors, within and outside Canada, may be consulted.
3. The application and all reviews received are sent to a selection committee composed of experts who have agreed to donate their services. This committee evaluates each application in the context of all applications sent to it at the same time.
4. The committee evaluates the application against the program criteria - these always include the quality of the proposed work and the qualifications and track record of the applicant(s); they may include additional criteria, depending on the program under which the application is made.
5. The selection committee recommends whether or not the application should be funded, and if funded, the size and duration of the grant.
6. If the application is unsuccessful, the committee provides brief notes to the applicant outlining the reasons for its decision.

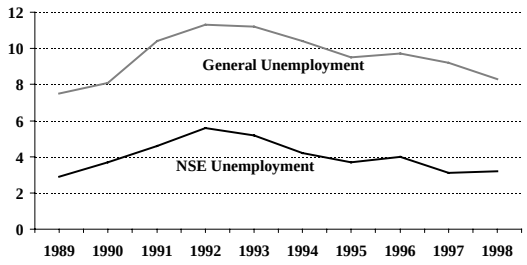
6.7 Analysis of Impact of Training Support

(Refer to Section 3.3.2)

Why does NSERC invest in training Canadians in the NSE? There are many reasons, but four will be highlighted with some independent data to support the conclusions:

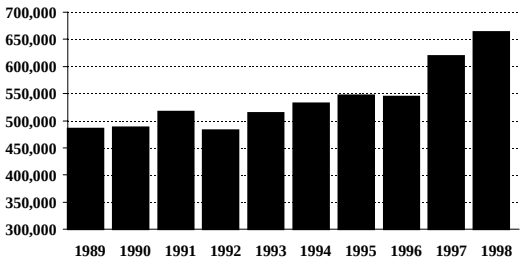
1. The demand for such people is high, as indicated by a very low unemployment rate for Canadians in the natural sciences and engineering, less than one-half the rate for the general population (see Figure 31).
2. Employment growth for natural scientists and engineers is strong (see Figure 32) and one of the highest of all occupation groups.
3. Unemployment levels fall and earnings increase as university graduates in the NSE earn higher degrees, NSERC's major training focus (see Figure 33).
4. Canada needs more research scientists and engineers to compete with the highly industrialized nations of the world (see Figure 34).

Figure 31: Unemployment Rate for Natural Scientists and Engineers (%)



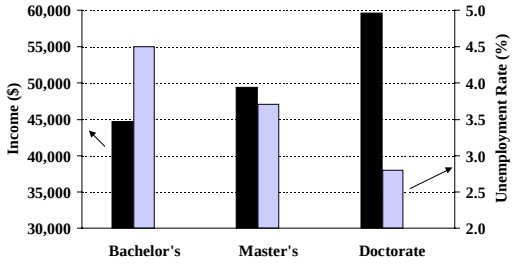
Source: Statistics Canada

Figure 32: Number of Natural Scientists and Engineers Working in Canada



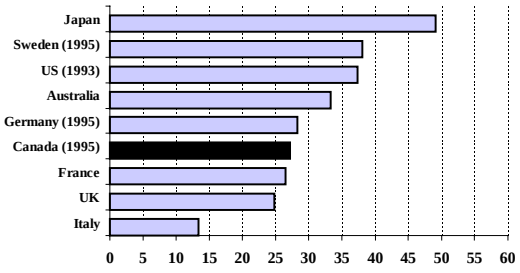
Source: Statistics Canada

Figure 33: Income and Unemployment Levels by Degree Level for Graduates in the NSE, 1995



Source: Statistics Canada

Figure 34: Scientists and Engineers Engaged in R&D per 10,000 Population, 1996



Source: OECD

7. Reader's Survey

NSERC would like to hear from Canadians who have read this report. Your comments will help ensure that NSERC provides information that is easy to understand and relevant. NSERC would appreciate it if you would take the time to answer the questions below and send in your completed questionnaire as soon as possible. Please use the scale provided and select the number that best represents your point of view.

	Not at All			Somewhat			To a Great Extent
1. Did the report explain clearly what NSERC does?	1	2	3	4	5	6	7
2. Did the report provide you with sufficient information to assess whether Canadians are receiving value for the money invested in NSERC?	1	2	3	4	5	6	7
3. Has the report presented accomplishments and performance information in a balanced manner (e.g., presented both positive and negative aspects)?	1	2	3	4	5	6	7
4. Overall, was the information presented in this report easy to understand?	1	2	3	4	5	6	7

Are there any additional comments you would like to make regarding this report?

Send your completed questionnaire:

By mail to
NSERC
Policy and International Relations
350 Albert Street
Ottawa, Ontario
K1A 1H5

Or by fax to
(613) 947-5645

Or by e-mail to
bjl@nserc.ca

Thank you for your co-operation.

8. Index