



# **Natural Sciences and Engineering Research Council of Canada**

## **Performance Report**

For the period ending  
March 31, 2002

**Canada**

## The Estimates Documents

Each year, the government prepares Estimates in support of its request to Parliament for authority to spend public monies. This request is formalized through the tabling of appropriation bills in Parliament.

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*.

The Estimates, along with the Minister of Finance's Budget, reflect the government's annual budget planning and resource allocation priorities. In combination with the subsequent reporting of financial results in the Public Accounts and of accomplishments achieved in Departmental Performance Reports, this material helps Parliament hold the government to account for the allocation and management of funds.

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## Foreword

In the spring of 2000, the President of the Treasury Board tabled in Parliament the document “Results for Canadians: A Management Framework for the Government of Canada”. This document sets a clear agenda for improving and modernising management practices in federal departments and agencies.

Four key management commitments form the basis for this vision of how the Government will deliver their services and benefits to Canadians in the new millennium. In this vision, departments and agencies recognise that they exist to serve Canadians and that a “citizen focus” shapes all activities, programs and services. This vision commits the Government of Canada to manage its business by the highest public service values. Responsible spending means spending wisely on the things that matter to Canadians. And finally, this vision sets a clear focus on results – the impact and effects of programs.

Departmental performance reports play a key role in the cycle of planning, monitoring, evaluating, and reporting of results through ministers to Parliament and citizens. Departments and agencies are encouraged to prepare their reports following certain principles. Based on these principles, an effective report provides a coherent and balanced picture of performance that is brief and to the point. It focuses on outcomes - benefits to Canadians and Canadian society - and describes the contribution the organisation has made toward those outcomes. It sets the department’s performance in context and discusses risks and challenges faced by the organisation in delivering its commitments. The report also associates performance with earlier commitments as well as achievements realised in partnership with other governmental and non-governmental organisations. Supporting the need for responsible spending, it links resources to results. Finally, the report is credible because it substantiates the performance information with appropriate methodologies and relevant data.

In performance reports, departments and agencies strive to respond to the ongoing and evolving information needs of parliamentarians and Canadians. The input of parliamentarians and other readers can do much to improve these reports over time. The reader is encouraged to assess the performance of the organisation according to the principles outlined above, and provide comments to the department or agency that will help it in the next cycle of planning and reporting.

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This report is accessible electronically from the Treasury Board of Canada Secretariat Internet site:  
<http://www.tbs-sct.gc.ca/rma/dpr/dpre.asp>

Comments or questions can be directed to:

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Investing in people, discovery and innovation

# Departmental Performance Report

for the period ending March 31, 2002

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**Allan Rock,**  
**Minister of Industry**



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# **Executive Summary**

## ***The challenge***

This century will see the continued expansion of the global knowledge-based economy. Canada's prosperity depends upon people, 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, environment, public education, and health system.

## ***Who we are***

NSERC (the Natural Sciences and Engineering Research Council of Canada) is one of the primary federal agencies investing in people, discovery and innovation. NSERC functions at arm's length from the federal government. It 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.

## ***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 over 9,000 of the most creative and productive Canadian professors;
- supporting the training of more than 58,000 master's and doctoral students, and young research professionals since 1978, who have had little trouble finding well-paying, productive 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 \$750 million since 1978 in university research and training activities;
- introducing new concepts and programs to ensure the research community optimises its contributions to Canada's prosperity.

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## **List of Abbreviations**

AUCC	Association of Universities and Colleges of Canada
CCAC	Canadian Council on Animal Care
CFI	Canada Foundation for Innovation
CIHR	Canadian Institutes of Health Research
CMC	Canadian Microelectronics Corporation
CRD	Collaborative Research and Development Grant
CRF	Consolidated Revenue Fund
DPR	Departmental Performance Report
HQP	Highly Qualified Personnel
IPM	Intellectual Property Management Program
IRF	Industrial Research Fellowship
NCE	Networks of Centres of Excellence
NSE	Natural Sciences and Engineering
NSERC	Natural Sciences and Engineering Research Council of Canada
OECD	Organisation for Economic Co-Operation and Development
PDF	Postdoctoral Fellowship
R&D	Research and Development
S&T	Science and Technology
SSHRC	Social Sciences and Humanities Research Council of Canada
TPP	Technology Partnerships Program (NSERC)
USRA	Undergraduate Student Research Award

# 1. Messages

## 1.1 Minister's Portfolio Message

The dawn of the twenty-first century has seen the development of the global knowledge economy. The Government of Canada has been working for the past decade to create winning conditions for Canadians to ensure that we are ideally positioned - with both the tools and the skills necessary - to seize the opportunities offered in the new economy.

It started with eliminating the deficit and with good fiscal management, followed closely by significant corporate and personal tax cuts and streamlining government. Over the last decade, we also built an impressive research and development (R&D) infrastructure and became one of the world's most connected countries. We are now global leaders in per capita access to information technology and the Internet.

*The Industry Portfolio is:*

- Atlantic Canada Opportunities Agency
- Business Development Bank of Canada\*
- Canada Economic Development for Quebec Regions
- Canadian Space Agency
- Canadian Tourism Commission\*
- Competition Tribunal
- Copyright Board Canada
- Enterprise Cape Breton Corporation\*
- 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 Departmental Performance Report*

Today we are seeing the benefits of these investments. Our success can be measured in having the fastest rate of growth among the G7 countries in areas such as: private-sector R&D spending; external patent applications; R&D intensity; and the number of workers devoted to R&D.

But in this global race we cannot afford to rest on our laurels. That is why, in February of 2002, our government launched Canada's Innovation Strategy. This strategy is designed to foster a culture of innovation in Canada, improve the quality of life for Canadians and to see the maple leaf become a hallmark of excellence for the world.

Canada's Innovation Strategy identifies opportunities in four key areas: creating new knowledge and bringing those ideas to market quickly and effectively; ensuring that Canada has enough highly qualified people with the skills needed to compete globally; modernising our business and regulatory policies to foster entrepreneurship; and supporting innovation at the local level so that our communities continue to be magnets for investment and opportunity.

To develop this strategy, we are talking to Canadians from coast to coast to coast to create an action plan for the next decade. Canada's Innovation Strategy is not a

government program but a call for all sectors of the economy to work together to achieve ambitious targets for the future. The action plan will identify specific ways that government, business, academia and communities can achieve our national goals.

The Industry Portfolio, consisting of 15 departments and agencies, is an important instrument in fostering innovation in Canada. NSERC plays a key role in the Industry Portfolio and I am pleased, therefore to present their Performance Report for 2001-2002.

In 2001-2002, NSERC invested \$556 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.

These are only a few highlights. I invite you to explore NSERC's Departmental Performance Report to discover the many ways that NSERC contributes to Canada's economic progress and growth.

Working together we are making our country a stronger and more prosperous place for all Canadians.

---

Allan Rock, Minister of Industry

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

The 2001-2002 chapter in the story of research and development in Canada is both exciting and optimistic: we have made much progress; we are doing well. At the same time, we look forward to being more innovative in order to do even better.

The Government of Canada knows that its quality of life, now and in the future, depends on innovation, which in turn depends on our ability to understand the world around us. In the last year, we have seen this idea translate into increased support for new and existing programs and initiatives, including: the Canada Foundation for Innovation, the Millennium Scholarships, the Canada Research Chairs Program, Genome Canada, the Canadian Institutes of Health Research and the Canadian Foundation for Climate and Atmospheric Change.

This year, the Government of Canada introduced its innovation strategy, placing research at the forefront of our government=s agenda. Key to this national innovation strategy is our progress in science and technology B and it is for this reason that one of the targets of the strategy is to make Canada one of the top five ranking countries in research and development (R&D) performance by 2010.

In the past year, the federal government has invested \$200 million to support the indirect costs of federally sponsored research in Canada=s universities. The National Research Council=s regional technology centres program received an increase in funding, as did the Natural Sciences and Engineering Research Council (NSERC) and the Social Sciences and Humanities Research Council (SSHRC). In the 2002 Speech from the Throne, our government pledged to build on these investments.

There is still much to do, but we have accomplished a great deal in building on our foundations. We will continue to ensure that Canada is a progressive country, valuing intellectual curiosity and creativity. We will continue to encourage our young people to study and work in Canada, and we will continue to support their efforts in leading-edge research, which will ultimately improve our quality of life. In so doing, we shall make Canada a model of innovation at its finest.

---

Hon. Dr. Rey D. Pagtakhan, P.C., M.P.



## **2. Departmental Overview**

### **2.1 Mandate, Vision, Mission and Strategic Outcome**

This century will see the global, knowledge-based economy create tremendous opportunities for greater prosperity and improved high quality of life for all Canadians. The country must seize these opportunities and build on our strengths.

To maximize the added value of investments Canadians make through NSERC, the Council must be flexible, dynamic, innovative, and forward-looking. NSERC is key to building a Canada that is prepared for the next new economy.

Created in 1978, NSERC's legal mandate, its vision and mission, and ultimately the desired strategic outcome are outlined in Figure 1.

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 and colleges 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.

**Figure 1: NSERC's Mandate, Vision, Mission and Strategic Outcome**

<p style="text-align: center;"><b><u>Mandate</u></b></p> <p>NSERC was created in 1978. Its legal mandate and functions 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 such research as the Minister may refer to the Council for its consideration.” (<i>Natural Sciences and Engineering Research Council Act, 1976-77, c.24.</i>)</p>	
<p style="text-align: center;"><b><u>Vision</u></b></p> <p>NSERC is working to build a “Smart Canada” for the 21<sup>st</sup> century – a country that’s safe, clean and prosperous.</p> <p>We see our people working at rewarding and meaningful jobs because they have the skills and knowledge to create value and meet needs in the global economy.</p> <p>We see our scientists and engineers respected throughout the world because of their leading-edge discoveries and trailblazing projects.</p> <p>We see our industries thriving because business is taking full advantage of the nation’s capacity for science-based innovation.</p> <p>And we see NSERC playing, and seen to be playing, a leading role in making all this happen by investing in <b>people, discovery and innovation</b>.</p>	<p style="text-align: center;"><b><u>Mission</u></b></p> <p>NSERC invests in people, discovery, and innovation to build a strong Canadian economy and to improve the quality of life of all Canadians. It supports research in universities and colleges research training of scientists and engineers, and research-based innovation.</p> <p>The Council promotes excellence in intellectual creativity in both the generation and use of new knowledge, and it works to provide the largest possible number of Canadians with leading-edge knowledge and skills to help Canada flourish in the 21<sup>st</sup> century.</p> <p>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.</p> <p>NSERC itself is committed to institutional innovation in achieving its mission.</p>
<p style="text-align: center;"><b><u>Strategic Outcome</u></b></p> <p><b>To provide Canadians with 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 and colleges to other sectors.</b></p>	

## 2.2 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 professors and students, and the best research programs and projects. NSERC's involvement guarantees objective and fair review of applications for support.

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.

## 2.3 Clients and Partners

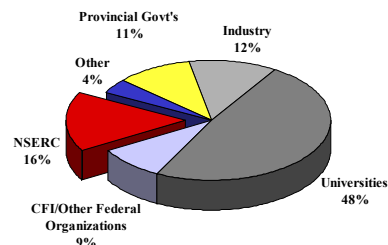
NSERC does not conduct any research in-house, nor does the organization have any training facilities. NSERC supports research in Canadian universities and colleges that meets the highest international standards of excellence and it supports the education of young people in that research. As a result, the universities, colleges, companies, government agencies, and other institutions with which NSERC collaborates are all key co-delivery partners. A brief summary of NSERC's clients and partners is presented below.

### Universities

NSERC is the single most important funder of research and development (R&D) in the natural sciences and engineering in Canadian universities. In 2001, \$2.9 billion in R&D was carried out by Canadian universities in the natural sciences and engineering. NSERC directly provided almost one-sixth 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 less than half of the funding. Figure 2 gives a breakdown of the total funding by direct source.

**Figure 2: University R&D Funding in the Natural Sciences and Engineering, 2001**



**Total: \$2.9 Billion**

Source: Statistics Canada

More than 9,200 university professors and more than 15,500 university students and postdoctoral fellows are supported by NSERC. The Council also supports a considerable number of university technicians and research associates. 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, 2001-02**

	Number Supported or Participating	Share of the Population <sup>1</sup>	Trends in Share of the Population Over Past 10 Years
<b>Clients:</b>			
University Professors	9,239	65% – 75%	Small Increase
Undergraduate Students	6,682	6%	Small Increase
Master's/Doctoral Students	7,418	35% - 40%	Stable
Postdoctoral Fellows	1,489	40% - 45%	Stable
University Technicians and Research Professionals	3,222	30% - 40%	Stable
<b>Partner Organizations:</b>			
Universities and Colleges	65	75%	Stable
Companies Performing R&D <sup>2</sup>	687	10%	Large Increase
Federal Science Departments/Agencies <sup>2</sup>	15	75%	Large Increase
Provincial Science Departments/Agencies <sup>2</sup>	13	25% - 40%	Large Increase

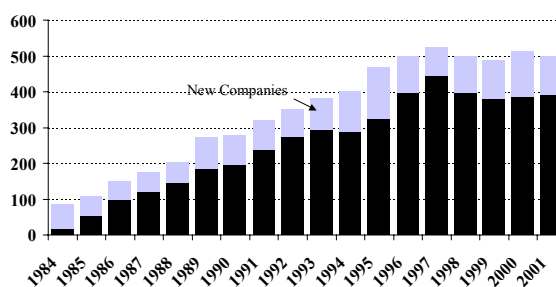
Source: NSERC

1. The percentage that NSERC supports of all individuals and organizations eligible for NSERC funding.
2. Organizations in partnership with NSERC (across all NSERC programs).

## 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 1,500 firms have participated, rising from less than 50 companies in 1983 to 500 businesses in 2001. 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. In 2001, twenty-nine of the top 50 Canadian R&D companies (as ranked by Research Infosource, 2002) have funded university research jointly with NSERC.

## Government Departments/Agencies

NSERC is also well known to most federal and provincial science-based departments and agencies. A list of federal and provincial departments and agencies NSERC has collaborated with in 2001 is presented in Figure 5.

**Figure 5: NSERC's Federal/Provincial Partners, 2001-02**

Federal Departments/Agencies	Provincial Departments/Agencies
Agriculture and Agri-Food Canada	Alberta Energy
Canada Mortgage and Housing Corporation	Alberta Environment
Canadian Heritage	Alberta Innovation and Science
Canadian Institutes of Health Research	Alberta Oil Sands Technology and Research Authority
Canadian Space Agency	Alberta Research Council
Cape Breton Development Corporation	Alberta Transportation
Environment Canada	Forest Renewal BC
Fisheries and Oceans Canada	Manitoba Conservation
Health Canada	Fonds FCAR (Quebec)
Indian and Northern Affairs Canada	Ministry of Environment (Quebec)
National Defence	Ministry of Natural Resources (Quebec)
National Research Council Canada	Ministry of Transportation (Quebec)
Natural Resources Canada	Ontario Ministry of Agriculture
Public Works and Government Services Canada	
Social Sciences and Humanities Research Council of Canada	

## 2.4 Challenges

The Government's recent paper on innovation, *Achieving Excellence – Investing in People, Knowledge and Opportunity*, is hugely important for the university research community. It builds on the Prime Minister's commitment to move Canada into the world's top five countries in R&D per capita, and to make Canada one of the most innovative countries in the world. But there's something more: Perhaps for the first time in history, research is seen as *central* to the Government's vision.

To start with, the title, *Achieving Excellence – Investing in People, Knowledge and Opportunity* is very gratifying because it reflects the principal value of the research community. The text also contains many statements of direct importance to university researchers.

Under "The Knowledge Performance Challenge," the first goal is to "vastly increase public and private investments in knowledge infrastructure to improve Canada's R&D performance," and the targets include ranking among the top five countries in the world in terms of R&D performance and doubling the Government of Canada's current investments in R&D by 2010. The priorities in this section include:

- *"Support the indirect costs of university research.* Contribute to a portion of the indirect costs of federally supported research, taking into account the particular situation of smaller universities.
- *"Leverage the commercialization potential of publicly funded academic research.* Support academic institutions in identifying intellectual property with commercial potential and forging partnerships with the private sector to commercialize research results.
- *"Provide internationally competitive research opportunities in Canada.* Increase support to the granting councils to enable them to award more research grants at higher funding levels."

Under "The Skills Challenge," the goal is to "develop the most skilled and talented labour force in the world," and the targets include increasing the admission of Master's and Ph.D. students at Canadian universities by an average of 5 percent per year until 2010, and significantly improving Canada's performance in the recruitment of foreign talent, including foreign students....."

To reach these objectives, the Government will consider taking the following steps:

- "Provide financial incentives to students registered in graduate studies programs, and double the number of Master's and Doctoral fellowships and scholarships awarded by the federal granting councils.
- "Create a world-class scholarship program of the same prestige and scope as the Rhodes scholarship; support and facilitate a coordinated international student

recruitment strategy led by Canadian universities; and implement changes to immigration policies and procedures to facilitate the retention of international students.

- "Establish a cooperative research program to support graduate and post-graduate students and, in special circumstances, undergraduates, wishing to combine formal academic training with extensive applied research experience in a work setting."

Obviously, NSERC strongly supports the thrust of this document. When its goals are met Canada will be an even better country, better able to afford the quality of life we all want to enjoy.

But no one should think that achieving those goals will be easy. First of all, the amount of R&D carried out in the private sector will need to increase enormously, by as much as \$20 billion per year according to some estimates. To support that R&D there will have to be a proportional increase in sales – about \$200 billion per year since the companies involved will spend an average of 10% of sales on R&D. And those sales will have to be mostly in world markets. All of that to say that if Canada is to become an R&D powerhouse, it will have to become an export powerhouse at the same time.

But there must also be a huge increase in the number of highly qualified people (HQP) to do the increased volume of R&D. If industry spends an average of \$200,000 per year per R&D employee, then 100,000 additional R&D employees will have to be found by the end of the decade – not a large number when compared to our current work force of slightly more than 15 million, but a very large number indeed when compared with Canada's annual output of HQP in science and engineering. And that output already has other claims on it that are driven by the irresistible laws of demographics: about 7,000 Ph.D.'s to replace retiring professors, several thousand more to replace retiring government scientists, and a comparable or larger number to replace retiring industry personnel.

On the supply side, Canadian universities annually award about 2,000 Ph.D.'s, 5,000 Master's, and 27,000 Bachelor's degrees in engineering, mathematics, and science, and an additional fraction of those numbers in the other areas that NSERC supports. There are three other sources of HQP: immigration, retraining people already in the workforce, and repatriating Canadians now abroad. We cannot predict what proportions of these people will choose to engage in R&D in Canada, but we can be sure that not all will. In light of all that, the graduation rate from Canadian universities of HQP at the Master's and Ph.D. levels in the NSERC areas will have to double, or perhaps even triple, to satisfy the increased demand in time to meet Canada's new goal.

But graduation rates depend on both the numbers of graduate students enrolled and the time that it takes to complete a degree. Completion times have been getting longer for decades, and the time from the Bachelor's degree to the Ph.D. has reached eight years in

some disciplines – and eight years take us to the end of the decade. That may be acceptable if the goal is to produce the greatest amount of research output for the money invested, but it is not acceptable if the goal is to provide large numbers of highly qualified people for an economy waiting for them.

But more is needed than just quantitative change. Since a very large proportion of the new graduates with advanced degrees will be heading to industry, their graduate education will have to help them acquire some skills that are important for work in the private sector. These include the capacities for team work, for finding and using knowledge from outside of their own field, for project management, for entrepreneurship, for developing a business case, etc. Teaching such skills is not new; what is new is the need for routinely including it in graduate education in the NSE.

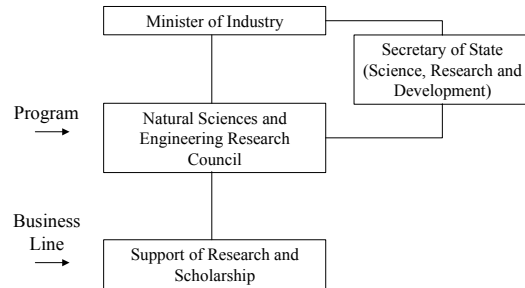
That frames the challenge to NSERC and to our research community. We must together learn how to increase graduation rates, but not sacrifice quality in the process. There are many factors at the university level and at the level of the individual professors and students that enter into consideration, but NSERC can only affect research funding and student support and the policies that govern them. We need to learn how best to help in meeting the new Canadian goals for R&D. And given the time scales of research and advanced training, we have only about two years to learn how to do it, if we are to contribute significantly to meeting Canada's goals for the end of the decade.

## 2.5 Departmental Organization

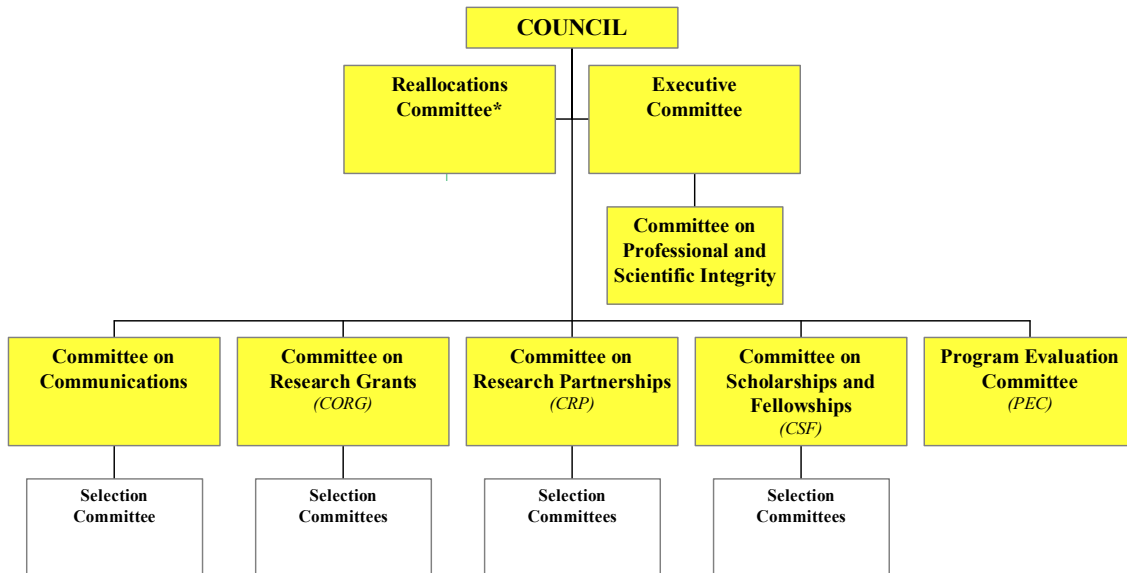
NSERC's sole business line is: Support of Research and Scholarship in the Natural Sciences and in Engineering. Figure 6 presents NSERC's organization structure.

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 7 presents NSERC's committee structure.

**Figure 6: Organization Structure**



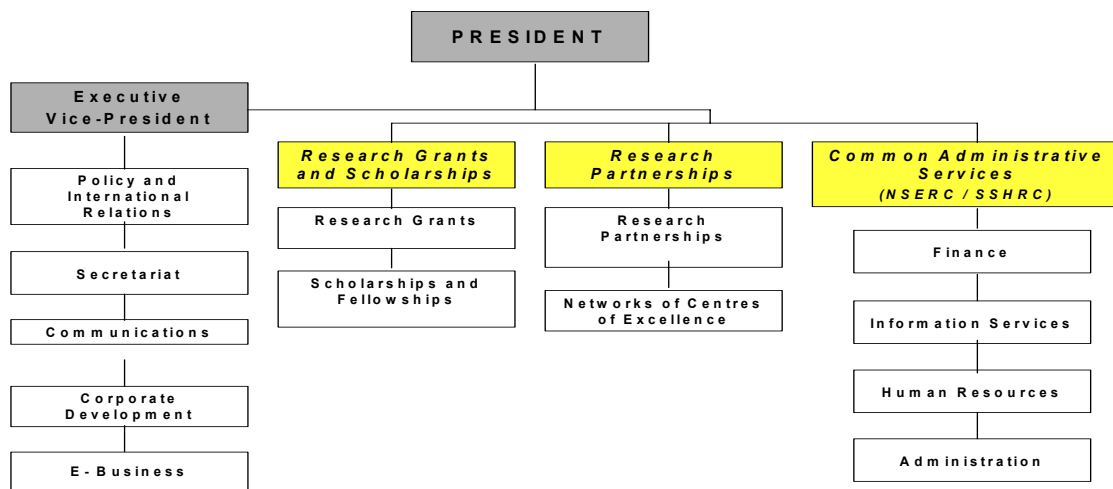
**Figure 7: Council Committee Structure**



\* Not a permanent committee, functions in connection with the 4-year reallocations cycle.

Figure 8 displays the corporate structure. NSERC is organized around two program directorates - Research Grants and Scholarships, and Research Partnerships. The Vice-Presidents of these directorates report directly to the President. There are also five corporate functions: Policy and International Relations, Corporate Development, E-Business, Communications, and the Secretariat; the Directors of these units report to the Executive Vice-President. Finally, there is the Common Administrative Services Directorate. This directorate is shared with the Social Sciences and Humanities Research Council (SSHRC), and handles Human Resources, Information Systems, Finance, and Administration for both Councils. Its Vice-President reports to the Presidents of both SSHRC and NSERC.

**Figure 8: Corporate Structure**





### 3. Departmental Performance

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

The strategic outcome that NSERC strives to achieve is to provide Canadians with 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 and colleges to other sectors. In more detailed terms, NSERC's performance expectations include:

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

The impact of NSERC's investment in research and training in the NSE can be fully assessed only 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) people, and (2) discovery and innovation.

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.

## 3.1 Investing in People

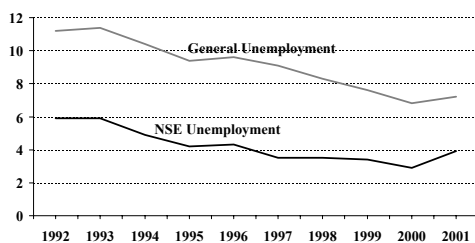
### Context

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 and will be unable to achieve the goal of ranking as a top five R&D country.

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:

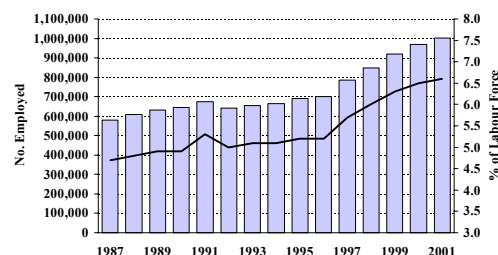
1. The demand for such people is high, as indicated by a very low unemployment rate for Canadians in the natural sciences and engineering, less than one-half the rate for the general population (see Figure 9).
2. Employment growth for natural science and engineering occupations is strong (see Figure 10) and 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 11).
4. Canada needs more research scientists and engineers to compete with the highly industrialized nations of the world (see Figure 12).

**Figure 9: Unemployment Rate for Natural Science and Engineering Workers (%)**



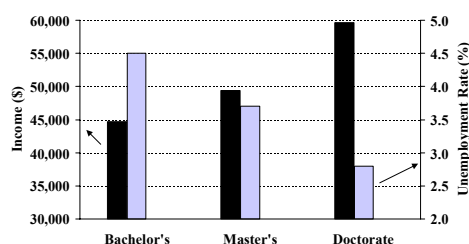
Source: Statistics Canada

**Figure 10: Number of Workers in Natural Science and Engineering Occupations in Canada (Professional and Technical)**



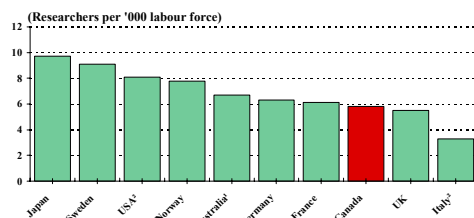
Source: Statistics Canada

**Figure 11: Income and Unemployment Levels by Degree Level for Graduates in the NSE, 1995**



Source: Statistics Canada

**Figure 12: Scientists and Engineers Engaged in R&D per Thousand Labour Force, 1999**



Source: OECD-STIHD Database.

1. Data for 1998.  
2. Data for 1997.

## ***Resources and Objectives***

NSERC invested \$235 million or 42% of total expenditures in 2001-02 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 professor from his or her NSERC grant.

### **Undergraduate Students**

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 professors also support undergraduate students through their NSERC research grants). NSERC's current annual investment of \$16 million brings this experience to nearly 3,500 students every year. Providing these students with valuable experience in a university or industrial laboratory, and encouraging them to undertake graduate studies are important indicators of the impact of the support.

### **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 3,100 students annually at a cost of \$57 million per year; and (2) indirectly through NSERC's research grants, which support more than 4,200 students (full-time equivalent), at roughly \$78 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 five years NSERC has completed annual surveys of directly funded master's and doctoral students.

### **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 now invests approximately \$13 million per year to support roughly 450 Canadian PDFs per year. NSERC also provides this PDF support for more nearly 900 other individuals through NSERC research grants at an annual investment of over \$30 million.

The career status of former NSERC-funded postdoctoral fellows and the degree to which NSERC funding affects their ability to pursue a research career are important indicators of the impact of the postdoctoral support. In 1999 NSERC completed a survey of directly funded postdoctoral fellows (See Figure 13).

### **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 175 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.

To determine if the program is staying on track, NSERC routinely monitors the employment situation of former IRF winners (See Figure 13).

### ***Outcomes Achieved***

As mentioned, NSERC routinely surveys former holders of its various scholarship and fellowships. Survey results for the students and fellows are presented in Figure 13. Overall, the results are extremely positive and NSERC's funding has proven to be instrumental in career development and progression.

**Figure 13: Student and Fellowship Survey Results**  
(Detailed Report: [www.nserc.ca/publicat.htm](http://www.nserc.ca/publicat.htm))

	Survey Results	Some Comments
<b>Under-graduate Students</b>  Surveyed after summer employment  3,364 respondents  60% response rate	<ul style="list-style-type: none"> <li>❑ Long term career objectives are more important to students than short term financial returns</li> <li>❑ Satisfaction is high with the USRA work experience</li> <li>❑ Students report learning practical techniques and methods and gain critical management skills</li> <li>❑ Students report that the supervision and instruction they received was excellent</li> <li>❑ Students' interest in research increased at a critical period in their career-choice</li> <li>❑ USRA work experiences had a significant impact on students' interest in careers in industry</li> <li>❑ Students overwhelmingly believe their USRA job experience will improve their permanent job prospects</li> <li>❑ A significant number of students plan to stay in university longer as a result of their USRA job experience</li> </ul>	<ul style="list-style-type: none"> <li>❑ "I enjoyed the hands-on laboratory work, that helped improve my skills and critical thinking."</li> <li>❑ "This is a very good opportunity for students to get a taste of formal R&amp;D."</li> <li>❑ "I feel the program as it is gives important experience and education to the participant."</li> <li>❑ "Increase the value of the USRA, not even enough to pay for tuition and books, much less living expenses."</li> <li>❑ "Excellent program that helps students acquire knowledge and experience that is otherwise unavailable."</li> </ul>
<b>Master's &amp; Doctoral Students</b>  Surveyed 9 years after award  1,195 respondents  49% response rate	<ul style="list-style-type: none"> <li>❑ Graduates' experience far less unemployment (1.7%) than the norm (Canada = 8%)</li> <li>❑ The vast majority (92%) have found full-time employment</li> <li>❑ Nearly 2/3 of the graduates are engaged in R&amp;D</li> <li>❑ Incomes are much higher than the Canadian average, with more than half earning more than \$50,000 a year</li> <li>❑ 70% report their graduate training was "critical" to their current employment</li> <li>❑ Over 80% of the graduates are living and working in Canada. Of the remaining 20%, half intend to return to Canada</li> <li>❑ 46% report that NSERC funding was "essential" to their decision to continue to graduate studies</li> </ul>	<ul style="list-style-type: none"> <li>❑ "I now have tremendous research opportunities in my current job which I would not have had without my NSERC-funded training. The knowledge is beneficial to myself and my employer certainly, but arguably for the country overall."</li> <li>❑ "NSERC support was critical to my decision to pursue graduate studies instead of employment. I appreciate very much the opportunities now available to me as a result of your investment in me."</li> <li>❑ "There are very few qualified Canadians available for hire in our industry. NSERC is a key enabler for generating suitable candidates, and thus plays a big role in our industry."</li> </ul>

**Figure 13: Student and Fellowship Survey Results**  
**(Detailed Report: [www.nserc.ca/publicat.htm](http://www.nserc.ca/publicat.htm))**

<p><b>Postdoctoral Fellows (PDF)</b></p> <p>Surveyed 7 years after award completion</p> <p>163 respondents</p> <p>38% response rate</p>	<ul style="list-style-type: none"> <li>❑ Most PDFs (59%) study abroad, thereby gaining access to the best training in their field</li> <li>❑ Only 2% of PDFs were unemployed, far below the national average</li> <li>❑ PDFs tend to return to universities (73%) to train the next generation of scientists and engineers.</li> <li>❑ The vast majority (88%) are still engaged in research, either as a university professor, research scientist, or engineer</li> <li>❑ Almost 80% of PDFs report their postdoctoral training was critical to their careers</li> <li>❑ For most PDFs, NSERC funding was either “essential” (50%) or very important (23%)</li> <li>❑ Over 2/3 (67.3%) of PDFs are working in Canada 7 years after the award.</li> </ul>	<ul style="list-style-type: none"> <li>❑ "Without my NSERC support I would simply not have conducted a research career – it changed my life."</li> <li>❑ “NSERC Postdoctoral fellowships are essential to ensure the brightest young people remain in the University setting to become faculty in our Universities. This is most important.”</li> <li>❑ “NSERC PDFs are vital to ensure that our best students get the opportunity to continue their studies in the world’s best laboratories. Excellent programme-Keep it up!”</li> </ul>
<p><b>Industrial Research Fellows and Companies (IRF)</b></p> <p>Surveyed after award</p> <p>386 respondents</p> <p>100+ firms</p>	<ul style="list-style-type: none"> <li>❑ Seventy-seven 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.</li> <li>❑ 98% of the firms said that the program was able to meet their requirements;</li> <li>❑ 98% stated that the research project undertaken by the Fellow was “successful,” and 94% believed it to be cost-effective.</li> </ul>	<ul style="list-style-type: none"> <li>❑ “The IRF program provides the added financial leverage to permit successful competition for talented Canadian Ph.D.s. It helps to keep these individuals in Canada. It helps the high tech company to expand its R&amp;D base with a reduced training burden or risk.”</li> <li>❑ “NSERCs IRF program is a very successful program, providing a means for smaller companies to effectively build their internal R&amp;D capability.”</li> </ul>

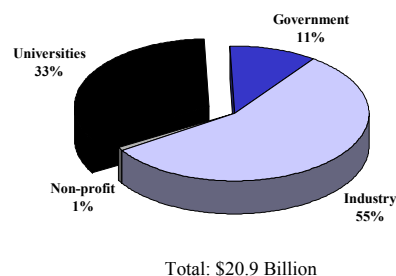
## 3.2 Investing in Discovery and Innovation

### Context

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

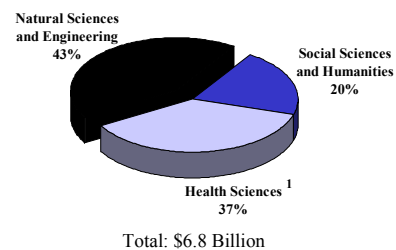
1. University professors conducted 33% of all Canadian research, as measured by expenditures, in 2001 (see Figure 14).
2. Of the \$6.8 billion of direct and indirect investment in Canadian university research in 2001, 43% was allocated to the natural sciences and engineering (see Figure 15).
3. Figure 16 shows trends in the funding of Canadian university research in the NSE. Over the past five years the federal government's share of funding has remained relatively stable.
4. Canadian university researchers perform 4% of the \$115 billion in university research in the OECD (see Figure 17). When measured as a percentage of GDP, Canada conducts roughly the same amount of university research as most of its G7 competitors.

**Figure 14: R&D Performance in Canada, 2001**



Source: Statistics Canada

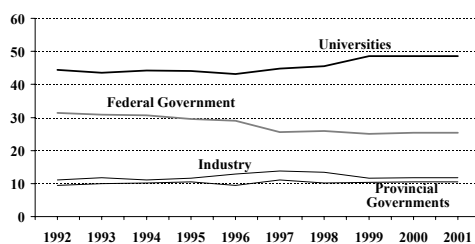
**Figure 15: University R&D in Canada by Discipline, 2001**



1. Includes hospitals.

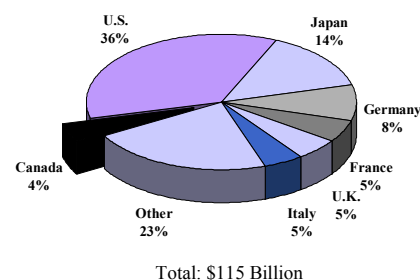
Source: Statistics Canada, NSERC estimate.

**Figure 16: Canadian University R&D Funding in the Natural Sciences and Engineering (%)**



Source: Statistics Canada, NSERC estimate.

**Figure 17: University R&D Expenditures in the OECD, 1999**



Source: OECD

## Resources

Across all its programs NSERC invested \$320 million or 58% of total expenditures on discovery and innovation in 2001-02. (This total excludes all expenditures on undergraduate/master's/doctoral students and postdoctoral fellows, which was discussed in section 3.1.)

## Outcomes Achieved

The results of the current and prior year's investments are described below under eleven indicators:

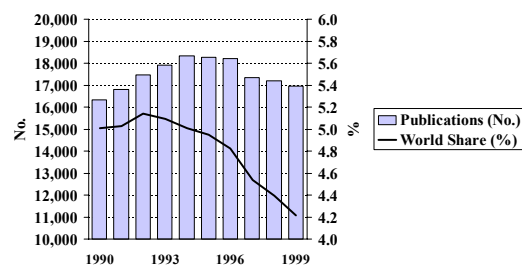
1. Publications
2. Collaboration/Partnerships
3. Editorial Board Memberships
4. Patents
5. Awards and Prizes
6. Licences
7. Leveraging
8. Industrial Survey Results
9. Companies Linked to NSERC-Funded Research
10. New Products and Processes
11. Success Stories

### 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.

- Canadian researchers (all sectors) in the NSE publish roughly 17,000 journal articles per year, ranking Canada 6<sup>th</sup> overall in the world. This has represented a declining share of worldwide production, from 5% at the beginning of the decade to 4.2% in 1999 (see Figure 18). Most of Canada's and the world's scientific and engineering publications are produced by university researchers.

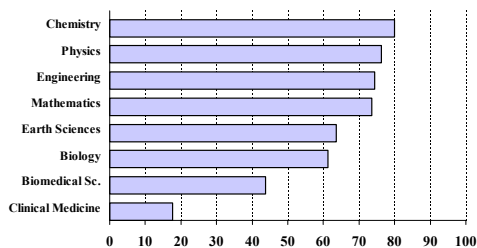
**Figure 18: Number of Canadian Publications in the NSE and World Share**



Source: Observatoire des Sciences et des Technologies

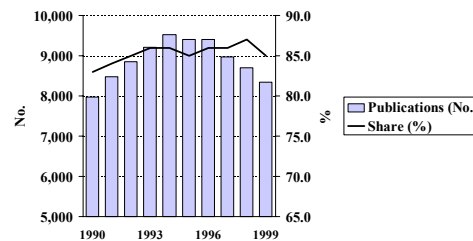
- One of the important objectives for NSERC is to maintain a significant presence in all fields of the natural sciences and engineering. Figure 19 indicates that for the most part this is being accomplished.
- Most of Canada's NSE publications are produced by university researchers funded by NSERC (see Figure 20). Of the average 10,000 university papers produced annually, 85% can be attributed to NSERC-funded researchers.

**Figure 19: NSERC-Funded Share of Canadian Publications by Discipline, 1996-99 (%)**



Source: Observatoire des Sciences et des Technologies

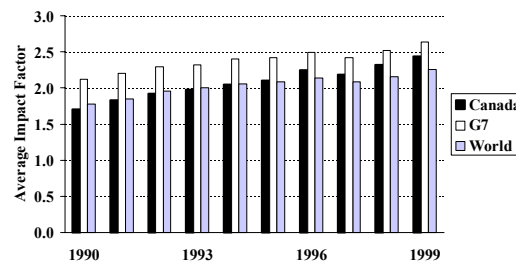
**Figure 20: Number of NSERC-Funded Publications in the NSE, and Share of University NSE Papers**



Source: Observatoire des Sciences et des Technologies

- Figure 21 provides an indication of the “impact” of Canadian 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 latter gap is narrowing).

**Figure 21: Average Impact Factor of Publications in the NSE**

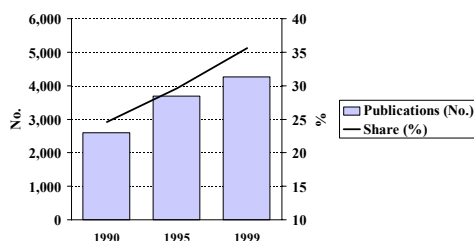


Source: Observatoire des Sciences et des Technologies

## 2. Collaboration/Partnerships

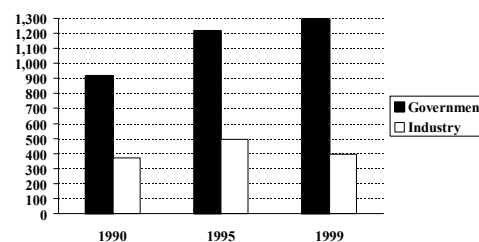
Increasingly Canadian researchers in the NSE are collaborating with international partners and benefiting from the globalization of R&D. Figure 22 shows the trend over the past decade, culminating in more than one-third of Canadian papers in the NSE being written with international partners. Canadian university researchers are also working closely with researchers in Canadian government laboratories and industry. Figure 23 indicates that over 1,000 university-government publications and on average 400 university-industry publications are produced annually. This trend has been fairly steady over the past decade.

**Figure 22: Number of NSERC-Funded Publications Co-Authored with International Partners, and Share of Total**



Source: Observatoire des Sciences et des Technologies

**Figure 23: Number of University-Industry and University-Government Publications with NSERC-Funded Professors**



Source: Observatoire des Sciences et des Technologies

## 3. Editorial Board Memberships

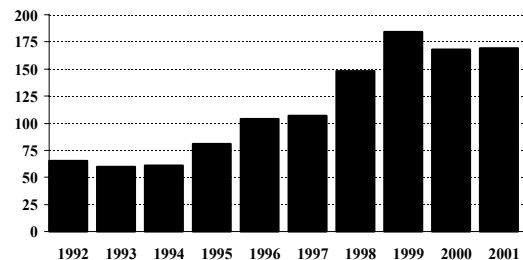
The contributions of established researchers to their fields of study are usually recognized by various awards and honours, such as invitations to give special lectures, to serve on editorial boards of scientific and technical journals, and on boards of professional societies. On this basis, membership on an editorial board is an indicator of “excellence”.

In a study conducted by NSERC, the top 10% of journals in 2000 in each science and engineering discipline were selected as the sample for editorial board membership. Canada ranked 6<sup>th</sup> in the G-7 in terms of number of researchers serving on the editorial boards of NSE journals. The Canadian share of the total number of members of editorial boards was 4.3%. Four hundred and eleven Canadian researchers were identified as editorial board members in the sample. NSERC-funded board members accounted for 92% of the Canadian share.

## 4. 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 over the decade (see Figure 24), but the 2001 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 24: Number of U.S. Patents Issued to Canadian Universities**



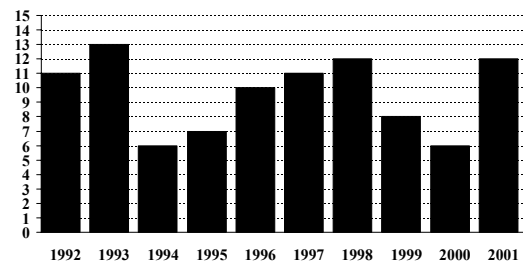
Source: U.S. Patent Office database ([www.uspto.gov/patft/index.html](http://www.uspto.gov/patft/index.html)).

In a study of the 170 patents issued to Canadian universities in 2001, it was found that 166 or 98% of the patents had an NSERC-funded professor as one of the inventors listed on the patent.

## 5. Awards and Prizes

Awards and prizes are a tribute to excellence in the research community. NSERC collected data on 191 international awards and prizes over the past ten years. NSERC-funded professors have received roughly 3% of the awards and prizes included in the analysis. (See Figure 25.)

**Figure 25: Number of International Awards and Prizes Won by NSERC-Funded Researchers**



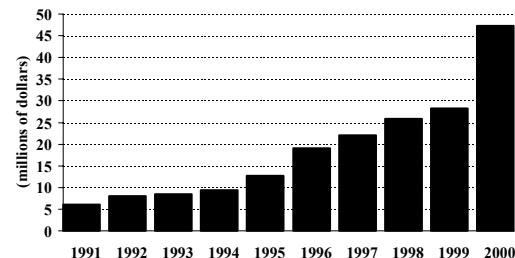
Source: NSERC

## 6. Licences

One way university research is transferred to industry is through a licence, 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 26 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 Canadian Institutes of Health Research (CIHR). 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, even after taking into account the relative expenditures on university research in each country.

**Figure 26: Canadian University Licensing Revenue (millions of dollars)**



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

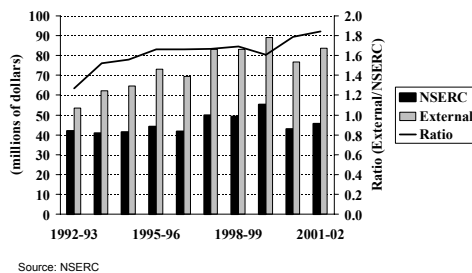
Examples of licences based on NSERC-funded research include:

- Dr. Raymond Andersen, an NSERC-funded researcher in the Department of Chemistry at the University of British Columbia, uses marine life to produce new drug innovations. Technology created from his research on aquatic sponges has resulted in four current licensing agreements, which enable the development of a natural asthma treatment, a novel antibiotic, and two anticancer treatment leads.
- Drs. Merle Olsen, Doug Morck, and Howard Ceri of the Biological Sciences Department at the University of Calgary have developed a canine vaccine for the gastrointestinal infection *giardia* (also known as “beaver fever”). The technology has been licensed to Wyeth (formerly American Home Products), which markets the vaccine in North America. The researchers are working to produce a human application for the treatment. NSERC helped fund this groundbreaking research.
- Dr. Elizabeth Cannon is an NSERC-funded professor in the Department of Geomatics Engineering at the University of Calgary. She has developed software packages that aid in satellite-based location, positioning, and navigation for land, air, and marine applications. The technology has been licensed to over 150 businesses worldwide.

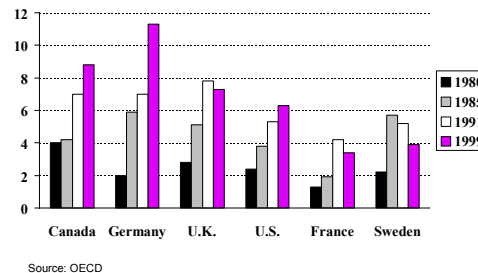
## 7. Leveraging

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 27.) The total contribution from NSERC partners over the decade is an impressive \$739 million. A comparison of NSERC funding to partner contributions is also presented in Figure 27. The ratio of partner contributions to NSERC funding has increased over the 10 years. From a low of 1.27 in 1992-93, this ratio now stands at 1.84. Put another way, for every dollar NSERC puts on the table for a University-Industry research grant, our partners contribute \$1.84, demonstrating the value they place on the R&D. The impact of NSERC's and CIHR's partnership programs has been to increase the share of university research funding from industry to levels well beyond most industrialized nations. (See Figure 28.)

**Figure 27: Contributions to NSERC's University-Industry R&D Programs**



**Figure 28: Share of University Research Funded by the Private Sector (%)**



## 8. Industrial Survey Results

NSERC tracks the outcomes of the Collaborative Research and Development (CRD) program, a program that brings university researchers and industrial partners together. A summary of the industrial participants' perceptions of their CRD experience and some short-term outcomes are described below:

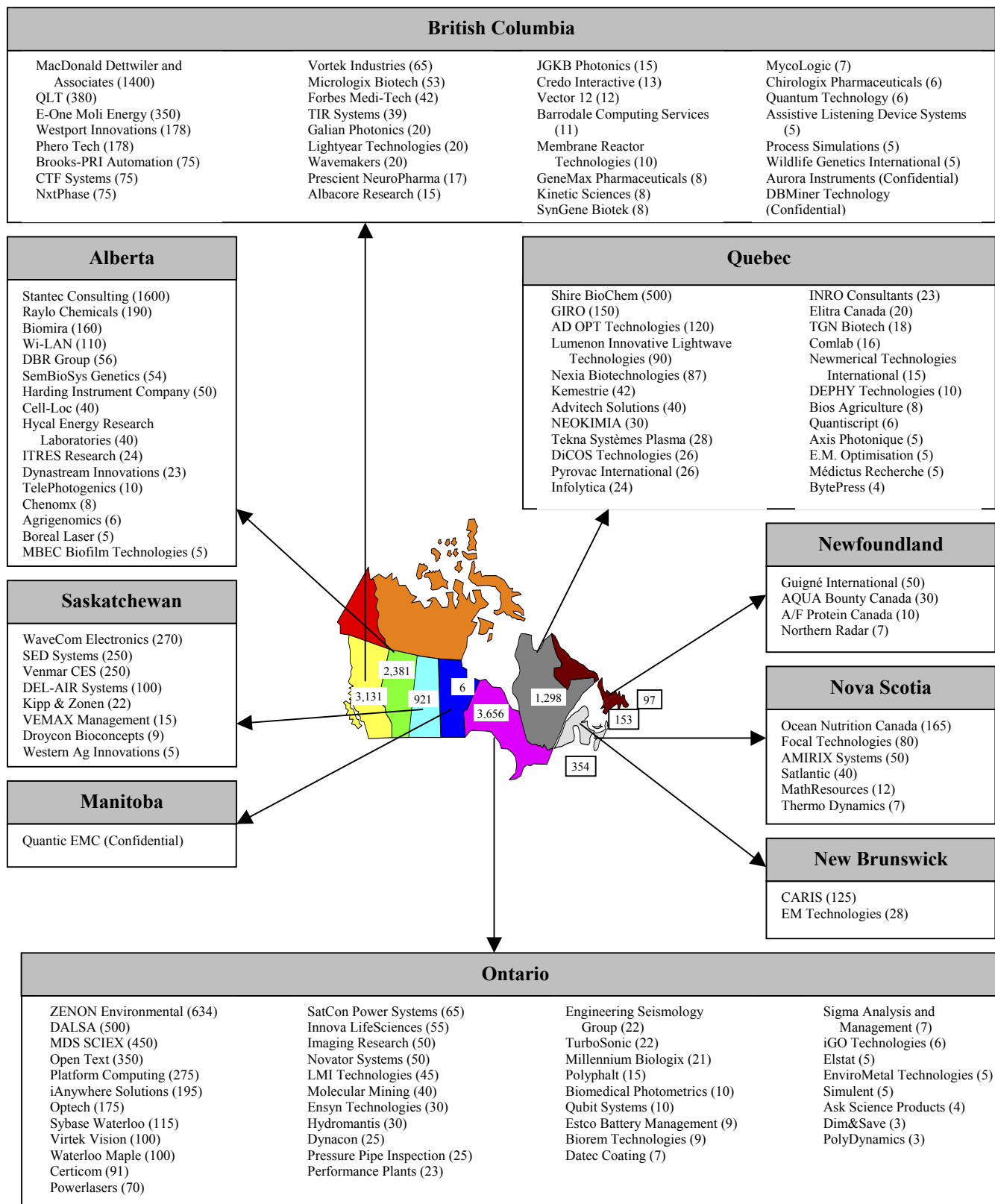
- Of the 64 projects studied to date, 92% of the industrial partners felt that the research objectives of the project were met.
- More than 20% of the industrial collaborators interviewed stated that "new products, processes, standards or services" were created as a result of the projects, 37% mentioned "improvement of existing processes or products," 86% "updating knowledge" and 25% experienced "improvement to product quality" through the CRD projects.

- A total of 15 patents and 12 licences have so far been issued with respect to the 64 projects examined. According to the industrial partners, commercializable results were achieved for two-thirds of the projects.
- 50% of university researchers indicated that their participation on the CRD project allowed them to bring real world examples into the classroom and the practical experience and industrial exposure their students received was a tremendous benefit.

## ***9. Companies Linked to NSERC-Funded Research***

The creation of a company remains one of NSERC's more tangible outcomes of university-funded research. The "start-up" companies highlighted in this report have all been founded on results of research partially funded by NSERC. The 134 "start-up" companies featured (see Figure 29 on the next page) are currently in business producing goods and services for Canadian and international markets. Combined, these companies employ 12,000 Canadians and generate nearly \$2.4 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 these advanced technology companies, which may be 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.

**Figure 29: Companies Linked to NSERC-Funded Research, 1954 to 2002**  
(Number of employees in Canada in 2002)



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

As of July 2002, 25 of the 134 spin-off companies examined are now publicly traded firms. Although the gyrations of the markets have been significant in recent years, the market capitalization of these 25 publicly traded firms on July 29, 2002 was an impressive \$7.5 billion (see Figure 30). The downturn in the markets in the past two years has reduced the market capitalization of these firms by roughly 50%.

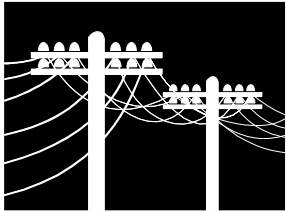
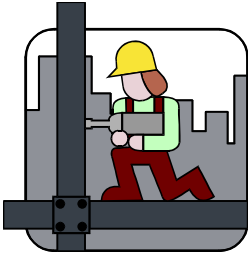
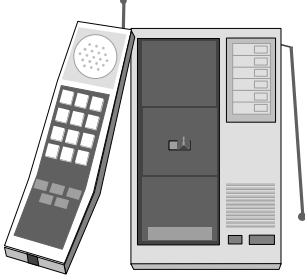

**Figure 30: Market Capitalization of Spin-Off Companies**

Company	Market Capitalization		
	July 29, 2002	August 15, 2001	June 12, 2000
Shire BioChem Pharma	\$3,406 M <sup>1</sup>	\$3,406 M	\$3,607 M
QLT	\$1,177 M	\$2,249 M	\$6,152 M
MacDonald Dettwiler	\$727 M	\$836 M	\$- M
Open Text	\$544 M	\$638 M	\$845 M
ZENON Environmental	\$429 M	\$319 M	\$153 M
Stantec	\$292 M	\$208 M	\$95 M
Westport Innovations	\$200 M	\$303 M	\$359 M
Biomira	\$185 M	\$460 M	\$674 M
DALSA	\$123 M	\$71 M	\$49 M
Nexia Biotechnologies	\$66 M	\$158 M	\$- M
Wi-LAN	\$54 M	\$85 M	\$852 M
Cell-Loc	\$47 M	\$27 M	\$491 M
Innova LifeSciences	\$35 M	\$18 M	\$21 M
Certicom	\$33 M	\$125 M	\$896 M
AD OPT Technologies	\$31 M	\$36 M	\$62 M
Micrologix Biotech	\$31 M	\$- M	\$- M
Virtek Vision International	\$24 M	\$60 M	\$53 M
GeneMax Pharmaceuticals	\$21 M	\$- M	\$- M
Forbes Medi-Tech	\$14 M	\$73 M	\$155 M
TIR Systems	\$10 M	\$6 M	\$6 M
Polyphalt	\$9 M	\$13 M	\$- M
Prescient NeuroPharma	\$7 M	\$- M	\$- M
Lumenon Innovative Lightwave Technologies	\$6 M	\$- M	\$- M
TurboSonic	\$3 M	\$- M	\$- M
Kipp & Zonen	\$2 M	\$- M	\$- M
<b>Total</b>	<b>\$7,476 M</b>	<b>\$9,091 M</b>	<b>\$14,470 M</b>

1. Market capitalization at time of buyout.

## 10. 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 31.

<b>Figure 31: Examples of New Products and Processes Developed by NSERC-Funded Researchers, by Sector</b>	
 <p><b>Energy</b></p>	<ul style="list-style-type: none"> <li>➤ HPDI, High Pressure Direct Injection for converting diesel engines to natural gas</li> <li>➤ PetroTag, a system for monitoring the mass, density and volume of fuel in storage tanks</li> <li>➤ MoliceL rechargeable lithium-ion battery</li> <li>➤ Solar Boiler domestic solar water heating system</li> <li>➤ Battery Health Manager battery management system</li> <li>➤ RPT, Rapid Thermal Processing for fuel recovery from wood residues and biomass</li> </ul>
 <p><b>Construction</b></p>	<ul style="list-style-type: none"> <li>➤ High-performance asphalt</li> <li>➤ Stantec pavement analysis system</li> <li>➤ Instrumented bridges</li> <li>➤ High-performance concrete</li> <li>➤ Acoustic emissions monitoring systems</li> <li>➤ Light Pipes, a lighting system for inaccessible areas</li> <li>➤ Heat exchangers for homes, offices, and livestock barns</li> <li>➤ Corrosion-resistant (composite) materials for bridges and buildings</li> <li>➤ Pavement engineering technologies for roads</li> <li>➤ Waste plastics-based binder for asphalt and roofing products</li> </ul>
 <p><b>Telecommunications</b></p>	<ul style="list-style-type: none"> <li>➤ Fibre optic filters, components</li> <li>➤ Hopper and Hopper Plus wireless modems</li> <li>➤ Speech compression software</li> <li>➤ SQL Anywhere Studio: mobile database technology</li> <li>➤ CELLOCATE™ System pinpoints exact location of cell phone for safety reasons</li> <li>➤ Digital Video Modulator for video-on-demand applications</li> <li>➤ Self-healing and self-organizing networks</li> </ul>
 <p><b>Earth Observation Systems</b></p>	<ul style="list-style-type: none"> <li>➤ CARIS spatial information and GIS solutions for marine and land applications</li> <li>➤ Shoals-Hawkeye airborne lidar bathymeter</li> <li>➤ <i>casi</i> digital imaging spectrograph for airborne remote sensing</li> <li>➤ SWR, Surface Wave Radar</li> <li>➤ DRUMS™, Dynamically Responding Underwater Matrix Sonar</li> <li>➤ Civilian multi-satellite capable Earth observation centres</li> </ul>

## **11. Success Stories**

The following are 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.

### **Mapping Canadian Retailing**

Dr. Ken Jones, an NSERC-funded researcher, is developing an interactive database of commercial activity. He is the Eaton/NSERC/SSHRC Chair in Management of Technological Change in Retailing and the Director of the Centre for the Study of Commercial Activity at Ryerson University. His novel Geographic Information System technology profiles all retail businesses in neighbourhoods across Canada—as small as 40 households—and then visually maps the information via 3D imagery. With information about the spatial distribution of commercial activity in a given vicinity, vendors can determine optimal store locations, plan marketing campaigns, and analyse their competition. Database users can even see the economic impact of a newly established big-box store in a community by “flying” through visual clips of the landscape changes that occur over time. Dr. Jones is a world leader in commercial demographic research as he continues to develop a unique picture of Canada’s retail sector.

### **Model Operations**

Dr. Randy Ellis is at the forefront of computer-enhanced medicine. This NSERC-funded researcher has developed image-guided orthopaedic surgery techniques currently in practice at Kingston General Hospital. Using a patient’s CAT scans, Dr. Ellis generates 3D computer models of the patient’s own knee, wrist, or hip to enable preoperative planning and help predict patient-specific postoperative outcomes. The Queen’s University professor also assists with computer-enhanced surgeries in a state-of-the-art operating room where an advanced guidance system leads the surgeons through complex treatments. The procedures are less invasive than conventional surgery and offer much shorter recovery times. The technology has even been adapted to remove extremely painful bone tumours. Dr. Ellis’ innovations provide novel solutions to the shortage of orthopaedic surgeons, nurses, and high-tech equipment and he hopes to expand the technology to neurosurgery and dentistry.

### **A Silver Lining for Oil Tanks**

Dr. Stephen Armstrong, in association with Jacques Whitford Environment Ltd. and the Insurance Bureau of Canada, has been examining cost-effective measures to mitigate the failure rates of home heating oil tanks. In a joint venture with Parrsboro Metal, Dr. Armstrong's research lab is currently field-testing a coating material that can withstand perverse erosive conditions. New oil tanks with the corrosion-resistant lining are expected to be sold in autumn 2002.

The Dalhousie University researcher's advancement, funded in part by NSERC, has far-reaching implications for homeowners and insurance companies. The remediation cost of domestic fuel-oil spills is approximately \$75,000 and homes can sometimes lose an average of 50 per cent of their equity after these accidents. In Atlantic Canada alone, the price of domestic oil tank failures to the insurance industry is about \$20 million per year.



## 4. 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	2	3	4	5	6	7
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?

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Send your completed questionnaire:

By mail to  
Policy and International Relations  
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Ottawa, Ontario  
K1A 1H5

Or by fax to  
(613) 947-5645

Or by e-mail to  
[bjl@nserc.ca](mailto:bjl@nserc.ca)



## Annex A - Financial Tables

Tables 1, 2, 3, 5, and 7 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 2001-2002.

**Table 1: Summary of Voted Appropriations**

Financial Requirements by Authority (millions of dollars)			
Vote		2001-2002	
		Planned Spending	Total Authorities Actual
	<b>Natural Sciences and Engineering Research Council Program</b>		
85	Operating expenditures	28.8	30.6 29.2
90	Grants	575.5	582.5 555.5
(S)	Contributions to employee benefit plans	2.6	2.6 2.7
	<b>Total Program</b>	<b>606.9</b>	<b>617.7 587.4</b>
	<b>Total Agency</b>	<b>606.9</b>	<b>615.7 587.4</b>

**Note:** Total Authorities are Main Estimates plus Supplementary Estimates plus other authorities.  
Due to rounding, figures may not add to totals shown.  
Actual results are lower mainly due to lapsed funding within the Canada Research Chairs program.

**Table 2: Comparison of Total Planned Spending to Actual Spending**

NSERC Planned versus Actual Spending (millions of dollars)			
Support of Research and Scholarship		2001-2002	
		Planned Spending	Total Authorities Actual
FTEs		264	264 257
Operating <sup>1</sup>		31.4	33.2 31.9
Capital		—	— —
Voted Grants & Contributions		575.5	582.5 555.5
Subtotal: Gross Voted Expenditures		606.9	615.7 587.4
Statutory Grants and Contributions		—	— —
Total Gross Expenditures		<b>606.9</b>	<b>615.7 587.4</b>
Less:			
Respendable Revenues <sup>2</sup>		—	— —
Total Net Expenditures		<b>606.9</b>	<b>615.7 587.4</b>
Other Revenues and Expenditures			
Non-Respendable Revenues <sup>3</sup>		(0.5)	(1.2) (1.2)
Cost of Services Provided by Other Departments		2.7	2.7 2.7
Total Transfer Payments		<b>609.1</b>	<b>617.2 588.9</b>

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 1999-00	Actual 2000-01	2001-2002		
			Planned Spending	Total Authorities	Actual
Natural Sciences and Engineering Research Council	549.8	564.9	606.9	615.7	587.4
<b>Total</b>	<b>549.8</b>	<b>569.9</b>	<b>606.9</b>	<b>615.7</b>	<b>587.4</b>

**Note:** Total Authorities are Main Estimates plus Supplementary Estimates plus other authorities.**Table 5: Revenue****Non-Respendable Revenues (thousands of dollars)**

	Actual 1999-00	Actual 2000-01	2001-2002		
			Planned Revenues	Total Authorities	Actual
Natural Sciences and Engineering Research Council	313	602	500	1240	1240
<b>Total Non-Respendable Revenues</b>	<b>313</b>	<b>602</b>	<b>500</b>	<b>1240</b>	<b>1240</b>

**Table 7: Transfer Payments****Transfer Payments (millions of dollars)**

Support of Research and Scholarship	Actual 1999-00	Actual 2000-01	2001-2002		
			Planned Spending	Total Authorities	Actual
Grants	526.9	538.8	575.5	582.5	555.5
Contributions	—	—	—	—	—
<b>Total Transfer Payments</b>	<b>526.9</b>	<b>538.8</b>	<b>575.5</b>	<b>582.5</b>	<b>555.5</b>

**Note:** Total Authorities are Main Estimates plus Supplementary Estimates.

## **Annex B - Contacts for Further Information and Web Sites**

Our Web site is located at: [www.nserc.ca](http://www.nserc.ca)

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