ESTIMATES

National Research Council 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.

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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Guide to Acronyms and Abbreviations

Acronyms and Abbreviations

AAFC	Agriculture and Agri-Food Canada
ALMA	Atacama Large Milimeter Array
AMTC	Aerospace Manufacturing Technology Centre
ATC	Aluminium Technology Centre
CFIA	Canadian Food Inspection Agency
CLS	Canadian Light Source
CPFC	Canadian Photonics Fabrication Centre
CTN	Canadian Technology Network
FTAA	Free Trade Area of the Americas
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
GOVERD	Government Expenditure on Research and Development
HPC	High Performance Computing
IPF	Industry Partnership Facility
ITA	Industrial Technology Advisor
IP	Intellectual Property
IT	Information Technology
MRI	Magnetic Resonance Imaging
NAFTA	North American Free Trade Agreement
NIC	NRC Information Centre
NMR	Nuclear Magnetic Resonance
NRC	National Research Council Canada
NRC-BRI	Biotechnology Research Institute
NRC-CHC	Canadian Hydraulics Centre
NRC-CISTI	Canada Institute for Scientific and Technical Information
NRC-CSTT	Centre for Surface Transportation Technology
NRC-HIA	Herzberg Institute of Astrophysics
NRC-IAR	Institute for Aerospace Research
NRC-IBD	Institute for Biodiagnostics
NRC-IBS	Institute for Biological Sciences
NRC-IC	Innovation Centre
NRC-ICPET	Institute for Chemical Process and Environmental Technology
NRC-IIT	Institute for Information Technology
NRC-IMB	Institute for Marine Biosciences
NRC-IMD	Institute for Marine Dynamics
NRC-IMI	Industrial Materials Institute
NRC-IMS	Institute for Microstructural Sciences
NRC-IMTI	Integrated Manufacturing Technologies Institute
NRC-INMS	Institute for National Measurement Standards
NRC-IRAP	Industrial Research Assistance Program

NRC-IRC	Institute for Research in Construction
NRC-NINT	National Institute for Nanotechnology
NRC-PBI	Plant Biotechnology Institute
NRC-SIMS	Steacie Institute for Molecular Sciences
NRC-TTC	Thermal Technology Centre
OECD	Organisation for Economic Co-operation and Development
R&D	Research and Development
RMAF	Results-based Management and Accountability Framework
S&T	Science and Technology
SBDA	Science-based Departments and Agencies
SME	Small and Medium-sized Enterprise
STM	Scientific, Technical and Medical
TPC	Technology Partnerships Canada
TRIUMF	Tri-University Meson Facility

Executive Summary

In 2001-2002, the Government of Canada released the *Innovation Strategy* setting forth a series of goals on how to strengthen Canada's research capacity and move Canada towards becoming one of the top five research and development performers in the world by 2010. The National Research Council Canada (NRC), as the Government of Canada's leading resource for scientific research, development and technology-based innovation, has responded to the innovation challenge with the launch of its new strategic Vision 2006 – Science at Work for Canada. The Vision 2006 strategic outcomes are directly aligned with the Government's challenge to improve Canada's innovation performance.

> "Our objective should be no less than to be recognized as one of the most innovative countries in the world. Achieving this will require a comprehensive approach and the support and participation of all governments, businesses, educational institutions and individual Canadians… An innovative economy is essential to creating opportunities for Canadians."
>
> ***Speech from the Throne***
> ***January 30, 2001***

With the launch of its Vision 2006, NRC focused on three main areas for leadership and its contribution to innovation in Canada: enhancing Canadian research and development performance; strengthening Canada's innovation system; and improving Canada's quality of life. Through research and innovation systems' work, NRC creates value for Canada through technology transfer, supporting Canadian firms, and creating new successful companies. Vision 2006 also places emphasis on the recognized drivers of innovation, the quality and motivation of employees, the approach to community-based innovation through technology clusters, and on global connections and research to maintain Canada's position as a leading knowledge-based economy. This past fiscal year marks the beginning of Vision 2006 and it has been remarkable with the launch of a new institute, significant scientific breakthroughs, contributions to partner success, and the creation of new companies. Highlights from this year's performance include:

- NRC is at the forefront of innovation in Canada. NRC launched the National Institute for Nanotechnology (NRC-NINT), a new collaborative initiative involving the Government of Canada, the Province of Alberta, and the University of Alberta. When completed, NRC-NINT will feature a 12,000 square metre research and industry partnership facility, 150 permanent, highly skilled research jobs, a program for 45 guest workers from industry and universities each year, training opportunities for some 275 post-graduate and post-doctoral researchers annually, and unique R&D collaborations, exchanges, and facility-sharing arrangements for researchers from NRC and the University of Alberta. Nanotechnology represents a revolution in science and promises many benefits for health, the economy and the environment.

- NRC contributes to Canadian excellence in research and development. NRC researchers wrote 1,009 articles in refereed journals and delivered 798 papers to external audiences at conferences around the world, and had eight original research articles in the highly ranked journals *Science* and *Nature.*

- NRC collaborates with research partners to promote innovation in Canada. NRC signed 423 new collaborative agreements with Canadian industry, universities and public organizations, an

increase of 7% over last fiscal year. The total number of collaborative agreements active during the fiscal year rose to 915 with a total value over the lifetime of the agreements of almost $115 million, a 15% increase over last year.

- NRC works with communities across Canada to help create an environment for innovation. NRC continues its support of the biopharmaceuticals technology and aerospace industry technology clusters in Montréal, the photonics technology cluster in Ottawa, and the agricultural biotechnology cluster in Saskatoon. Progress has been made in the development of the life sciences, marine biotechnology, ocean and marine technologies, e-business and information technology clusters in Atlantic Canada. NRC continues the development of an aluminium technologies cluster in the Saguenay region of Quebec, a medical devices technology cluster in Winnipeg, and a fuel cells technology cluster in British Columbia. In addition, NRC is proud to be contributing to the development of a new nanotechnology cluster in Alberta.

- NRC stimulates the creation of new firms, jobs, exports and investment growth in communities through its Industry Partnership Facilities (IPF). NRC had 71 incubating firms within its IPFs, an increase of 16% over last year. IPFs were fully occupied and NRC graduated nine successful tenants.

- NRC continues to play a crucial role in enhancing the innovation capacity of Canadian firms. In 2001-2002, NRC provided advice, services and support to some 12,400 Canadian firms through its Industrial Research Assistance Program (NRC-IRAP). The Canadian Technology Network's (CTN) 850 organizations and 349 advisors across Canada facilitated exchanges and collaborations among the different players of the Canadian innovation system. A client survey revealed that NRC-IRAP is credited with helping young entrepreneurs succeed in business, increasing innovation and increasing sales and jobs. The Canada Institute for Scientific and Technical Information (NRC-CISTI) provided almost one million documents to its clients, 90% of them delivered in one day or less. NRC-CISTI's performance was also highlighted by two key achievements: the establishment of a Canada-wide electronic network and the provision of free access for Canadians to the NRC Research Press electronic journals.

- NRC creates new technology-based companies. Despite unfavourable market and economic conditions for new company creation in 2001-2002 as compared to the previous fiscal year, NRC managed to create three new Canadian companies. This brings the total of new companies created by NRC since 1995-1996 to 52. NRC technology developments have the potential to create nine new companies in 2002-2003.

- NRC contributes to federal horizontal initiatives. NRC contributed to a number of horizontal initiatives including national security, climate change and the environment, the Genomics Research Initiative, and the innovation strategy where NRC has led discussions on the development of a Canada-wide strategy in nanotechnology, photonics and Canada's fuel cell innovation strategy.

- NRC conducts research that benefits Canadians. In 2001-2002, research results in the astronomy and molecular sciences, biotechnology, engineering and construction, manufacturing, information and communications, provided many health, safety, environmental and economic

benefits to Canadians. NRC entered into 51 new license agreements to transfer technology to Canadian businesses and licensing revenue was $3.84 million.

- NRC helps Canadian companies to be better positioned to take advantage of globalization through international partnerships. In 2001-2002, NRC was engaged in 355 formal international collaborative agreements. These agreements involved a total of 546 partners from private, public and university sectors. The total value of international collaborative research agreements was $146 million. NRC advances Canada's national standards, measurements and codes, signing new international agreements to help reduce technical barriers to trade and increase exports by Canadian companies.

NRC is focused on Canada's future and is committed to delivering what Canada needs to build the nation's knowledge and innovation capacity to succeed in the global knowledge economy. Building on the success of 2001-2002, NRC is committed to demonstrating a valued return on the government's investment over the next five years. NRC will strengthen Canada's innovation system through its technology cluster strategy, the development of new technologies and technology-based enterprises, technology transfer mechanisms and knowledge transfer systems, the cornerstones of wealth creation.

Section 1 Messages

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.

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.

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 Performance Reports*

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. The National Research Council Canada (NRC) plays a key role in the Industry Portfolio and I am pleased, therefore to present their Performance Report for 2001-2002.

During the past fiscal year, NRC continued to demonstrate why it is key to achieving Canada's innovation goals. NRC bolstered Canada's R&D infrastructure in new and emerging fields of vital national importance, helping create a new $120M National Institute of Nanotechnology in Edmonton. NRC delivered economic value for Canada, through the creation of spin-off companies, private-sector collaborations, technology licencing and assistance to SMEs through its Industrial Research Assistance Program. NRC fostered innovation at the local level, investing and encouraging the growth of new innovation clusters in Ville Saguenay (NRC Aluminium Technology Centre), Montréal (NRC Aerospace Manufacturing Technology Centre) New Brunswick (NRC E-Business facility). NRC reinforced Canada's international position, signing numerous research partnerships and collaborations with international organizations, including the renewal of a highly successful Canada-Taiwan memorandum of understanding in science and cooperation. And, NRC launched its Employment Philosophy, a commitment to NRC staff and Canadians to being an outstanding employer of outstanding people.

These are only a few highlights. I invite you to explore NRC's Departmental Performance Report to discover the many ways that NRC 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

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 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.

Section 2 Departmental Performance

2001-2002: The Innovation Challenge

Innovation in Canada became the focus of national attention in early 2002 with the release of the Government of Canada's *Innovation Strategy -- Achieving Excellence: Investing in People, Knowledge and Opportunity*. It sets forth a series of goals on how to strengthen Canada's science and research capacity, support Canadian firms to capture new markets, and secure Canada's economic and social future[1]. The *Innovation Strategy* follows through on the goal set in the *Speech From the Throne* (January 2001) for Canada to become one of the top five research and development (R&D) performers in the world. (Please visit *Achieving Excellence* on-line at http://www.innovationstrategy.gc.ca)

Achieving the Government's objectives is important in order to become a global leader in innovation performance. For example, *Investing in Excellence, 1996-2001: A Report on Federal Science and Technology – 2001* reports that more than 100,000 new researchers will be required in Canada to meet the challenge of moving to 5th in the world in R&D by 2010. In addition, both governments and businesses will have to double their current investments in R&D. The report reminds readers that innovation is a global imperative, stating "[…] all leading nations are investing heavily in R&D as a basis for economic growth, so we are chasing a moving target".[2] (Please visit *Investing in Excellence, 1996-2001* on-line at http://www.nrc.ca/~indcan/s+t/4rpt/english/index.html)

The Road Ahead for NRC

Through its scientific, research, development and technology transfer efforts, the National Research Council (NRC) consistently develops new solutions and technologies that help Canadian industry adapt to and succeed in rapidly changing circumstances. NRC recognizes that today's research is the source of tomorrow's opportunities. NRC strives to identify emerging fields of national importance where sustained research will advance the frontiers of knowledge and bring future social and economic benefits to Canada. With its national R&D infrastructure and capabilities and international linkages, NRC is well-positioned to lead in improving Canada's innovation capacity, building essential networks of researchers and entrepreneurs, providing the training ground for the next generation of highly skilled workers, creating new companies and products, and working with industry to translate new knowledge into economic and social benefits for Canadians.

NRC spans the innovation spectrum from research and discovery to technology and commercialization, making a unique contribution to the national system of innovation. NRC is a national organization with a strong regional and community presence. Stretching from St. John's to Victoria, NRC is physically located in over 90 communities across Canada through its 265 Industrial Technology Advisors (ITAs) of the Industrial Research and Assistance Program (NRC-IRAP), 1,000 Canadian Technology Network (CTN) members, the Canada Institute for Scientific and Technical Information (NRC-CISTI), 18

[1] Achieving Excellence: Investing in People, Knowledge and Opportunity; Government of Canada; 2002; page 2.
[2] Investing in Excellence, 1996-2001: A Report on Federal Science and Technology –2001; Government of Canada; 2002; page 11.

research institutes and two technology centres. NRC is a strategically focused, integrated and agile knowledge organization that helps leverage the value of its investments in people, infrastructure and knowledge for the benefit of all Canadians. Finally, NRC has developed invaluable international networks of technological and scientific intelligence that are strategically important to Canada. NRC's knowledge and expertise are used not only to transfer S&T information to Canadian firms and universities, but also to open up innovation opportunities for Canadian industry internationally.

NRC has responded to the innovation challenge with the launch of Vision 2006: Science at Work for Canada. Figure 3 on page 14 demonstrates how NRC's Vision 2006 is integrated within the Government of Canada's innovation agenda. NRC is also aligned with other main government goals; Appendix B gives an overview of the linkages between NRC's Vision 2006 and the President of the Treasury Board's annual report to Parliament, *Canada's Performance*. (Please visit *Canada's Performance* on-line at http://www.tbs-sct.gc.ca/report/govrev/01/cp-rc_e.html)

Innovation Abroad: Canada's Performance

Compared to OECD countries, Canada ranks 15th for R&D spending and is behind the leading innovative countries (Sweden, Finland, Japan and the United States), based on the Gross Domestic Expenditure on R&D (GERD) to GDP ratio[3]. For Sweden, the GERD to GDP ratio is 3.8% while it is only 1.83% for Canada. The OECD has an average of 2.21%.

In 1999, Sweden, Finland, Japan and the United States, the innovation leaders, each saw at least two thirds of their GERD contributed by industry. In comparison, the Canadian private sector accounted for 42.6% of GERD. Over the past two decades, Canada has significantly improved its innovation performance across a range of key indicators. Canada achieved the fastest rate of growth in the G-7 in the number of workers devoted to R&D, in external patent applications, and in business expenditures on R&D. However, we continue to exhibit an "innovation gap" relative to other G-7 countries. (See *Table 1.*)

Table 1. Canada's Innovation Performance *

	Canada	U.S.
External Patent Applications	**5**	1
Human Capital Devoted to R&D	**5**	2
Business-Funded Expenditures on R&D	**6**	2
R&D Intensity	**6**	2
Technology Balance of Payments	**5**	3
National Patent Applications	**5**	7
Government Expenditures on R&D	**7**	2

* Ranking within the G-7 countries, 1999

Source: Achieving Excellence: Investing in People, Knowledge and Opportunity; Government of Canada; 2002.

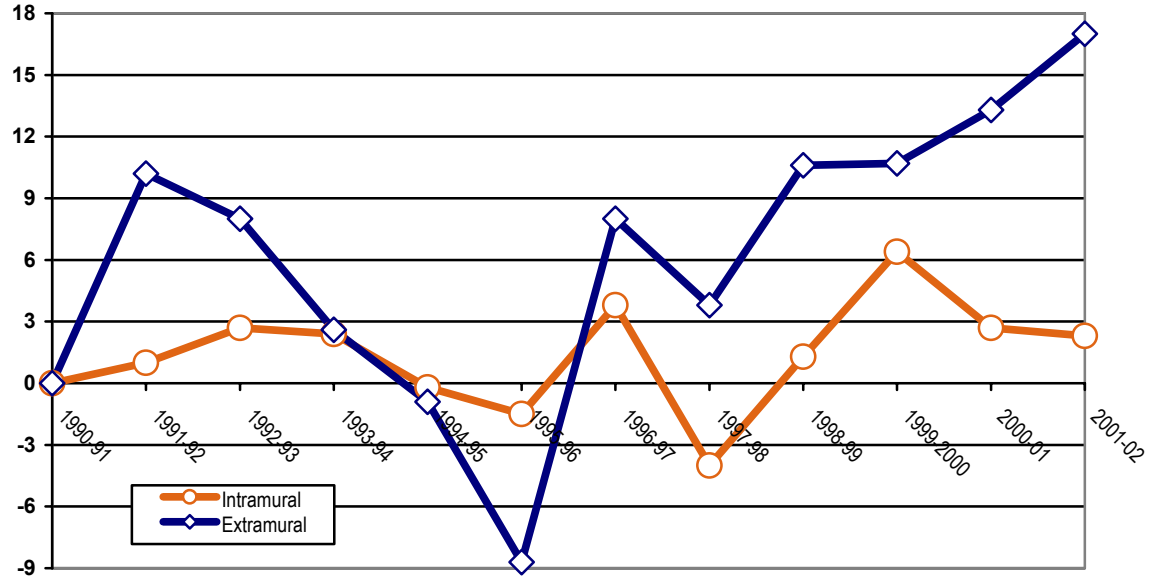
Innovation at Home

Working closely with other federal departments and agencies, NRC has increased its focus on innovation since the release of *Science and Technology for the New Century – A Federal Strategy* (1996). NRC and its partners (*See chart on page 66.*) have been working hard at closing the "innovation gap", and their efforts are having positive results. For NRC's achievements linked to the 1996 Federal Strategy, please visit *Investing in Excellence* (http://www.nrc.ca/~indcan/s+t/4rpt/english/sec11n.html) and read the annex on NRC's achievements.

[3] The data for this section is extracted from the OECD Main Science and Technology Indicators, November 2001.

From 1997-1998 to 2001-2002, federal budgets increased government R&D expenditures by 138 percent[4] to create new extramural research organizations (Canada Foundation for Innovation and Genome Canada) and new programs (Canada Research Chairs), signalling a more diversified approach to R&D funding. While extramural federal R&D expenditures for universities, granting agencies and contribution programs have risen, intramural expenditures for federal science-based departments such as NRC have remained fairly stable at $1.9 billion over the same period. (See *Figure 2.*) However, NRC has been successful in receiving significant funding increases in the last two federal budgets to assist in translating the Government's innovation agenda into action.

Figure 2. Federal Intramural & Extramural Expenditures (1990-2001) – expressed in percentage change from the previous fiscal year, 1997 Constant Dollars



Source: Statistics Canada, Federal Scientific Activities, March 2002.

Federal laboratories face monetary, human resource and infrastructure challenges. While some aspects of the human resources management issues (e.g. numerous retirements over the coming years) hold true for the federal public service at large, NRC faces considerable competition in attracting and retaining highly educated, skilled and talented staff, which include scientists, engineers and technicians. NRC is committed to ensuring that it continues to be a magnet for the most talented and imaginative workers.

NRC's staff and specialized research equipment are located in almost 200 laboratories, test facilities and offices across Canada. Sixty percent of NRC's buildings were constructed over 30 years ago and NRC faces challenges in keeping its facilities and equipment up-to-date. It must continually invest in new leading-edge equipment and facilities in the role of supporting Canadian industry to become more technology intensive and innovation driven. Maintaining the infrastructure is more cost-effective than having to rebuild.

[4] Based on data from Statistics Canada, Federal Scientific Activities, March 2002.

Economic conditions during 2001-2002 had adverse effects on the business climate and the availability of venture capital. These, in turn, affected the launching of new technology-based businesses, including NRC's own spin-offs. Changes in the value of the Canadian dollar also affect NRC's operating expenditures. NRC purchases much of its scientific and technical equipment and reference documents in the US. Furthermore, participation in international consortia and projects often requires contributions in US dollars.

Vision 2006: NRC's new five-year vision

During 2000-2001, NRC undertook the most extensive consultations in its history to chart its course for the next five years. It engaged hundreds of stakeholders inside NRC, as well as from government, industry and academia and key interest groups to develop a sense of shared purpose to continue to excel at driving innovation. The new Vision launched on April 8 2002 focuses NRC's efforts for the benefit of Canadians. (For more details on the Vision launch, please visit http://www.nrc.ca/corporate/regional_innovation/newsroundtable_vii.html).

NRC's Vision 2006 places emphasis on the recognized drivers of innovation; the quality and motivation of its employees; the focus on excellence in emerging, multidisciplinary S&T fields; the approach to community-based innovation through technology clusters; the creation of value for Canada through patents, licenses and spin-offs; and the emphasis on global connections and research to maintain Canada's position as a leading knowledge-based economy. As part of NRC's Vision 2006 commitments, a Web site has been created at http://www.nrc.ca/corporate/vision06/.

NRC's Vision 2006

Recognized globally for research and innovation, NRC is a leader in the development of an innovative, knowledge-based economy for Canada through science and technology.

This Vision is founded on five strategic pillars:

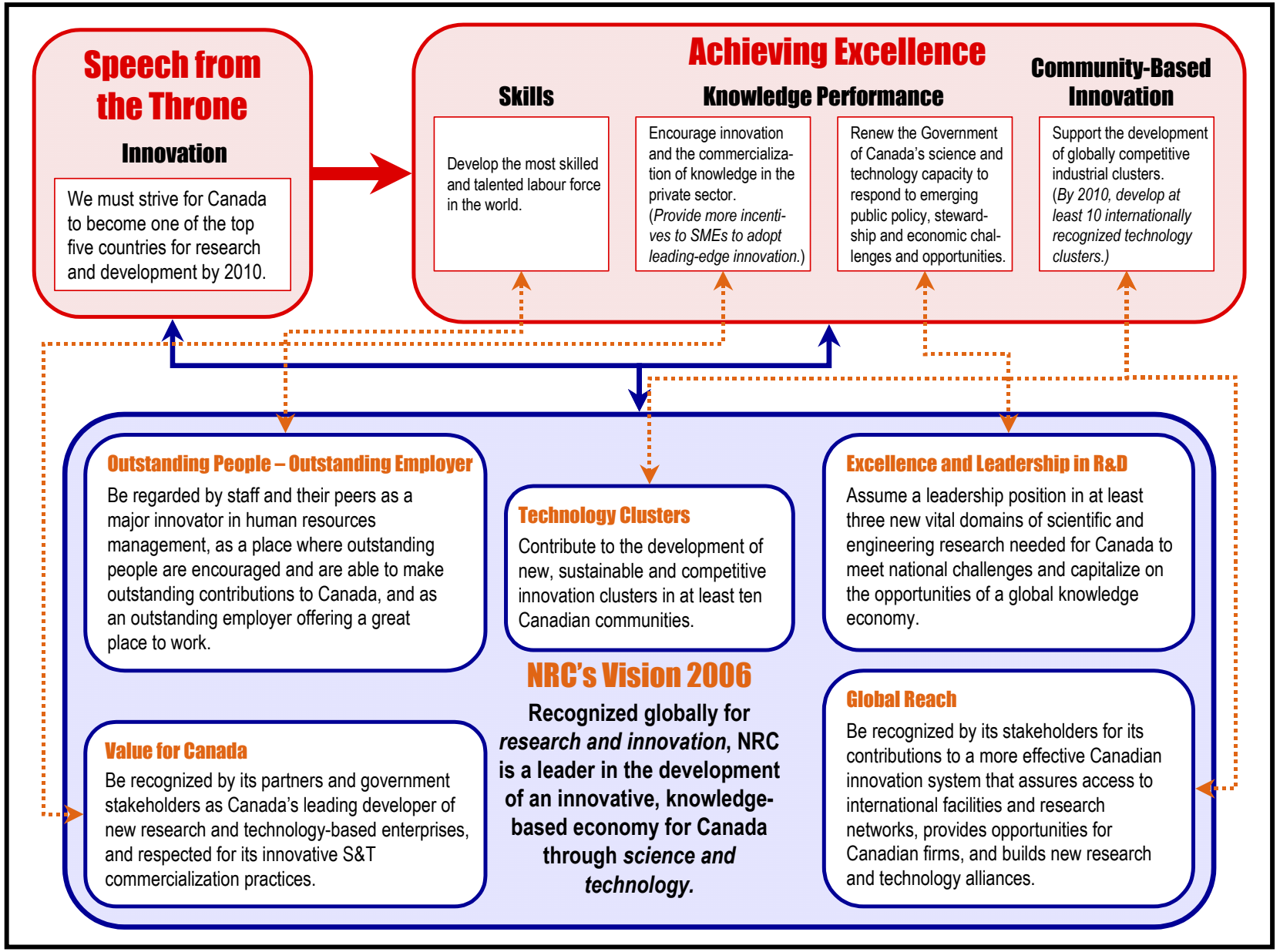
- **OUTSTANDING PEOPLE – OUTSTANDING EMPLOYER:** recognition as a leading research organization distinguished by creativity and innovation;
- **EXCELLENCE AND LEADERSHIP IN R&D:** integration of public and private strengths to create new opportunities and meet national challenges for Canada;
- **TECHNOLOGY CLUSTERS:** development of the innovative capacity and socio-economic potential of Canada's communities;
- **VALUE FOR CANADA:** commitment to the creation of new technology-based enterprises, technology transfer and knowledge dissemination to industry; and
- **GLOBAL REACH:** access to global research & information networks and science facilities, stimulation of enhanced international opportunities for Canadian firms and technologies.

Figure 3 on page 14 shows how the strategic outcomes of NRC's Vision 2006 align with the challenges to improve Canada's innovation performance as described in the *Speech from the Throne (January 2001*) and in *Achieving Excellence: Investing in People, Knowledge and Opportunity*.

NRC is currently developing a new results-based performance management framework against the goals and strategic outcomes of Vision 2006. The performance indicators presented in this document,

although aligned with the strategic outcomes of Vision 2006 and Government of Canada innovation goals, are still in preliminary form. A final version of performance indicators for Vision 2006 will be released in Fall 2002. A temporary chart of key results commitments is presented on page 15.

Figure 3: NRC and Government-wide Objectives – How NRC ties in the Innovation Agenda



NRC's Strategic Outcomes (Chart of Key Results Commitments)

DEVELOPMENT OF AN INNOVATIVE, KNOWLEDGE-BASED ECONOMY			
***VISION 2006* STRATEGIC PILLARS AND OUTCOMES**	***VISION 2006* GOALS**	**RELEVANT BUSINESS LINE(S)**	**REPORTED ON PAGE**
Outstanding People – Outstanding Employer *By 2006, NRC will be regarded by staff and their peers as a major innovator in human resources management, as a place where outstanding people are encouraged and are able to make outstanding contributions to Canada, and as an outstanding employer offering a great place to work.*	▪ Recruitment and retention of highly qualified people ▪ Rewarding professional development and productivity ▪ Leading-edge facilities and equipment ▪ An outstanding place to work	▪ BL 1, 2 and 3 ▪ BL 1, 2 and 3 ▪ BL 1, 2 and 3 ▪ BL 1, 2 and 3	p. 45 p. 47 p. 47 p. 48
Excellence and Leadership in R&D *By 2006, NRC will assume a leadership position in at least three new vital domains of scientific and engineering research needed for Canada to meet national challenges and capitalize on the opportunities of a global knowledge economy.*	▪ New and emerging research domains ▪ A Canadian R&D leader ▪ Stewardship for strategic large-scale S&T infrastructure ▪ Active contributor to federal strategies and initiatives ▪ Research that benefits Canadians	▪ BL 1 and 2 ▪ BL 1 and 2 ▪ BL 1 and 3 ▪ BL 1, 2 and 3 ▪ BL 1 and 2	p. 17 p. 18 p. 19 p. 20 p. 22
Technology Clusters *By 2006, NRC will contribute to the development of new, sustainable and competitive innovation clusters in at least ten Canadian communities.*	▪ Competitive research and technology base for cluster development ▪ Cluster champions, community leadership and strategies ▪ Impacts of technology-based clusters	▪ BL 1, 2 and 3 ▪ BL 1, 2 and 3 ▪ BL 1, 2 and 3	p. 28 p. 28 p. 33
Value for Canada *By 2006, NRC will be recognized by its partners and government stakeholders as Canada's leading developer of new research and technology-based enterprises, and respected for its innovative S&T commercialization practices.*	▪ Creation of new technology-based companies ▪ Enhancing innovative capacity of firms ▪ Dissemination of knowledge to industry	▪ BL 1 and 3 ▪ BL 1, 2 and 3 ▪ BL 1, 2 and 3	p. 34 p. 35 p. 38
Global Reach *By 2006, NRC will be recognized by its stakeholders for its contributions to a more effective Canadian innovation system that assures access to international facilities and research networks, provides opportunities for Canadian firms, and builds new research and technology alliances.*	▪ Integrator and facilitator of international research ▪ Harmonizing international standards ▪ New international S&T alliances ▪ Access to international research facilities ▪ Stimulating new foreign investments in Canada	▪ BL 1, 2 and 3 ▪ BL 1 ▪ BL 1, 2 and 3 ▪ BL 1, 2 and 3 ▪ BL 1, 2 and 3	p. 40 p. 41 p. 42 p. 42 p. 43

Legend:
BL 1 – Research and Technology Innovation; BL 2 – Support for Innovation and the National Science and Technology Infrastructure; BL 3 – Program Management

Performance Accomplishments

This is the first year that NRC is reporting its performance against Vision 2006. NRC can report on a number of successes in R&D, in technology development and commercialization, in forging global connections for industry and in nurturing the growth of Canadian innovation – nationally, regionally and at the community level across Canada.

NRC strives to be an agile, adaptive organization through its focus on entrepreneurship, collaboration with partners and international linkages as well as working horizontally across NRC and across government. Each year, illustrating all of the NRC activities and their impacts and results is a challenge, simply because of the breadth and depth of achievements. This report showcases some of the best examples of NRC's results in providing benefit and value to Canadians for 2001-2002.

Challenges of Measuring R&D performance

Research and development can take several years before projects achieve results or are ready for industrial application. Each year the progress on most projects is incremental in nature. Therefore, some of the results described in this report could be attributed to investments made two, five, or even ten years ago. However, after several years, it becomes a complex and expensive undertaking to trace all of the impacts and assess a reasonable attribution back to NRC. This is true for internal research projects, as well as for R&D projects supported by IRAP. The challenges in measuring results from R&D organizations on an annual basis have been noted by the Office of the Auditor General of Canada[5], the United States' General Accounting Office[6], the OECD, and public and private sector R&D organizations.

In response to the challenges in measuring direct results and identifying the impacts of R&D, leading R&D organizations, such as NRC, have developed and implemented performance measurement strategies based on indicators that are both qualitative and quantitative. Over the last six years, NRC has been consistently using these performance indicators in its decision-making around the achievement of objectives.

[5] Office of the Auditor General of Canada. Chapter 22, Attributes of Well-Managed Research Organizations, November, 1999

[6] United States General Accounting Office. Measuring Performance: Challenges in Evaluating Research and Development, (GAO/T-RCED-97-130), April, 1997.

Excellence and Leadership in R&D

Outcome: By 2006, NRC will assume a leadership position in at least three new vital domains of scientific and engineering research needed for Canada to meet national challenges and capitalize on the opportunities of a global knowledge economy.

Key Performance Indicators:

- Leadership in new and emerging research domains
- Excellence in R&D and innovation
- Stewardship of large-scale S&T infrastructure
- Contribution to federal strategies and initiatives
- Research that benefits Canadians

Canada faces major challenges in areas such as industrial competitiveness and productivity, security, climate change, sustainable development, energy efficiency, a clean environment, and a cost-effective, quality health system. As an integrated, dynamic, national R&D organization, NRC helps address these challenges by working with industry, academia and government through strategically focussed collaborative research and investment into emerging fields of science to build the future technological capacity that Canada will need to succeed.

New and emerging research domains

NRC research institutes work actively in collaboration with industrial partners, but they also devote a substantial percentage of their resources to leading edge basic research. Work in forefront areas like nanotechnology, genomics and proteomics, nutraceuticals, quantum information science, advanced materials, imaging, drug design, photonics and fuel cells helps NRC maintain a strong and diversified knowledge base and thus determine future technologies and competencies needed for Canada to meet national and international challenges. NRC anticipates roadblocks to innovation and addresses these well ahead of the market curve. For example, availability of materials and prototyping facilities inhibit growth in semiconductor design. In response, NRC is examining new and novel materials and working on completely different data transmission methods.

In 2001-2002, NRC achieved milestones in several emerging domains, more notably in:

- **Nanotechnology:**
  NRC launched the **National Institute for Nanotechnology** (NRC-NINT), a new collaborative initiative involving the Government of Canada, the Province of Alberta, and the University of Alberta. When completed, NRC-NINT will feature a 12,000 square metre research and industry partnership facility, 150 permanent, highly skilled research jobs, a program for 45 guest workers from industry and universities each year, training opportunities for some 275 post-graduate and post-doctoral researchers annually, and unique R&D collaborations, exchanges, and facility-sharing arrangements for researchers from NRC and the University of Alberta.

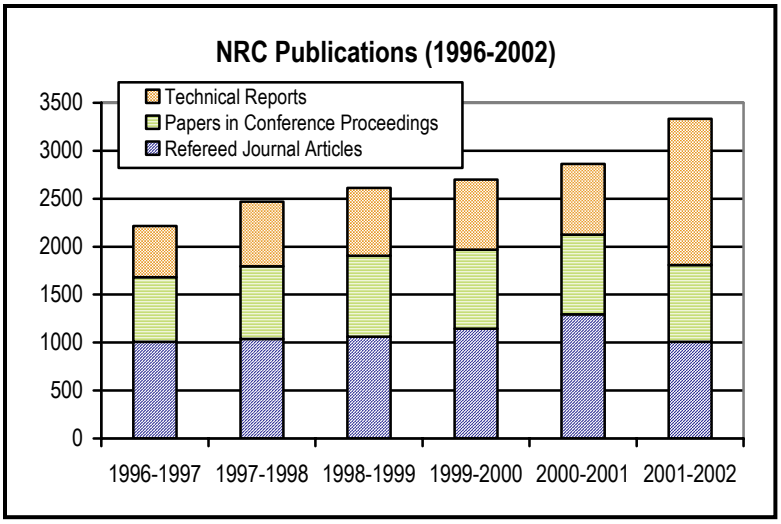
  Nanotechnology represents a revolution in science and promises many benefits for health, industry and the environment. NRC researchers investigated the development of nanotechnology applications in such areas as fuel cell technologies, bio-compatible medical implants, new construction materials, polymer and ceramic nanocomposites, protective coatings, and quantum and molecular computing. In addition, NRC researchers investigated the application of nano-

structures such as carbon nanotubes for optoelectronic and acoustic applications, ferromagnetic composite materials, and large-scale synthesis of carbon nanotubes for storage of hydrogen to be used in fuel cells, and nanostructured semiconductors for electronic applications. All of these accomplishments are the result of exceptional expertise, itself an illustration of how NRC continues to be ahead of the curve.

- **Proteomics:**
  NRC researchers are pursuing research in the new fields of genomics and proteomics, which are of great significance to human health and safety. Proteomics is a field of study within genomics that allows the identification, characterization and quantification of all proteins involved in a particular pathway, cell, tissue, organ or organism that can be studied in concert to provide accurate and comprehensive data about that system. The Institute for Marine Biosciences (NRC-IMB) is recognized as a leader in biological mass spectrometry as applied to proteomics. The Institute for Biological Sciences (NRC-IBS) used proteomics to develop a live vaccine to eliminate the threat of water contamination by *E. coli* from cattle. Researchers at the Biotechnology Research Institute (NRC-BRI) are applying micro-array technology for genomic and proteomic analysis to environmental issues, a new area of research with as yet few international competitors. The Plant Biotechnology Institute (NRC-PBI) is using genomics and proteomics in the modification of crop and plant products aimed at increasing the value of starch, fibre, oil, protein and resisting insect and disease pressures to enhance human health.

- **Fuel Cells:**
  NRC's Fuel Cell program supports fuel cell research and development across Canada. Five NRC institutes with the support of NSERC are collaborating to conduct research, sponsor conferences, and support industry. Highlights of the research include: the development of less expensive, easier to manufacture metallic interconnects for the fuel cell industry, the production of new higher performance cathode materials for fuel cells, development of oxide and bi-metallic alloy coatings for methanol fuel cells, and carbon nanotubes for storage of hydrogen. Research is being done in collaboration with companies such as Noranda, Syncrude, Ballard Power, Fuel Cells Canada and H2 Energy Systems.

National leadership in new and emerging domains of research is demonstrated by the participation of NRC research institutes on 432 national committees and by the 151 conferences and workshops organized by institutes in 2001-2002.



Excellence in R&D and Innovation

Scientific papers in leading peer-reviewed publications and conference proceedings are

internationally acknowledged measures of research quality and relevance. They are also a key tool for dissemination and creating value for Canada. NRC researchers wrote 1,009 articles in refereed journals (a rate of nearly three per day) including eight research articles in the highly ranked journals *Science* and *Nature*. NRC publications show a steady overall growth with articles in refereed journals having fallen from a high of approximately 1,300 articles in 2000-2001 to a level more in keeping with the average yearly output of 1,079 over the last seven years. NRC researchers delivered 798 papers to external audiences at conferences around the world. Technical reports have more than doubled primarily due to NRC-INMS having authored substantially more international standards comparison reports and calibration reports for public and private clients as a result of the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement.

NRC researchers are recognized as leaders in their fields. In 2001-2002, 159 held positions on the editorial boards of scientific journals, a 15% increase over last fiscal year. NRC also holds 270 adjunct professorships with universities and colleges across Canada, an increase of 5% over last fiscal year.

Stewardship for strategic large-scale S&T infrastructure

NRC provides stewardship over Canada's investments in large-scale S&T infrastructure of importance to the research community. NRC is essential in initiating, planning and developing such facilities. Large-scale research facilities include:

- **TRIUMF (Tri-University Meson Facility):**
  Through TRIUMF, NRC administers Canada's contribution to the worldwide network of high-energy physics facilities, linking every major country in the industrialized world. In 2001-2002, the leading-edge Isotope Separator and Accelerator (ISAC) facility was completed and TRIUMF conducted many successful experiments in nuclear astrophysics, structure of matter, and life sciences as well as submitting 11 patent applications, securing three new patents, three new licenses, and the creation of a start-up company and one spin-off company. (*See Section 3.0 for more information on TRIUMF.*)

- **NRC Herzberg Institute of Astrophysics:**
  NRC-HIA contributions to three major international facilities provide Canadian researchers with access to forefront research opportunities in astronomy and astrophysics. In 2001-2002, NRC-HIA contributed 42.5% of the operating costs of the Canada-France-Hawaii Telescope and 25% of the operating costs of the James Clerk Maxwell Telescope on Mauna Kea, Hawaii. NRC-HIA also contributed 14.3% of the operating costs to the new international Gemini facility on Mauna Kea, Hawaii and will be contributing to the new facility in Chile in 2002. NRC-HIA also developed advanced scientific instrumentation and software for use of all observers, supported independent peer review committees that allocate Canada's share of observing time based solely on scientific merit, and archived scientific data.

> "CONGRATS to the entire GMOS team for a FANTASTIC "first light" last night. You absolutely nailed the telescope bore sight, focus, and alignment angle with your first image - I was dead impressed with this achievement!… I can't wait to do this next year in Chile with GMOS-S! "
>
> **Dr. Doug Simons**
> ***Associate Director for Instrumentation, Gemini***

- **Canadian Neutron Beam Laboratory (CNBL):**
  NRC maintains and provides technical support for neutron facilities at Chalk River (Ontario). CNBL provides research scientists and industry with knowledge to improve current materials and develop new ones. In 2001-2002, commercial applications for neutron scattering were identified for such organizations as Pratt & Whitney Canada, Marubeni Canada, Atomic Energy of Canada Ltd, and the University of British Columbia. NRC researchers, in collaboration with McGill University, established that the residual stress distribution in steel created during the temper-levelling process is not detrimental to applications in bridge building. The finding will increase the market share for Canadian steel-makers, help reduce infrastructure costs, and ensure public safety. (http://neutron.nrc.ca/)

- **Canadian Light Source (CLS):**
  NRC researchers are involved with and contribute as team leaders, coordinators and investigators at the new CLS synchrotron facility at the University of Saskatchewan currently being built. For example, researchers from NRC-SIMS are involved in planning research for the Far-Infrared Beamline at CLS. They will address research questions that until now have remained unanswered such as: how does energy flow from different parts of a molecule; what are the nature and the forces among atoms and molecules; and what are the properties of carbon chain molecules and why do astronomers find so many of them in outer space? Beamline-based studies of surfaces and other interfaces with high spatial precision will help in the development of miniature optical and biochemical sensors. (http://www.cls.usask.ca/)

- **C3.ca Coordinating Office (CCO):**
  NRC supports C3.ca, the national organization for advanced high-performance computing (HPC), through the operation of a national coordinating office. The office coordinates the sharing of time on HPC installations across the country, manages a technical-analyst support program to assist approximately 650 HPC users and supports the annual HPC conference.

Active contributor to Federal strategies and initiatives

Through 2001-2002, NRC contributed to a number of Federal strategies and initiatives:

- **Canada's *Innovation Strategy*:** *Achieving Excellence* marks an important milestone in the development of a bold and comprehensive national innovation strategy for Canada. NRC's Technology Clustering Strategy and NRC-IRAP's role in the commercialization of knowledge and SME support are cited as priority actions by the government. As an example of one of the four core roles of Federal research institutions the report states under development and management of standards: "The National Research Council Canada's Institute for Research in Construction provides research, building code development, and materials evaluation services"[7]. NRC-IRC initiated and organized an International Construction Innovation Symposium focused on key innovation issues in the construction industry. Resulting from this work was the creation of a National Steering Committee for Innovation in Construction that will lead the development of an action plan for Canada. NRC has led nation-wide discussions on photonics and nanotechnology, and has played a key role in the sector consultations for fuel cells, construction, aerospace and biotechnology.

[7] Achieving Excellence: Investing in People, Knowledge and Opportunity; Government of Canada, 2002, page 46.

- **National Security:** NRC responded to the threat of bioterrorism by putting forward a new proposal for developing a multi-valent vaccine against the predominant bioterrorism agents. It was awarded a grant from the U.S. National Institutes of Health to develop a vaccine against these potential biological warfare agents. A member of NRC-IRC was invited to join the team of experts formed to investigate the collapse of the World Trade Centre and a researcher from NRC-IMB was seconded to New York to help establish DNA profiling and identification of individuals killed in the September 11th, 2001 attack on the World Trade Centre (*see sidebox on page 48*). NRC researchers also participate on the CBRN Research and Technology Initiative (CRTI) coordinated by the Department of National Defence, concerning chemical, biological, radiological and nuclear (CBRN) threats to public safety and security. NRC worked with the Department of Foreign Affairs and International Trade to showcase an event that brought together Canadian and European researchers, other federal departments and agencies, and industry players to address issues related to privacy and security.

- **Genomics and Health Initiative (GHI):** NRC in collaboration with others is making key contributions to a national initiative designed to bring the benefits of revolutionary advances in genomics to a variety of Canadian industrial sectors. NRC's contribution to the initiative included advances in the areas of agriculture, aquaculture, infectious diseases, age related diseases and biodiagnostics. These advances generated 77 peer-reviewed articles, seven collaborative agreements with Canadian companies, 18 patent applications, one license agreement and the creation of one spin-off company. In addition, as part of the *Canadian Biotechnology Strategy,* NRC has participated in working groups concerning technology forecasting, commercialization, and bioproducts.

- **Climate change and the environment:**

  - NRC, in collaboration with Agriculture and Agri-Food Canada (AAFC), is addressing targets established in the Kyoto Protocol through the study of greenhouse gases using NRC-IAR's airborne research facilities. In collaboration with industry, NRC-IAR is looking for ways of lowering the release of harmful emissions from gas turbine engines. In collaboration with the University of Alberta and the Canadian Petroleum Association, NRC-IAR is studying the environmental consequences of flaring off the gaseous emissions from oil and gas wells.

  - NRC's Institute for Chemical Process and Environmental Technology (NRC-ICPET) participated in the National Roundtable on Environment and the Economy to develop indicators for sustainable development. (http://www.nrtee-trnee.ca/eng/programs/Current_Programs/SDIndicators/index.html).

  - NRC-IC and the work of the national Fuel Cells Initiative on alternative energy sources is focused on economic growth and positive environmental impacts.

  - NRC-BRI in collaboration with Environment Canada identified the potential uses of micro-arrays and gene chips for environmental analysis of the presence of pathogens or toxic chemicals. This technology allows for the monitoring of the environmental impacts of industrial and agricultural activities.

- The NRC Canadian Hydraulics Centre (NRC-CHC) is expanding its role in the area of environmental hydraulics, an area which addresses issues of watershed management, water quality, flood routing and dam break simulation. CHC, in collaboration with Environment Canada, has developed an Environmental Prediction and Decision Support System for the Seymour Watershed. The Technical-User-Interface developed for this system allows managers to anticipate consequences, as measured by changes in water quality, associated with changes in the landscape. The system is currently being extended to include the Coquitlam and Capilano Watersheds of the Vancouver area.

Research that benefits Canadians

NRC's research covers a broad spectrum of science and technology and provides direct benefits to Canadians. NRC pursues research and development – from fundamental sciences and engineering, to emerging and cross disciplinary fields such as photonics, genomics, nanotechnology, bio-informatics and quantum computing – to help build Canada's technology capacity, improve its R&D performance and support the needs of Canadian industry in emerging opportunity areas. This section provides the highlights of selected projects from across NRC.

BASIC SCIENCES

- *Astronomy and Astrophysics*
  The work of NRC-HIA has lead to new knowledge about the universe. Two astrophysicists made a discovery that challenged the dominant theory of the interstellar medium. The interstellar medium is mainly hydrogen gas, which had been thought too cold to form clouds of molecular hydrogen. But the discovery of an immense cloud of extremely cold atomic hydrogen gas 6,000 light years across with a mass 20 million times that of the Sun questions that belief.

  NRC-HIA's collaborative work has also yielded compelling new observations on star formation using the James Clerk Maxwell Telescope in Hawaii. Magnetic fields within the Orion Molecular Cloud are very likely helical as theory predicts. Helical magnetic fields may play a crucial role in enabling stars to condense from clouds of amorphous interstellar gas. NRC-HIA's results contribute to advancing the fundamental quest for understanding how stars, and ultimately how planets, form.

- *Molecular Sciences*
  NRC researchers have developed a process for large-scale synthesis of carbon nanotubes for future fuel cell applications and as a result a new NRC spin-off company is proposed.

  NRC researchers established the underlying principle that leads to the formation of high performance thermoelectric materials. This research is important to semiconductor cooling and may eventually result in the creation of new generations of thermoelectric materials and cool electronic devices such as laptop computers.

  NRC researchers have also made further advances in optical pulses. In collaboration with the Technical University of Vienna, NRC-SIMS generated and measured laser pulses with a duration of 650 attoseconds – the world's record short-pulse duration. NRC is a recognized leader in laser science and the discoveries are not only of fundamental significance but also potentially important for photonics, advanced manufacturing and structural biology.

- *Metrology*
  Canada's reputation was enhanced as a result of NRC's Institute for National Measurement Standards (NRC-INMS) work on best measurement uncertainty of high voltage impulse readings, which will allow for improved calibration of high voltage impulses for cable manufacturers and electrical utilities. NRC-INMS's work on new techniques for determining radio frequency power is essential for the improvement of power to the satellite and communications industries. NRC demonstrated its first operating Cesium Fountain Clock that will have important benefits for satellite telecommunications and geo-positioning applications with its improved time base.

Measuring Hole Positions

NRC researchers devised a custom non-contact method to measure the hole position and diameter in miniature fibre-optic connectors – to 100 nanometre uncertainty. This work is particularly important to manufacturers and users of micro-sized devices, and should lead to improved production quality for Canadian high-tech sectors.

Institute for National Measurements Standards

BIOTECHNOLOGY

NRC's five biotechnology institutes made significant breakthroughs with the potential to improve the health and environment of Canadians in 2001-2002: (http://www.nrc.ca/research/biotechnology_e.html)

- NRC-IBS developed a new automated nucleic acid extraction and preparation technology designed to improve the diagnosis of disease and the detection of genetically modified organisms in food. In collaboration with several universities, NRC-IBS has also made important discoveries leading to the development of a vaccine against a virus that causes ear infections.

" Precision BioLogic is a locally owned company based in Halifax. Over the past 10 years we have developed a range of specialized diagnostic products used in blood coagulation testing. Through contacts at the NRC-IMB in Halifax, we recently became aware of some antibody engineering technology, which promises to enable rapid development of antibodies. The work is going well and we have been delighted with the way in which members of the NRC-IMB group have responded to our needs. The NRC-IMB introduced us to this area of opportunity and the relationship with them has been essential to developing it. As a small company, we could not have embarked alone on an evaluation and commercialization effort. We are therefore very appreciative of how they have approached this with us."

Michael Scott
Chairman and CEO
Precision BioLogic Inc.

- NRC-IMB is working to increase seafood production and make seafood safer to eat. The potential has been shown to exist to more than double haddock output by improving survival during the larval stage. Results of this work will promote aquaculture diversification. NRC-IMB also completed a collaborative project that investigated the accumulation of toxins in shellfish to improve seafood safety assessments.
- NRC-BRI completed a number of projects for the development of new cancer treatments as well as environmental research projects on the impacts of and remedial action for the

Sydney tar ponds. The impacts of petroleum mining activities on natural surface waters in the Athabasca Tar Sands have also been studied.

- NRC-IBD has discovered a new contrast mechanism for functional Magnetic Resonance Imaging (fMRI) that results in superior resolution and improvement of disease diagnosis and treatment. NRC researchers have pioneered the application of magnetic resonance spectroscopy for the analysis of stool samples, resulting in a highly accurate and non-invasive means of detecting colon cancer.
- NRC-PBI discovered the genes that encode enzymes in seed oil synthesis. It continues its research on increasing oil content and the optimal fatty acid profile of Canola seeds – an important $2 billion per year cash crop for the Canadian economy.
- The Canadian Bioinformatics Resource (CBR) continued expansion with approximately 219,000 pages retrieved monthly from the CBR Web site in 2001-2002. CBR not only expanded its infrastructure to support SMEs, but it also assisted users by delivering training to 110 people. In the same year, Genome Prairie announced $5 million in funding for the creation of an integrated and distributed bioinformatics platform for Genome Canada. CBR is a major stakeholder in this initiative leading to CBR's extension to provide a bioinformatics support platform for Genome Canada projects that are not able to establish their own.

ENGINEERING AND CONSTRUCTION

- *Aerospace*
  NRC-IAR conducted extensive research contributing to transportation safety, efficient design and economical operation of both civilian and military aircraft, and understanding of factors affecting global warming and protection of the Earth's atmosphere. In collaboration with NASA, research was performed to understand ice accumulation on aircraft, its effect on flight safety, and how to alleviate icing problems. Work was performed to ensure safe flight in poor weather and low visibility conditions, and to develop systems that assist airborne search and rescue. Extensive work was performed to facilitate safe operation of military aircraft such as the CF-18 and Aurora Long Range Patrol Aircraft through contributions to service life extension programs being conducted at the international level. Basic research was performed to develop new analytical tools for modeling and simulation, and to improve the experimental methods employed in many NRC-IAR large aeronautical test facilities. New materials were investigated that have the potential to perform economically and effectively in demanding conditions experienced in aerospace structures and power plants. A major effort was made to investigate new design and manufacturing concepts with the potential to strengthen Canada's supply chain.

Wave Impact and Scaling

NRC researchers along with Defence Research Establishment Atlantic studied the loads exerted by ocean waves on ship hulls. The work will help ship designers meet requirements for maximum strength with minimum weight and cost.

Institute for Marine Dynamics

- *Ocean Engineering and Marine Industries*
  NRC's Institute for Marine Dynamics (NRC-IMD) in collaboration with Fisheries and Oceans Canada, Memorial University of Newfoundland and the private sector conducted notable work on the "bergy bit" project. NRC-IMD completed full-scale trials to measure the intensity of the impact between a ship and "bergy bits" – house sized icebergs that are difficult

to see in rough weather and often go undetected by on-board radar. Retrofitting the Canadian Coast Guard icebreaker *Terry Fox* allowed for 170 impact tests over six days in Hare Bay, Newfoundland. The knowledge gained will influence how oil tanker hulls are designed for strength and the guidelines pertaining to the size of ice masses that are safe to strike during normal transit at various speeds.

- *Construction*
  NRC-IRC conducted numerous studies designed to improve fire and home safety as well as reduce costs to industry and homeowners. Studies included evaluating an affordable residential plastic pipe sprinkler system to improve home fire safety, developing a software tool for insulating buildings against noise from aircraft, and a third study developed a model to identify indoor contamination sources which will help to reduce ventilation energy consumption in buildings and improve occupant health. In addition, NRC-IRC has developed a new compressed-air-foam fire suppression system with superior performance over traditional foam suppressant technology. This new technology offers the potential for increased public safety and damage reduction and as an alternative to halon in certain applications, it may have tremendous (positive) environmental impact.

MANUFACTURING

In 2001-2002, NRC's four manufacturing technology institutes made research breakthroughs of significant benefit to Canadians:

> " The NRC Industrial Materials Institute (NRC-IMI) was instrumental in the development of the RTICA's insulation technology. IMI played for us the role of an R&D wing, readily providing the resources and expertise that would have been practically impossible to gather in an SME, particularly when we consider their ability to help us, from the first steps of the technical feasibility study to the development of the commercial production line. Basically, our group benefits from a productive and balanced partnership with IMI; and I recommend this to any company with similar needs. "
>
> ***Warren Arseneau***
> ***President, RTICA Corporation***

- NRC's Industrial Materials Institute (NRC-IMI) developed and patented a new process for manufacturing metallic foam from metallic powders. This new technology is of use to both the electrochemical and biomedical sectors and has the potential to improve health, reduce chemical and sound pollution, and may spawn the creation of new spin-off companies. NRC-IMI helped RTICA Corporation bring a new thermal and acoustical insulation to market. The new insulation is made of 100 percent recycled plastic, has a 25 percent better thermal insulating efficiency than conventional fiberglass and cellulose insulation and poses no health risk to installers or users.
- NRC-ICPET developed a process for coating solid oxide fuel cell metallic interconnection plates with conductive and corrosion resistant ceramic films. This advance will result in the more efficient use of energy, a cleaner environment and benefits the manufacturing industry economically. NRC-ICPET also researched particulate emissions from gasoline engines to identify sources and understand the

Tissue Engineering and Artificial Corneas

NRC is collaborating with the University of Ottawa on the development of artificial corneas that can be fully integrated into the human body. The effort includes fabricating bio-synthetic polymers used to produce scaffolds and habitats for living cells. The cells may be from the patient or "pre-seeded" cells that evolve with the bio-synthetic material to become corneal or nerve cells. Tissue fabricated from bio-synthetic polymers is expected to advance the science of tissue engineering for a variety of transplant applications, improving the health and quality of life for many Canadians.

Institute for Chemical Process and Environmental Technology

mechanisms of particulate formation and emissions from different fuels. Potential advances will result in reduced emissions from advanced engine concepts.

- For the automotive and aerospace industries, NRC's Integrated Manufacturing Technologies Institute developed a process of coating magnesium alloys using an innovative application of ultrasonics. This is a first in the field and the benefits will be weight reduction, less pollution and increased efficiency of vehicles. NRC-IMTI also continued enhancements to Internet architecture for a virtual shop floor distributed control. The virtual shop floor interface allows users to visualize the machines and the shop floor in 3D, to collaborate in a distributed fashion and to dynamically plan and optimize production.
- At NRC's Innovation Centre in Vancouver, researchers developed a novel, multi-stage, non-mechanical hydrogen compressor that will be of benefit to the fuel cell industry by reducing the cost of hydrogen compression and producing more economical fuel cells. In collaboration with AAFC, NRC-IC researched the use of farm wastes as a bio-mass source of fuel for fuel cells. The results point to a market opportunity for the emerging Canadian fuel cell industry and positive environmental impacts. NRC-IC also invented a new modeling and simulation tool for the design and development of fuel cell-based hybrid power systems.

INFORMATION AND COMMUNICATIONS TECHNOLOGIES

- NRC-IMS entered into a collaborative agreement with Nortel Networks to improve the performance of active devices for the telecom industry. The use of InGaNAs epitaxial layers on gallium-arsenic (GaAs) substrates for telecom wavelength lasers offer substantial cost savings and improved characteristics compared to standard InP-based systems. The first laser that was processed lased at 1.3 μm. NRC researchers also fabricated GaN High Electron Mobility Transistors for high power, high frequency applications and were successful in producing a device with f_{max} = 180 GHz, a world record in frequency performance. This research has the potential to substantially improve performance and reduce cost of components used in communication, manufacturing and defence applications.

> "The NRC-IIT team has played a major role in the ROSA – Remote Operation with Supervised Autonomy – project by developing advanced vision technologies and making them available for the project. These technologies included model-free motion estimation, post acquisition, multi-camera calibration, estimation of manipulator configuration, and ground based control and visualization station. Selected software modules have been integrated and tested with the MDR Space Vision and Robotic Testbed. The IIT development has been possible due to the world-class expertise at NRC, many years or earlier research, and dedication and creativity of the NRC team".
>
> ***Piotr Jasiobedski***
> ***Vision Systems Team Leader***
> ***MD Robotics***

- NRC's Institute for Information Technology (NRC-IIT) worked jointly with NRC-IBS to develop data mining tools, techniques and methodologies for applications to genomics and bio-chip research. The Biominer software data-mining tool holds the promise of identifying genes involved in a number of major diseases including Alzheimer's and various forms of cancer.
- A new approach for providing confidential network connections has been developed by NRC-IIT. The new approach makes it very difficult to launch a "hacking" attack based upon timing and

network traffic analysis. This advance will improve the protection of confidential and private information, vital for the growth of e-business.

- NRC-IIT continued its work on 3D-object management with a number of projects. One such project entitled Cosmos involved remote supervision of robotic tasks. Cosmos is a proof of concept human-computer interface demonstrating the use of 3D direct manipulation for the remote control and monitoring of space robots. This is a collaborative project with MD Robotics and the Canadian Space Agency and the results will enable remote servicing of satellites.

Technology Clusters

Outcome: By 2006, NRC will contribute to the development of new, sustainable and competitive innovation clusters in at least ten Canadian communities.

Key Performance Indicators:

- Competitive research and development base for cluster development
- Community involvement in technology cluster – local leadership and strategies
- Impacts of technology cluster activities

Competitive research and technology base for cluster development

NRC is a national organization with exceptional local presence. NRC has developed a technology cluster strategy that focuses on linking existing local strengths and opportunities in established and emerging sectors to core NRC R&D capabilities and SME support (IRAP). The result is the creation of a globally competitive research and technology base for cluster development at the community level. NRC participates with regional innovation stakeholders to foster networking, community leadership, cluster champions, and knowledge-based strategies. To continue its work in this area, NRC was provided with $110 million over five years in June 2000 to develop clusters in Atlantic Canada and an additional $110 million in the Budget of 2001 to expand cluster initiatives across Canada. Results of NRC's technology cluster initiatives for 2001-2002 are described below.

> "The Research Institutes of the National Research Council Canada form the nuclei of technology clusters in areas such as biotechnology, aerospace, fuel cells and nanotechnology across Canada."
>
> ***Achieving Excellence, page 46***

Nova Scotia – Life sciences, Marine Biotechnology and Information Technologies

In Halifax, a life sciences technology cluster is progressing under the leadership of NRC. NRC-IMB and IRAP representatives serve on the board of the Life Sciences Development Association (LSDA). NRC-IRAP is contributing to LSDA outreach, networking and communications activities (http://www.researchvillage-novascotia.org/). LSDA is a community organization created to spearhead cluster development in Halifax and developed an action plan, a strategic plan and a master plan for life sciences facilities. NRC-IMB provides expertise and services in marine toxins, DNA sequencing, nuclear magnetic resonance (NMR), mass spectroscopy, and microscopy to the cluster. NRC-IMB also oversaw the building of a High Performance Molecular Separation and Mass Spectrometry Centre and a new Shellfish Research Centre. In addition, plans were initiated for a new Industry Partnership Facility (IPF). NRC-CISTI provided information and current awareness services to the LSDA involved in developing the life sciences technology cluster.

> "As a founding partner of the Life Sciences Development Association, the early support of the IMB has been critical to our success. The IMB is a leading member of Nova Scotia's life sciences community and the resources, expertise and commitment the IMB staff and leadership bring to the community are essential ingredients for our growth and prosperity. "
>
> **Thelma Costello**
> ***Executive Director***
> ***Life Science Development Association, Halifax, Nova Scotia***

NRC-IBD and IRAP were key participants in planning the Brain Repair Centre. As a result, a satellite institute, NRC-IBD (Atlantic), has been formed and will house a new

MRI facility in the community in collaboration with the Dalhousie University Faculty of Medicine and the Capital Health Authority.

In Cape Breton, NRC-IIT has established a research group at the University College of Cape Breton (UCCB) that will work to develop core competencies in software engineering for real-time control and embedded systems for short-range, dynamically reconfigured wireless networks. Complementing this initiative, NRC-IRAP began an internship program with UCCB that will see up to 10 graduates per year join the NRC-IIT research group. NRC-CISTI opened a reading room at UCCB with the support of UCCB and NRC-IIT, providing access to a range of specialized and hard-to-obtain information resources.

NEWFOUNDLAND – OCEAN AND MARINE TECHNOLOGIES

NRC-IMD formed a working group of nine community members to oversee a technology cluster action plan. NRC-IMD and NRC-IRAP have supported the hiring of an Executive Director to develop the St. John's cluster action plan with the support of the working group. NRC-IMD provided technological advice to four Newfoundland SMEs and participated in three proposals prepared by agencies in Atlantic Canada. NRC-IMD completed plans and contracted the design of a new building extension to house an IPF, Young Entrepreneurs Incubator, NRC-CISTI and NRC-IRAP. The IPF and young entrepreneurs program are being developed by NRC-IMD and NRC-IRAP. IRAP has also funded a number of R&D projects with SME members of the cluster. NRC-CISTI staff will be involved in an audit of information resources and competitive technical information studies in ocean technology and staff will also support the ocean technology roadmapping and cluster building activities at NRC-IMD.

As part of the Marine and Ocean Technology roadmap process 10 workshops were held across Canada, a database of over 2,000 marine and ocean technology ideas for the future was developed, four scenario papers were written, and a summary paper of final recommendations from the roadmap initiative was drafted with the final version due December, 2002.

NEW BRUNSWICK – E-BUSINESS

NRC-IIT initiated a workshop as a follow-up to the Moncton Roundtable of the previous year to determine the best way to grow the information technology (IT) industry in New Brunswick. In addition, NRC-IIT co-chaired the eNB and Innovation Roundtable where over 100 leaders from all over New Brunswick came together to determine the path for achieving a world-class leadership position in the 21st century digital economy for the emerging e-business technology cluster. NRC-IIT contacted and provided advice to 49 companies and/or organizations in Atlantic Canada. Thanks to the tremendous effort and enthusiasm of IIT staff, three of the four New Brunswick and Nova Scotia groups have been established and are operational: Fredericton, e-Business; Moncton, e-Learning; Sydney, Wireless Systems. In Saint John, the broad lines of the research agenda were determined at the end of the reporting period, in consultation with the stakeholder community. Construction began on the new research institute devoted to information technology and e-business in Fredericton and when completed in Fall 2002 the facility will be the hub of NRC's research program in e-business, housing approximately 40 employees and up to 40 guest workers and staff from incubating companies. In addition, NRC-CISTI's new NRC Information Centre (NIC) and NRC-IRAP will be co-located within NRC's new research facility.

PRINCE EDWARD ISLAND – BIO-RESOURCES

NRC-ICPET participated and co-chaired the PEI Bio-resource Technology Roadmap steering committee. With representation from across Canada and industry, government and academic sectors, the committee met several times to develop a roadmap addressing opportunities for PEI and Atlantic Canada bio-resources sector. The roadmap process, completed in March 2002, considered over 100 opportunity areas and recommended a focus on discovery, screening and efficacy evaluation of bioactive compounds from marine and other sources. An implementation team was formed to bring the recommendations forward. NRC-CISTI contributed resources to complete the bio-resources inventory and supplied information, patent research and analysis.

NRC-IRAP contributed to the success of the technology cluster initiatives in Atlantic Canada through its facilitation and organizing of meetings that fostered discussions, partnerships and linkages to R&D facilities. In Atlantic Canada, a total of $12.61 million was provided to SMEs in the form of support to 450 innovation projects and an additional $4.43 million was provided to community partners to support community innovation infrastructure initiatives. NRC-IRAP has participated in several workshops to build technology clusters in Atlantic Canada.

Further information on all of NRC's activities in Atlantic Canada can be found at http://www.nrc.ca/atlantic.

QUEBEC – AEROSPACE MANUFACTURING, BIOPHARMACEUTICALS AND ALUMINIUM TECHNOLOGY

NRC-IAR continued with work on the Aerospace Technology Infrastructure Initiative with the design of the Aerospace Manufacturing Technology Centre (AMTC) on the grounds of the Université de Montréal École Polytechnique and the procurement of equipment. AMTC will promote the development of the aerospace industry technology cluster in the Greater Montréal area and strengthen the Canadian supply chain. Construction of the centre is expected to commence in early Fall 2002 and will be completed within 15 months. IAR interacted extensively with the Aerospace Industries Association of Canada, the Ontario Aerospace Council and the Association of Quebec Aerospace Companies, thus reinforcing an already strong national network. Once completed, AMTC will accommodate up to 100 staff and guest workers working with advanced metal products, information systems and computation methods, advanced composite materials, and functional materials – focused on next generation manufacturing relevant to SMEs. To further networking with industry, universities and public research institutions, NRC-IAR became a member of the Consortium pour la recherche et l'innovation en aérospatiale du Québec (CRIAQ), a provincially based network centre of excellence that attracts industrial investment to Quebec.

NRC-BRI is part of an established and growing biopharmaceuticals cluster in Montréal and is an active participant in locally based business networks such as BioQuébec. NRC-BRI continued its success in networking and strengthening Montréal's biopharmaceuticals cluster through expansion of its Industry Partnership Facility (expected completion end of 2003). NRC-BRI had 18 companies within its IPF with a total of 393 employees on site. NRC-BRI is involved in the elaboration of strategies to accelerate the development of Montréal's life sciences sector. Along with major players from academia, government, and industry, a strategy was prepared for release in late April 2002. NRC-BRI plays a key role within this strategy, which will require major investments both in capital and human resources to move forward. In 2001-2002, NRC-BRI implemented a high throughput screening facility that brings together industrial partners and academia to work in collaboration

fostering and enhancing technology transfer from NRC-BRI to industry through agreements, contracts and licensing.

NRC-IMI is fostering an aluminium technology cluster in the Saguenay region with the creation of the Aluminium Technology Centre (ATC) on the campus of the Université du Québec à Chicoutimi (UQAC). The ATC will provide Canadian Industry with the technical support and expertise required to develop value-added aluminium-based products and services. Work has begun on the infrastructure, collaborative projects, and the establishment of linkages with university partners (UQAC, McGill University, l'Institut National de la Recherche Scientifique, University of Windsor). ATC will be home to 80 researchers, technicians and technical staff working to support industry. Alcan formalized a strategic partnership with NRC for $10 million over five years and discussions were initiated with Alcoa, GM and Magna International.

ONTARIO – PHOTONICS

NRC-IMS has championed the Canadian Photonics Fabrication Centre (CPFC) in Ottawa to support the local photonics technology cluster. The CPFC will be a unique facility in Canada for the fabrication of components and devices of importance to the photonics technology cluster. Once completed, the CPFC will give industry, universities, and governments a state-of-the-art prototyping facility -- a key link in the chain of photonics innovation. This facility will serve many purposes: one is to help SMEs with the fabrication of prototypes or small production runs to secure initial venture capital funding. It is also meant to train highly qualified personnel in the design and fabrication of semiconductor-based photonics devices to address the critical shortage of personnel in this area. NRC-IMS' IPF will be available to house any companies collaborating with IMS in the photonics area.

MANITOBA – MEDICAL DEVICES TECHNOLOGIES

NRC-IBD announced of a new Industry Partnership Facility (IPF) in Winnipeg. Construction of the future home of high tech medical technology enterprises, training, and research activities is slated to begin in 2003. The IPF will act as a catalyst for the growth of start-up and spin-off companies. Entrepreneurs will benefit from close proximity to top medical device researchers at IBD, as well as a unique prototyping facility that will be located in the IPF. NRC-IBD's Business Development Office, NRC-IRAP and the Prairie Centre for Business Intelligence will complete the spectrum of capabilities to be housed under one roof. The IPF will be a focal point for private sector research and development, and educational initiatives, all poised to make Winnipeg and Manitoba globally competitive for information and medical technology development and commercialization. NRC-IBD has established IBD (West) as a satellite of NRC-IBD in Calgary as a partnership with the University of Calgary and the support of the Calgary Regional Health Authority. This collaboration has resulted in the application of MR imaging to leading edge biomedical research.

SASKATCHEWAN – AGRICULTURAL BIOTECHNOLOGY

NRC-PBI continued to support the established agricultural biotechnology cluster in Saskatoon. NRC-PBI is recognized as one of the key driving forces of this technology cluster with 24 of 26 local ag/biotech firms having had linkages to NRC during their development. NRC-PBI also invested $2.5 million in mass spectrometry facilities to support the growth of SMEs in Saskatoon by giving new access to highly specialized equipment. Expertise in many diverse areas such as transformation and recombinant DNA technology, cell and tissue culture, experimental haploidy, analysis of plant growth

regulator activity, lipid and fatty acid biochemistry and metabolic engineering has attracted a wide range of collaborations. Large multi-national organizations such as Dow AgroSciences, Aventis and AgrEvo appreciated the wealth of expertise available at NRC-PBI. NRC is an active participant in local networks with membership on various boards including Ag West Biotech, Inc, Genome Prairie, and various councils such as the Canadian Agricultural Research Council, AAFC Saskatoon Research Centre, and Saskatoon Regional Economic Development Agency. To support ag/bio SME formation and enhance linkages with industry, NRC-PBI is building a $15.4 million 5,000 square metre IPF, which will be open for business in the fall of 2002.

ALBERTA - NANOTECHNOLOGY

NRC moved forward on the establishment of NRC-NINT, a $120 million world-class facility to be located on the campus of the University of Alberta in Edmonton. NRC-NINT augments NRC's nano-sciences and nanotechnology R&D strengths and opens new R&D avenues to emerging opportunities in computing and electronic devices, nano-materials, nano-biology, nano-fabrication and devices, quantum information, and nanometrology.

Research in nanotechnology is inherently multi-disciplinary and requires critical mass. NRC-NINT will establish three integrated components within its research organization - fabrication and synthesis, characterization, and modeling. Through the integrated approach and with its concentrated resources, NRC-NINT will pursue its key objective to facilitate and support the growth of a cluster of nanotechnology-based firms. NRC-NINT's state of the art research facility will be the heart of this cluster.

NRC-NINT's research focus will be on programmable, adaptive nanosystems. Programmed materials can be constructed from individual atoms or molecules that use molecular self-assembly techniques to create complex molecules with novel properties. Adaptive materials respond to external triggers such as temperature or pH and react to their environment. NINT will develop programmable, adaptive systems to explore new opportunities in:

- Cellular, DNA and quantum computing
- Bio-sensing and new approaches to cell signaling and transduction; and
- Materials manufacturing including smart catalysts and coatings.

BRITISH COLUMBIA – FUEL CELLS

B.C. has the nation's most promising emerging cluster of fuel cell innovators. NRC through the National Fuel Cell program and five of its institutes is supporting fuel cell cluster development in British Columbia and across Canada. NRC researchers were involved in 12 fuel cell projects. In addition, NRC-IC sponsored the World Hydrogen Conference in Montréal as well as a state of the industry survey by Fuel Cells Canada. NRC has visited every major fuel cell company in Canada as part of technology road mapping exercise with Industry Canada and Fuel Cells Canada to help define the agenda and action plans to drive the technology cluster in B.C. and across Canada. NRC-IC is working to complete the construction of six hydrogen-safe fuel cell research laboratories to help meet the demand of the region's innovative companies. The impact of NRC's fuel cell technology cluster development includes cost reduction, improved reliability, a substitute for the combustion engine and the creation of Canadian fuel cell design and manufacturing capacity. In 2001-2002, NRC-IC had five incubating firms two of which, Chrysalix and BC Biotechnology Alliance, graduated in January 2002.

Impacts of technology-based clusters

NRC stimulates the creation of new firms, jobs, exports and investment growth within regions through its incubation facilities, a vital component in fostering technology clusters. Incubating companies receive added value from access to NRC expertise. In 2001-2002, NRC had 71 incubating firms located within two IPFs (Montréal and Ottawa) and in other locations across the country. This represents an increase of 16% over last year. Successful firms eventually graduate from IPFs and go on to create jobs and wealth within their communities. NRC graduated 9 tenants from its IPFs, similar to the number of graduating tenants last year. The success of NRC's IPFs is also evidenced by demand. A total of 10,129 square metres of space was available to firms and this space was fully occupied. The new IPF at NRC-PBI will open in Fall 2002 and the construction of a new IPF in Winnipeg will begin in 2003. Construction is also set to start on IPFs in Chicoutimi, Fredericton, Edmonton, Penticton, Victoria, and Halifax, bringing the number of facilities from two to nine.

Table 2: NRC's Industry Partnership Facilities

Location	Area (in m^2)	In operation since:
Biotechnology Research Institute (Montréal, Quebec)	8,222	1998-1999
Institute for Microstructural Sciences and Institute for Information Technology – M-50 Facility (Ottawa, Ontario)	1,604	1998-1999
Plant Biotechnology Institute (Saskatoon, Saskatchewan)	303	To begin operations in Fall 2002
Total	**10,129**	

Value for Canada

Outcome: By 2006, NRC will be recognized by its partners and government stakeholders as Canada's leading developer of new research and technology-based enterprises, and respected for its innovative S&T commercialization practices.

Key Performance Indicators:

- Creation of new technology-based companies
- Enhanced innovation capacity of firms
- Improved dissemination of knowledge

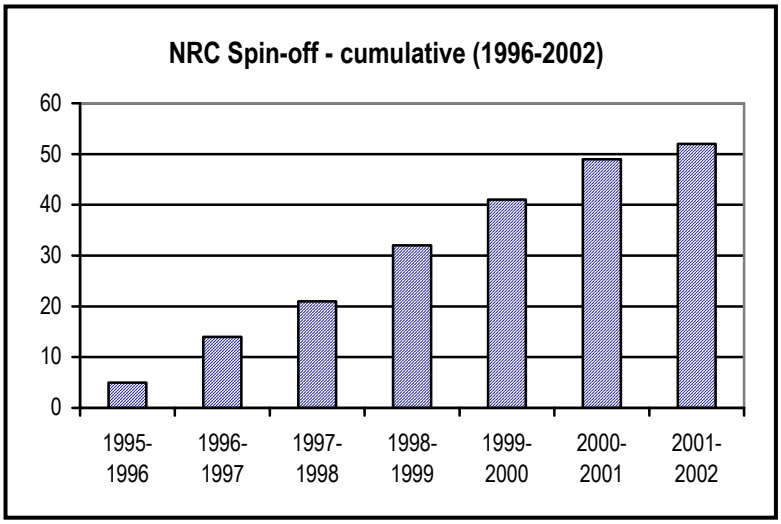
NRC creates value for Canada and its industry through research, innovation and commercialization activities. NRC showed its ability to lead innovation in government in 1996 when it launched its Entrepreneurship Program to promote the commercialization of its technologies. NRC-IRAP helps to increase the innovation capacity of Canadian SMEs. NRC continues to foster entrepreneurial thinking and action and seeks to accelerate technology transfer, knowledge dissemination, and the development of new research-based technology enterprises and jobs for Canadians.

Creation of new technology-based companies

When NRC develops a technology that shows particularly strong market potential, entirely new companies will sometimes be created to take the product to market. These new companies create innovative products and services for the global marketplace, and create new jobs. Despite unfavourable market and economic conditions for new company creation in 2001-2002 as compared to the previous year, NRC created three new companies and close to 15 new jobs for highly qualified Canadians. This brings the total of new companies created by NRC since 1995-1996 to 52 with approximately 670 new jobs and $247 million in cumulative private investment. Nine new NRC technology developments have the potential to result in the formation of new companies in 2002-2003. NRC spin-off companies such as Novadaq Technologies have been successful with their Intra-operative imaging system having received approval from Health Canada to allow fluorescence angiography for use in cardiac surgery.

Following is a list of new companies created in 2001-2002:

- NavSim Technology Inc. was established in January 2002 to develop ship manoeuvring simulation software and at the end of 2001-2002 had seven employees.
- Capital Laser was established in October 2001 from NRC-IMTI. The company uses NRC laser technology for micro-machining and by April 2002 had two employees.



- Ionalytics Corporation was established in October 2001 to manufacture high-Field Asymmetric waveform Ion Mobility Spectrometry (FAIMS) chemical analysis systems. Ionalytics has licensed NRC's FAIMS, which was developed in collaboration with MDS-Sciex, a manufacturer of mass spectrometry equipment. By placing a FAIMS device at the front end of a mass spectrometer, the sensitivity and specificity of the instrument can be increased dramatically. This new device will be important for areas such as proteomics and development of therapeutic drugs and therapies. Ionalytics Corporation had six employees at the end of 2001-2002.

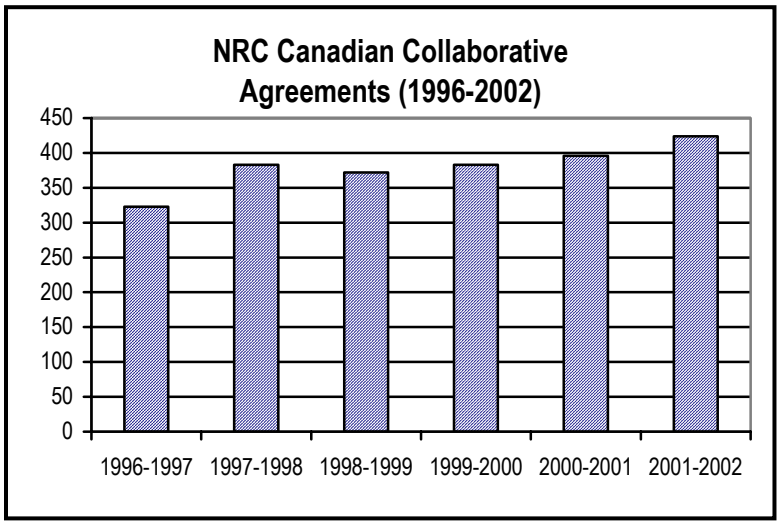
Efficient refining processes for food industries

ICPET's Separation Technology group has successfully completed a collaborative project with Colarôme Incorporated based in Montréal, to improve the company's processing system for refining food grade colours from vegetable extract. Process modifications included replacing a biological processing stage with a physico-chemical stage. These modifications were successfully implemented on-site, reducing the overall number of process stages and decreasing overall processing time by 33%. The development and introduction of new processing components, licensed from NRC by Colarôme Inc., has produced significant savings in process operations and has improved product quality.

Major food companies in the U.S and Japan have approved Colarôme's food-based colorants for use.

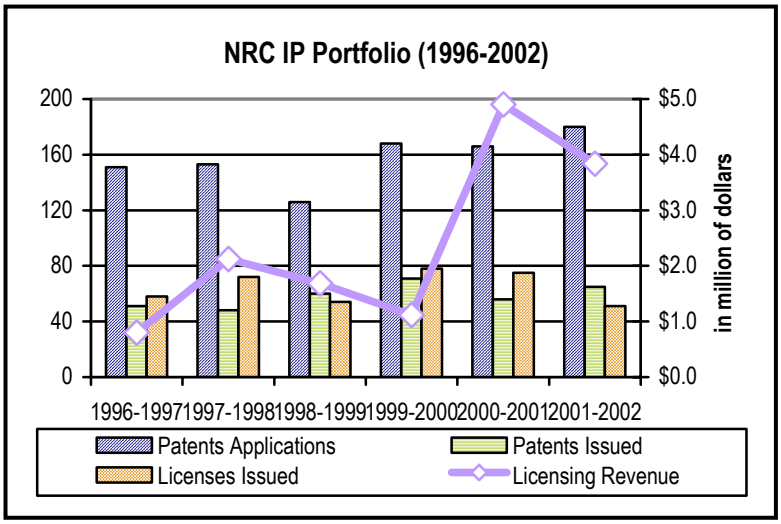
Enhanced innovation capacity of firms

An NRC partnership with Canadian industry, universities and public organizations is an indicator of the assistance and value that NRC provides. NRC signed 423 new collaborative agreements with partners, an increase of 7% over last fiscal year. The total number of collaborative agreements active during the fiscal year rose to 915 with a total value over the lifetime of the agreements of almost $115 million, a 15% increase over last year's value.



The management of intellectual property is important for enhancing the innovative capacity of existing firms. NRC's success in securing patents and licensing its innovations results in the transfer of technology to Canadian businesses and socio-economic growth. A new patent or patent application is a key step in the continuum from discovery to innovation. In 2001-2002, NRC applied for 180 new patents, and secured 65 patents from applications made in previous years. Thirty-eight percent of these were U.S. patents (an OECD measure of competitiveness).

Licence agreements show a direct flow of innovation into business application. NRC entered into 51 new licence agreements. By negotiating a license agreement to use NRC technology, the industrial partner endorses the merit of NRC research. Intellectual property (IP) licensing revenue for 2001-2002 was $3.84 million, down slightly from last year's $4.9 million, but substantially greater than the average of $2.4 million over the last six years.



A few examples of the many ways in which NRC licence agreements moved technology to Canadians in 2001-2002 are:

- **Fluorescence angiography:** NRC developed and tested an imaging system and software for use in cardiac surgery that was delivered to Novadaq Technologies, an NRC spin-off company. The system is superior to any system available in terms of performance, software and overall flexibility and will reduce health care costs and improve surgical outcomes.

- **Black Layer technology:** Through an innovative business arrangement, a portfolio of patents centred around NRC's black layer technology for thin, flat panel displays was structured for international licensing. NRC revenues from black layer technology increased by 85% in 2001-2002. In early 2002, NRC signed a manufacturers' agreement for black layer technology with Japan's Tohuku Pioneer, the world's largest provider of organic light emitting diode displays.

- **Monte Carlo System software for radiation therapy:** NRC's Monte Carlo software developed in 2000 and licensed to MDS Nordion has extended its reach to the medical physics community through a new licensing agreement with Swiss-based Varian Medical Systems International AG. This software significantly improves the speed and accuracy of radiation therapy treatment for cancer patients.

- **Water requirements model in FIERAsystem:** NRC developed a system for use in the planning and evaluation of water requirements for firefighting in Canadian municipalities and licensed it to Ken Richardson Technologies. The model ensures the cost-effective provision of water for firefighting needs.

Meningitis-C Vaccine Approved for Canada

In January 2002, NRC and its partners – Shire Biologics and Baxter Corporation – celebrated the launch of a breakthrough vaccine technology developed by NRC. Approved by Health Canada, the Neis Vac-C vaccine will protect people of all ages, especially young children, against Meningitis-C.

- **Metabolic engineering of canola seed:** NRC has successfully developed canola seed with a highly significant reduction in the content of anti-nutritional substances. This technology has been transferred to Dow Agrosciences. The commercialization of this technology will provide nutritionally and environmentally superior canola products. This is an important scientific advancement in genetic engineering that has not been possible to achieve by established breeding methodologies.

- **Petrochemical processing:** Imperial Oil signed a license agreement with NRC to use NRC's patented fluid coker feed nozzle technology for petrochemical processing. The system, jointly owned with Syncrude Canada Ltd., was originally developed for use in coker reactors used in bitumen processing to increase the volume of synthetic crude oil produced. Imperial Oil will use the technology to refine and recycle lower quality feed that remains after primary refining. The result is reduced waste and a value-added, higher-grade petroleum product.

NRC Industrial Research Assistance Program

In 2001-2002, NRC-IRAP's total level of activity was $149.65 million. It provided some 12,400 firms with customized information, advice and referral services. The program's total financial contributions to firms were $97.87 million, including $29.71 million in Technology Partnership Canada (TPC) funding on behalf of Industry Canada and $3.95 million in Youth Initiatives on behalf of Human Resources Development Canada. The contributions went to some 2,841 SMEs for 3,271 innovation capacity building projects.

The program played a proactive role in identifying and facilitating potential SME partnerships, networks and multi-stakeholder interactions at the local, regional, national and international levels.

IRAP maintains a vital and growing network that includes more than 100 of Canada's leading public and private research and technology-based organizations. The organizations collaborate with IRAP to increase the innovative capability of SMEs, through the Technology Advisory Services as well as other agreements for specific collaboration initiatives. These collaborations enhance client value-added services, strengthen the national/local infrastructure, extend the Program's reach, and bridge gaps in the Program's capabilities by creating more innovation services for SMEs.

In 2001-2002, total contributions to organizations amounted to $23.52M and IRAP contributed $4.31M to the Canadian Technology Network (CTN) to address gaps in the national, regional and community innovation system. IRAP also worked with local stakeholders across Canada to collectively improve the understanding of the cluster concept, reinforce the innovation agenda, encourage more SMEs and local institutions to participate in clusters, and facilitate coordination among players.

CTN is a key facilitator of exchanges and collaborations among the different players of the Canadian innovation system with a membership base of 850 organizations and 349 advisors across Canada. NRC-IRAP renewed the network by shifting funding support towards special regional and national initiatives from an earlier focus on funding business advisors. Information and success stories on many national and regional initiatives can be found at http://ctn.nrc.ca/ctn/hss_e.html.

NRC-IRAP made substantial progress in advancing strategic priorities in 2001-2002. Performance highlights include:

- Integrating innovation system players through the Canadian Technology Network (CTN);
- Modernizing program delivery;
- Improving mechanisms for S&T knowledge transfer and innovation capacity;
- Encouraging sustainable development practices; and
- Adapting and adopting new models for partnership in innovation.

As a result of the trusted relationships established with its clients, NRC-IRAP enables SMEs to strengthen their innovation capacity where they need it most. Clients credit NRC-IRAP with:

- Acquiring new technical knowledge and increasing technical competence
- Investing in new technology areas with broad applications
- Helping young entrepreneurs succeed
- Enhancing linkages with experts
- Improving processes
- Increasing innovation
- Increasing sales and jobs
- Supporting access to international collaborations and markets.

For more information on NRC-IRAP, refer to http://www.nrc.ca/irap/home.html

NRC WORKING WITH PROVINCIAL AND TERRITORIAL GOVERNMENTS ON BUILDING AND FIRE CODES.

As part of a multi-year project to introduce fundamental changes to Canadian building regulations, NRC led a national cooperative effort with 18 provincial/territorial regulatory bodies. The highly effective consultations covered the objectives, format and cycle of the National/Provincial Building, Fire and Plumbing Codes. This initiative represents a milestone for the regulatory community in Canada where regulatory bodies jointly consulted stakeholders on a major code/regulatory issue. Consultations will play a major role in advancing greater uniformity in building regulations and will promote the acceptance of Objective-based codes in Canada.

Dissemination of knowledge

NRC-CISTI maintains, publishes and provides access to scientific, technical and medical (STM) information critical to Canada's innovation system. Overall in 2001-2002, CISTI maintained its collection of STM information to levels similar to those of the previous year with 49,342 scientific journals, 676,182 monograph titles, and a large collection of technical reports. More than 90% of the almost 1 million documents ordered from the CISTI collection were processed for delivery to clients in 24 hours or less and 94% within 48 hours. The average daily volume of document orders processed was 4,065; the maximum processed in one day was 6,310. NRC-CISTI provided over 308,000 documents to the academic sector; this represents 50% of all documents ordered by Canadians and 31% of NRC-CISTI's total document delivery activity, nationally and internationally.

As Canada's largest publisher of scientific and technical journals, the NRC Research Press holds a favourable international position and maintains a leadership position in the area of electronic publishing. In 2001-2002, NRC added another journal to the Press – the *Journal of Environmental Engineering and Science (JEES).* This new journal addresses all aspects of environmental

engineering and applied environmental sciences and brings the total to 15 journals available in both printed and electronic formats. The on-line versions of NRC Research Press journals are available free to Canadian readers.

The NRC Research Press continued to expand its publishing services program. New publishing agreements were signed over the past year with:

- the Canadian Aeronautics and Space Institute (*Canadian Journal of Remote Sensing, Canadian Aeronautics and Space Journal,),* and
- the Canadian Institute of Forestry (*Forestry Chronicle*).

The number of agreements now stands at eight and includes:

- the Canadian Phytopathological Society (*Canadian Journal of Plant Pathology*),
- Entomological Society of Canada (*Canadian Entomologist*),
- Canadian Institute of Mining, Metallurgy and Petroleum (*Canadian Metallurgical Quarterly*),
- Agricultural Institute of Canada (three electronic journals),
- the International Society for Plant Molecular Biology (*Plant Molecular Biology*), and
- the Mineralogical Association of Canada (*Canadian Mineralogist*).

Merck Frosst: timing is everything

"Timely and efficient" are words often used to describe CISTI's Document Delivery Services. Merck Frosst Canada Ltd., the research-based pharmaceutical company, can certainly attest to this.

On a Thursday and Friday in February 2002, scientists at the Merck Frosst Centre for Therapeutic Research made an urgent request for some 300 articles. Although the company's in-house library was able to supply most of the articles from its own collection, some had to be obtained elsewhere. And this is where CISTI came in. Not only was CISTI able to provide the 75 articles needed, it did so in a very timely manner. In fact, the articles were delivered within 24 hours of the order, despite the fact that it was just before the weekend, a time when most document suppliers do not provide services.

"…. It is critical for world-class R&D organizations, such as the Merck Frosst Centre for Therapeutic Research, to be able to count on CISTI in order to be at the forefront of scientific knowledge and ensure the leadership of Canadian innovation."

Dr. Daniel Bouthiller
Director of Research Administration,
Merck Frosst

The previous fiscal year was highlighted by two key achievements: the establishment of e-Infostructure and the provision of free access for Canadians to the NRC Research Press electronic journals. CISTI has continued to build on these successes as the foundation for a future national STM digital information network. The concept of such a network for CISTI is widely endorsed. Significant progress has been made in developing and enhancing the e-Infostructure.

NRC also provides an educational service and disseminates knowledge about astronomy to Canadians through HIA's visitor centre, the *Centre of the Universe* (CU). The CU is the new interpretive centre at the Dominion Astrophysical Observatory in Victoria that opened in June 2001 and has had nearly 19,000 visitors from 10 provinces and all over the world (http://www.hia.nrc.ca/cu/Who.htm).

"As a long time volunteer with the Saturday night open-house program, I have witnessed how effectively the Centre of the Universe is raising public awareness of Canadian astronomy. We RASC volunteers cherish our relationship with the Centre: it is based on the mutual interest we share in public outreach, which truly represents the spirit of amateur astronomy. "

David Lee
President
RASC Victoria Centre

Global Reach

Outcome: By 2006, NRC will be recognized by its stakeholders for its contributions to a more effective Canadian innovation system that assures access to international facilities and research networks, provides opportunities for Canadian firms, and builds new research and technology alliances.

Key Performance Indicators:

- Integrator and facilitator of international research
- Harmonizing international standards
- New international S&T alliances
- Access to international research facilities
- Stimulating new foreign investments in Canada

NRC has a long-standing reputation as a Canadian scientific authority in such areas as national measurement standards, astrophysics, and building codes. NRC's reputation has allowed it to develop a valuable international network of technical and scientific intelligence. This knowledge and expertise is used to transfer S&T information to Canadian firms and universities and also to leverage new innovation opportunities for Canadian industry internationally. NRC also takes the lead on international technology missions and facilitates vital connections to centres of advanced technology around the world.

Integrator and facilitator of international research

NRC's growing role as an integrator and facilitator of international research is evidenced in its participation on international committees and representation at international conferences. In 2001-2002, NRC employees participated on 589 international committees and attended 646 international conferences. NRC also organized 105 international conferences and workshops.

Throughout 2001-2002, NRC continued to build networks, collaborations and strategic alliances around the world for Canada through hundreds of bilateral organization-to-organization and multi-level agreements, technology and research alliances, as well as over 50 formal collaboration agreements with 22 nations. In 2001-2002, NRC received over 70 in-coming foreign delegations and led over 40 out-going missions to other countries. Individual institutes also conducted numerous technology missions or visits on specific areas of specialization, to countries around the globe. For example, a mission to Taiwan explored potential opportunities for collaboration in nanotechnology and another in aerospace. Both identified promising collaborative research areas where NRC and Taiwanese institutions have complementary expertise.

SUPPORTING CANADIAN SMES

In 2001-2002, NRC-IRAP undertook a number of technology missions to Taiwan, Thailand, China, Korea, Hong Kong and Germany, including participation in the Team Canada mission to Germany. Although all the numbers for all missions were not available (since some missions took place late in last quarter of 2001-2002), by the end of the fiscal year, the 53 SMEs involved in the missions had signed 8 MOUs, 7 contracts, and 41 partnership agreements. NRC-IRAP also undertook a series of exploratory missions to Asia, Hungary, Mexico and the United States, as well as participating in

several missions organized by the Department of Foreign Affairs and International Trade, as well as individual missions.

In addition to technology missions, NRC signed or extended a number of key international arrangements:

- A new agreement was signed with the China-United Nations Industrial Development Organization (UNIDO) to assist technology transfer and technological linkages between Canadian and Chinese SMEs
- NRC-IRAP's support to Intelligent Manufacturing Systems Canada in its work with seven international regions on collaborative R&D also was extended, with several collaborative projects under development involving SMEs and NRC institutes
- The agreement with the Canada-Israel Industrial R&D Foundation was extended to facilitate linkages between Canadian and Israeli SMEs and institutions
- The agreement for exchanges of an NRC Industrial Technology Advisor with the Agence national de valorisation de la recherche (ANVAR) of France was extended to investigate best practices and stimulate linkages with SMEs from both nations.
- An agreement was signed with Thailand's National Science and Technology Development Agency to develop its Industrial Technology Assistance Program, modeled after NRC-IRAP.

NRC-IRAP also led a mission with 14 Canadian SMEs to the APEC Technomart in Suzhou China to form technology-based joint ventures and seek out new research collaborations. NRC made seven presentations during the Technomart and organized a major exhibit at the technology fair for the event. Firms signed a number of new agreements.

Harmonizing international standards

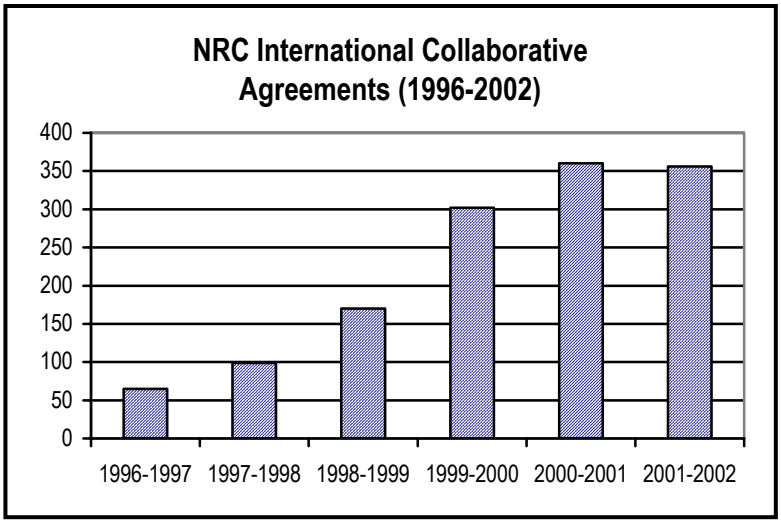
NRC-INMS acts as Canada's national metrology institute, providing most of the mandated measurement standards related activities at NRC. Metrology requirements for international trade have greatly increased over the last decade with international trade agreements now demanding demonstrated equivalence between buyer and seller nations.

Metrology is a crucial element in the regulation of trade and the resolution of trade disputes. There are several metrology related cooperative ventures under regional trade agreements including the North American Cooperation in Metrology (NORAMET) under NAFTA and the Inter-American Metrology System supporting the development of the FTAA. NRC-INMS is a member of and plays a leading role in these cooperations and in about 150 related international committees under the auspices of the regional cooperations and global bodies such as Comité international des poids et mesures (CIPM). NRC-INMS estimated that it spent $1.6 million on international activities in support of trade agreements. The growing number of multilateral measurement agreements means that even more expenditures will be needed to support measurement standards activities in the foreseeable future. NRC-INMS was involved in 43 measurement comparisons with other national metrology institutes to document and establish equivalences. Other international comparisons included 73 under the Time Dissemination program and 11 with various other international organizations.

Codes, standards and evaluation guides are critical tools for consolidating knowledge, reducing transaction costs and facilitating the introduction of new products and processes in the Canadian construction industry and for facilitating trade. During the reporting period NRC-IRC was involved in five projects promoting international standards harmonization, including supporting the transition to a market based economy in Russia where Canada's National Building Code was used as a model for Russian housing codes.

New international S&T alliances

NRC collaborates with international partners to create new technologies and improve existing products and services. Collaborations range from projects with single international companies to multi-partner arrangements with small, medium and large Canadian and international firms and university partners. In 2001-2002, NRC was engaged in 355 formal international collaborative agreements. These international collaborative agreements involved a total of 546 partners from private (121), public (307) and university sectors (118). In 2001-2002, the total value of international collaborative research agreements was $146 million.



NRC's contribution to the Canadian European Research Initiative on Nanostructures (CERION) agreement covers research in nano-electronics with ten international organizations including eight Canadian universities, with links to European researchers through exchange visits, joint projects and annual workshops. CERION has funded research projects that have led to papers and articles in *Nature*, *Science* and in *Physical Review Letters*. This research contributes to generating international recognition for the NRC in quantum physics research.

Access to international research facilities

NRC provides Canadian scientists with access to international research facilities through international agreements. For example, in return for projected contributions to the Atacama Large Milimeter Array (ALMA) under the terms of the NAPRA agreement, Canadian astronomers will have access, on an equal footing to that of U.S. astronomers, to all current and future major U.S. national facilities in radio astronomy. These major international agreements extend Canada's investment in astronomy facilities by giving all Canadian astronomers access to forefront observational facilities.

In 2001-2002, NRC's international agreements and relationships world-wide provided access to several organizations including the following:

- Commonwealth Scientific and Industrial Research Organization (Australia);

- Defence Science and Technology Organisation's Aeronautical and Maritime Research Laboratory (Australia);
- Science Technology and Higher Education Secretariat (Parana State, Brazil);
- *Programa Antártico Brasileiro* – Antarctica research station (Brazil);
- Micro-Nano Technology Research Centre, Tsinghua University (People's Republic of China);
- Institute of Scientific Instruments (Czech Republic);
- Laboratoire des Champs magnétiques intenses (GHMFL/LCMI), (France);
- NATO's Research and Technology Organization;
- Institute of Nuclear Physics (Poland);
- National Nano Device Labs (Taiwan);
- Lighting Research Centre Joint LightRight facility (United States);
- Virginia Tech Transportation Institute (United States);
- U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (United States);
- U.S. Department of Energy Brookhaven National Laboratories (United States); and
- U.S. Department of Energy Spallation Neutron Source (United States).

NRC-CISTI's international presence provides access for Canadians to the information resources of other major S&T libraries around the world. NRC-CISTI has established mutually beneficial partnerships with the following organizations:

- British Library Document Supply Centre (United Kingdom);
- Institut de l'Information Scientifique et Technique (France);
- Korea Institute for Science and Technology Information (Korea);
- Institute of Scientific and Technical Information of China (People's Republic of China);
- Sunmedia (Japan); and
- Science and Technology Information Centre (Taiwan).

Stimulating new foreign investment in Canada

NRC works to stimulate new foreign investment in Canada primarily through its spin-off companies. Spin-offs since 1995-96 have been thriving. Of the 52 created as of March 2002, 49 companies have survived. NRC was successful in attracting DSM Biologics, a large European biopharmaceutical firm, as a tenant to the Montréal NRC-BRI IPF. NRC-BRI will help DSM Biologics develop a proprietary cell line as a means of attracting industrial investment to Montréal. Despite the downturn in both employment and investment in Canada's high-tech sector over the past two years, NRC witnessed a number of venture capital deals with NRC spin-offs during 2001-2002.

- *NovaDAQ Technologies* a 2001 spin-off raised $15 million from Canadian sources and over $750,000 (CAD.) from the US for its digital laser imaging system. With the additional funding the company expects to increase staff by 50%.

- *Trillium Photonics* a November 2000 spin-off is an intelligent optical amplifiers firm that continues to attract backing by internationally respected tier-one venture capitals. To date, Trillium Photonics has successfully completed two rounds of venture capital funding from the U.S. exceeding $56 million (CAD)

- *IatroQuest* a 1998 spin-off commercializes technology for the virtually instantaneous detection of chemical and biological toxins. IntraQuest received almost $5 million in venture capital funding in 2001 and it is developing unique, miniaturized sensing and diagnostic systems for defence and peacekeeping, medical diagnostics and environmental monitoring applications.

- *SiGe Semiconductor* a 1997 spin-off develops specialized chips for high-speed semiconductors. It raised almost $40 million in venture capital in 2000, with almost $8 million in follow-on financing in 2001.

Outstanding People – Outstanding Employer

Outcome: By 2006, NRC will be regarded by staff and their peers as a major innovator in human resources management, as a place where outstanding people are encouraged and are able to make outstanding contributions to Canada, and as an outstanding employer offering a great place to work.

Key Performance Indicators:

- Highly qualified personnel
- External and internal awards
- Research facilities and equipment
- Activities promoting an outstanding work environment

Recruitment and retention of highly qualified personnel

Being a leading research and development organization requires highly qualified workers. Outstanding people are NRC's most valuable asset and it is essential that NRC continue to attract and retain the best of the best. NRC faces strong competition in finding and keeping premier research talent. Progress has been made over the last three fiscal years in recruiting and filling vacant positions for highly qualified personnel. In 1999-2000, more than half of NRC's knowledge workers were over 45 years old. As of March 2001, 10% were eligible to retire and this number will likely double by March 2006.

In 2000-2001, NRC launched its new **Employment Philosophy**, a comprehensive strategy aimed at developing the human and intellectual capital that is crucial to drive innovation and discovery. In 2001-2002, NRC implemented several initiatives in support of this strategy:

The *Employment Philosophy* rests on four principles:

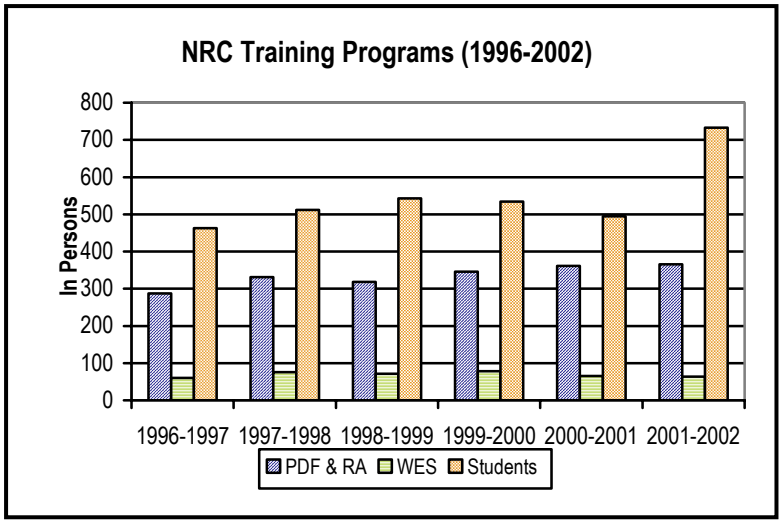
- Recruit and retain outstanding people;
- Give them the opportunity to grow professionally, to utilize their strengths and to deliver to the maximum of their capabilities;
- Reward them based on their level of professional development and their level of productivity; and
- Create a respectful partnership with them based on trust and understanding.

- An **Employment Philosophy (EP) survey** was administered in Fall 2001 to all of NRC's Technology and Industry Support (TIS) program staff and was piloted with four institutes from the Research and Technology Development (RTD) program. This baseline survey is designed to measure NRC's progress towards goals outlined in the NRC Employment Philosophy. The response rate from staff to the survey was 81% from TIS and 82% from RTD. Each Institute and Program that participated in the survey developed an action plan to address issues raised by employees. The Employment Philosophy survey will be administered to the remaining centres in September 2002.
- The **Leadership Management Development Program** continued to be implemented as a pilot in eight Research Institutes. 37 participants completed personalized learning plans. This activity was complemented by providing coaching to NRC staff identified as potential candidates for the Leadership Management Development Program.

- NRC has implemented a **new Recruitment Strategy** to attract recent graduates. The University Liaison Program, established last year to advertise key positions, continued its outreach activities and extended the network to over 225 contacts in all relevant departments in major universities and colleges across Canada.
- NRC implemented the **New Horizons – New Opportunities** initiative to facilitate the recruitment of outstanding researchers in 2002.
- The **Persons with Disabilities Recruitment Program** was launched to address the under-representation of that group within the NRC workforce.
- The **Human Resources Management Steering Committee** (HRMSC) was established in 2001 to provide for open and frank dialogue with our senior executive regarding the HRM challenges NRC faces as an organization and the strategies for dealing with them. This includes the development of HR strategies that range from compensation to attract and retain key individuals to performance management based on open, clear and ongoing communication, alignment of individual and corporate goals, and the support of top management.

  The HRMSC has been active the last year and is just beginning to influence the development of HRM strategy. The HRMSC created six sub-committees in 2001 to address important challenges in achieving the goals of the Employment Philosophy. The six sub-committees are Governance; Work Force Flow-through; Work Systems/ Work structures; Performance Management; Rewards and Human Resources Measurement. Each sub-committee has representatives from NRC institutes, programs and branches who work as volunteers with the chairpersons in developing and implementing action plans.

  The work of the sub-committees is expected to foster the development and implementation of innovative HR management practices at NRC. The deliverables developed in consultation with the HRMSC include – Workforce Composition Policy, NRC Recruitment Strategy, Recommendations to the President regarding Performance Bonus Program Guidelines, Recruitment Program for Disabled Persons, Career Development Program for the Administrative Group of employees at NRC, HRM Priorities and Action Plans for the HRMSC Sub-committees.



The development of highly qualified personnel is a priority for Canada's Innovation Strategy. NRC directly contributes to the development of highly qualified personnel through the training of students and recent graduates. Over 1,300 students and post-doctoral fellows (PDF) or research associates (RA) work on research teams in NRC laboratories each year, thereby gaining valuable experience and training that is complementary to university and college courses. In 2001-2002, NRC recruited 66 Women in

Engineering and Science (WES) students, 153 Research Associates, 325 graduate students, 456 summer and co-op students, and 222 NSERC Visiting Fellows (or post-doctoral fellows).

Other programs and contributions made by NRC in 2001-2002 include:

- Through NRC-IRAP's Youth Employment Initiative, 550 graduates were placed in 460 SMEs representing a total value of $3.95 million for firms.
- 152 formal collaborations with universities were conducted, involving the participation of Canadian university researchers and students and post-doctoral fellows (PDF) in NRC laboratories.

Rewarding professional development and productivity

NRC recognizes outstanding work of a number of its employees through internal awards programs, including the NRC Outstanding Achievement Awards. In 2001-2002, over 95 employees received a NRC Outstanding Achievement Award (either as part of a team or as an individual) and 213 employees received institute-level awards. In 1998-1999, NRC instituted the *Researcher Emeritus* program to mark the past achievements of retired employees at NRC and to recognize the benefit gained from their great knowledge and experience. In 2001-2002, NRC appointed five employees to the title of Researcher Emeritus, bringing up the total to 12: Lars Öhman; Donald A. Ramsay; Paul Redhead, Edgar Shaw and Alex Szabo.

The formal recognition by peers in Canada and around the world is a primary indicator of having the best research and innovation talent for Canada. In 2001-2002, 73 employees received external awards. Ramu Ramachandran, a Researcher Emeritus at NRC-IRC, was appointed Fellow of the Royal Society of Canada. With this nomination, NRC now has 43 fellows in the Royal Society of Canada. (*See Appendix C for a list of notable awards and achievements.*)

Some of the prestigious recognitions include:

- The International Council on Aeronautical Sciences recognized the NRC's CF-18 International Fellow-on Structural Test Team with the von Karman Award for International Collaboration.
- The Royal Society of Edinburgh appointed Dr. Keith Ingold as Honorary Fellow; and
- The Canadian Association of Research Libraries awarded Bernard Dumouchel the 2001 award for Distinguished Service to Research Librarianship.

NRC at Ground Zero

Dr. Venkatesh Kodur was the only non-American invited to join the Building Performance Study Team, a coalition of leading engineers led by the American Society of Civil Engineers and the U.S. Federal Emergency Management Agency, set up to investigate the cause of the collapse of the World Trade Center on September 11th.

NRC's Dr. Simon Mercer's expertise as one of the world's foremost contributors in genetic database management and DNA sequencing was critical in helping to identify the victims from the World Trade Center.

Leading-edge research facilities and equipment

The development and maintenance of leading-edge research facilities, equipment and practices is fundamental to attracting the best research talent and in achieving excellence and creativity in

research and innovation as well as providing a competitive edge to companies. NRC has made enormous efforts to keep its facilities and equipment up-to-date and to maintain the government's infrastructure investment. A total of $67 million was invested in major new equipment and facilities in 2001-2002. All research institutes made investments in new equipment and facilities. The majority of NRC's laboratories and facilities are available to Canadian industry and academia through research collaborations and through fee-for-service arrangements. NRC provided fee-based services to over 1,400 clients. Major capital investments included:

- **NRC-IAR *Aeronautical Research Infrastructure*:** NRC invested $12 million towards the construction of the Aerospace Manufacturing and Technology Centre in Montréal ($5.4 million), re-engineering the Twin Otter aircraft, refurbishing of the gas turbine engine test cells in Ottawa, developing a new burner test rig, and starting work on the Gas Turbine Environmental Research Centre in Ottawa ($4.1 million).
- **NRC-PBI *Industrial Partnership Facility*:** As part of the agricultural biotechnology cluster initiative in Saskatoon, NRC invested $5.2 million to complete the IPF addition to NRC-PBI that will be operational Fall 2002.
- **NRC-IIT *E-Business Institute*:** $5.2 million was invested in the construction of the NRC-IIT E-Business institute in Fredericton, New Brunswick to support this technology cluster and it will be operational Fall 2002.
- **NRC-IMI *Aluminium Technology Centre*:** Due to open Fall 2003, NRC invested $3.6 million towards the construction of the 6,000 square metre Aluminium Technology Centre on the campus of the Université du Québec à Chicoutimi to support aluminium technology cluster development in the Saguenay.
- **NRC-*National Institute for Nanotechnology*:** NRC invested $3.3 million fitting out 2100 square metres of temporary laboratory space that will open in Edmonton in 2002. NRC-NINT will build its research team here while a permanent laboratory is constructed. Move in to this purpose-built laboratory will be summer, 2005.
- **NRC-*Centre for Surface Transportation Technology*:** NRC invested $2 million to construct a 1,580 square metre new addition to its CSTT facilities. As a result of an improved partnership with the Department of National Defence, a portion of this space is shared with the Maintenance Techniques Detachment. NRC-CSTT also expanded through the acquisition of the Environmental Simulation Laboratory, formerly part of InNOVAcorp in Dartmouth, Nova Scotia. A major multi-year contract signed with Railtrack PLC in the UK to provide advice in track grinding, lubrication and profiles firmly establishes NRC-CSTT as the world centre of expertise in vehicle track systems.

An outstanding place to work

NRC is committed to providing a work environment that enhances the creativity of employees. Beyond developing and maintaining leading-edge research facilities, equipment and practices, NRC institutes, programs, and branches are engaged in a number of activities promoting an outstanding work environment, such as:

- **Employee Recognition**: Institutes, programs and branches have instituted *DG Awards* where outstanding employees are recognized for their invaluable contributions to the institute, program or branch;

- **Competencies:** A competency profiling initiative was undertaken to develop a competency-based HR management system. The focus included: leadership development, learning and career development, recruitment and staffing, and performance management. NRC defines behavioural competencies as " those behaviours that are the key ingredient for success consistently displayed by exemplary performers"
- **Classification Systems Review:** Within the context of NRC's Employment Philosophy, the NRC Work Systems/Work Structures were reviewed and the recommendations for change could result in a new or revised classification system affecting a large portion of NRC employees.
- **Organizational Development Initiatives:** NRC's IRAP, IIT, IC and ICPET conducted a whole system change initiative in support of their strategic planning and visioning exercise.

Managing to Realize our Vision 2006

Sustainable Development

As a Schedule II (Financial Administration Act) departmental corporation, NRC is not subject to the 1995 amendments to the Auditor General Act requiring the preparation of a Sustainable Development Strategy (SDS). However, NRC implements an Environmental Management Policy to ensure that its operations contribute to sustainable development. NRC fosters the integration of sustainable development strategies and practices across Canada and in the innovation processes of Canadian SMEs. NRC's sustainable development efforts for 2001-2002 are characterized by intensive collaboration with a number of key organizations and projects:

- Representation on the Interdepartmental Panel on Energy Research and Development (PERD).
- Participation on the Climate Change Action Fund's TEAM (Technologies for Early Action Measures).
- Participation on the Climate Change Action Fund's executive committee on Science, Impacts and Adaptation.
- The Environmental Management Office at NRC-ICPET.
- Participation on the Industry Portfolio working group and ADM Committee on climate change.
- Participation on the National Roundtable on Economy and Environment's project to develop indicators for sustainable development.
- Participation on the Ontario Eco-Efficiency Innovation Initiative to help SMEs identify eco-efficiency opportunities in their operations.
- Collaboration with Canada Economic Development for Quebec Regions in implementing regional EnviroClubs to assist firms to improve their environmental performance, profitability and competitiveness.
- Participation on the British Columbia EcoDesign Innovation Pilot Project to reduce industrial energy usage, water use and disposal of waste.

NRC-IRC's emerging leadership in the area of sustainable development in the environment is no accident, and research in a number of key areas is leading the way. In concrete research, the work focuses heavily on the use of supplementary cementing materials (diverted from industrial waste streams) as a vehicle for achieving climate change objectives. Through its GreenRoof project, NRC-IRC's Building Envelope and Structure Program has bridged the gap between financial efficacy and public (environmental) policy. NRC-IRC's work in asset management offers systematic methodologies to control resources through the life-cycle of the built environment.

Sustainable Development in Operations

In 2001-2002, NRC continued to modify existing buildings to reduce energy consumption and save money. To reduce greenhouse gas emissions and contribute to "green" federal operations, NRC installed a new high-efficiency boiler in a major heating plant and retrofitted several buildings with efficient light fixtures that use 30% less energy. NRC developed communications materials to increase awareness of energy conservation including a poster, 'energy tip' cards, and the 'Energy at NRC' Web site (http://www.nrc.ca/energy_tips/main.html).

Government-On-Line (GoL)

NRC provided special funding to establish a coordination office to implement the Common Look and Feel (CLF) in collaboration with institutes, branches and programs. NRC-CISTI is managing this office and has a leadership role in the implementation of the new federal CLF Standards and Guidelines for the Internet, Intranets, Extranets and other electronic networks at NRC. NRC plans to meet the December 31, 2002 goal for implementation.

NRC actively supported developments within the GoL effort, more particularly the Science and Technology Cluster and the portal on Services to Canadian Business. NRC-CISTI, a member of the Strategic Alliance of Federal Science and Technology Libraries, is proposing the establishment of *Federal Science eLibrary* to support the provision of seamless desktop access to the world's published research information by all federal government employees working in science, engineering, medical and technology disciplines. The common digital library would help increase Canada's competitiveness and R&D capacity and would encourage collaborative and integrated activities across government departments and agencies.

Modern Management Practices (Modern Comptrollership)

A solid management infrastructure is critical to supporting NRC's continued achievement of excellence in S&T and its Vision to 2006. NRC is committed to having this infrastructure of management tools and practices in place by integrating Modern Comptrollership into its management activities.
A Steering Committee comprising Director Generals from corporate as well as scientific groups, and chaired by the President, guides the project. A Project Management Office (PMO) has been fully operational since January 2002 with two dedicated FTEs. The PMO has been planning, preparing and delivering related communications to managers, as well as managing the NRC-wide baseline self-assessment of management capabilities, referred to as the "Capacity Assessment". Significant activity is already underway in several areas, including NRC's Employment Philosophy, Competency-Based Human Resources, Data Warehousing, Performance Management, and Government-On-Line.

Financial Performance Overview

NRC receives its appropriation budget through Main and Supplementary Estimates voted by Parliament. In 2001-2002, NRC also received $14.0M from Treasury Board's Contingency Vote 15 for the costs of collective bargaining. In 2001-2002, NRC's Main Estimates budget was approved at $577.1 million. Through Supplementary Estimates, NRC received an additional $29.4 million for items such as additional funding for the Industrial Research Assistance Program (IRAP), the establishment of the new National Institute for Nanotechnology, the implementation of the Aluminium Technology Centre initiative, an increase in the contribution in support of the Gemini Telescopes and Operating Budget carry-forwards. Pursuant to the NRC Act, the organization is able to spend revenues generated through the provision of goods and services. In 2001-2002, the NRC earned $71.4 million in revenue and used all of it to offset expenditures.

In 2001-2002, NRC's actual expenditures were 9.1%, or $53.4 million higher than planned. This increase was largely financed from funding received through Supplementary Estimates, Treasury Board's Contingency Vote 15 and generated revenues.

Consolidated Reporting – Transfer Payments

Tri-University Meson Facility (TRIUMF)

TRIUMF, located on the campus of the University of British Columbia, is Canada's national laboratory for research in particle and nuclear physics. It is managed as a joint venture by a consortium of universities and operated under a contribution from the Government of Canada administered by NRC. An Advisory Committee on TRIUMF (ACOT) monitors TRIUMF's overall scientific program and ensures that all program initiatives are of an appropriate scientific quality, while an Agency Committee on TRIUMF (ACT) oversees the federal investment, with a particular focus on financial and commercialization matters.

In 2001-2002, TRIUMF commenced the second year of a five-year, $200 million funding commitment by the federal government, which allows TRIUMF to proceed with its two major initiatives: to further develop its Isotope Separator and Accelerator (ISAC) into a unique world-class facility, and to participate in the construction of the world's highest energy accelerator, the Large Hadron Collider (LHC), at the European Organization for Nuclear Research (CERN) in Geneva, thereby assuring Canadian access to this leading-edge facility. The number of universities in the TRIUMF Joint Venture has increased, with Carleton University joining the universities of Alberta, British Columbia, Simon Fraser and Victoria as a full member. (http://welcome.cern.ch/welcome/gateway.html)

A results-based management and accountability framework incorporating performance indicators and expected results and outcomes has been prepared for TRIUMF for the current 2000-2005 funding period.

FY 2001-2002 has been one of the most successful years at TRIUMF in terms of scientific accomplishments. The major investments of the last five years at ISAC have paid off.

Among the outcomes were:

- Successful experiments in nuclear astrophysics, structure of matter, and life sciences
- Continued delivery of magnets manufactured by ALTHOM to CERN as Canada's contribution to the LHC
- Infrastructure support for the ATLAS detector at CERN on behalf of university researchers in Canada
- Overall scientific and technical status of the laboratory reinforced by ACOT reports
- Contract and royalty income increased with three new patents granted, eleven patent applications under way, the creation of one start-up company and one spin-off company, and three licenses granted.

For additional information on TRIUMF, refer to http://www.triumf.ca.

Summary of Financial Tables

Table 1 – Summary of Voted Appropriations

Table 2 – Comparison of Planned Spending to Actual Spending

Table 3 – Historical Comparison of Planned Spending to Actual Spending

Table 4 – Respendable Revenues

Table 5 – Statutory Payments

Table 6 – Transfer Payments

Table 7 – Resource Requirements by Organization and Business Line

Table 8 – Capital Spending

Table 9 – Capital Projects

Table 10 – Contingent Liabilities

Table 1 – Summary of Voted Appropriations

FINANCIAL REQUIREMENTS BY AUTHORITY (MILLION OF DOLLARS)				
		2001-2002		
Vote		Planned Spending	Total Authorities	Actual
	National Research Council Program			
75	Operating expenditures	287.2	314.0	**310.9**
80	Capital expenditures	76.2	67.0	**67.0**
85	Grants and contributions	133.6	150.0	**149.8**
(S)	Spending of revenues pursuant to the *National Research Council Act*	56.6	100.0	**77.9**
(S)	Contributions to employee benefit plans	33.4	34.8	**34.8**
	Total Department	**587.0**	**665.8**	**640.4**

Notes:
Figures above exclude the spending of proceeds from the disposal of surplus crown assets.
Total Authorities are Main and 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

DEPARTMENTAL PLANNED VERSUS ACTUAL SPENDING BY BUSINESS LINE (MILLION OF DOLLARS)

Business Lines	FTEs	Operating [1]	Capital	Grants and Contributions	Subtotal Gross Expenditures	Statutory Items [2]	Total Gross Expenditures	Less Respendable Revenues [3]	Total Net Expenditures
Research and Technology Innovation									
Planned spending	2,180	224.9	69.0	47.7	341.5	25.8	367.3	-	367.3
Total authorities	*2,180*	*241.3*	*59.0*	*52.6*	*353.0*	*52.4*	*405.4*	-	*405.4*
Actuals	**2,376**	**218.8**	**63.2**	**52.6**	**334.6**	**43.5**	**378.0**	**-**	**378.0**
Support for Innovation and the National Science and Technology Infrastructure									
Planned spending	393	41.3	-	85.0	126.3	28.9	155.2	-	155.2
Total authorities	*393*	*47.2*	-	*96.4*	*143.6*	*38.9*	*182.5*	-	*182.5*
Actuals	**650**	**45.9**	**0.6**	**96.4**	**142.9**	**29.4**	**172.3**	**-**	**172.3**
Program Management									
Planned spending	554	54.4	7.2	1.0	62.6	1.9	64.5	-	64.5
Total authorities	*554*	*60.2*	*8.0*	*1.0*	*69.2*	*8.7*	*77.9*	-	*77.9*
Actuals	**586**	**81.0**	**3.2**	**0.8**	**85.0**	**5.0**	**90.0**	**-**	**90.0**
Total									
Planned spending	3,127	320.6	76.2	133.6	530.4	56.6	587.0	-	587.0
Total authorities	*3,127*	*348.8*	*67.0*	*150.0*	*565.7*	*100.0*	*665.8*	-	*665.8*
Actuals	**3,612**	**345.7**	**67.0**	**149.8**	**562.5**	**77.9**	**640.4**	**-**	**640.4**
Other Revenues and Expenditures									
Non-respendable Revenues [4]									
Planned Revenues									-
Total authorities									-
Actuals									**-**
Cost of Services provided by other departments									
Planned spending									13.7
Total authorities									*13.7*
Actuals									**14.9**
Net Cost of the Program									
Planned spending									600.7
Total authorities									*679.5*
Actuals									**651.7**

Notes

(1) Operating includes contributions to employee benefit plans.
(2) Spending of revenues pursuant to the *National Research Council Act*.
(3) Formerly "Revenues Credited to the Vote"
(4) Formerly "Revenues Credited to the General Government Revenues (GGR)".

Planned spending indicates numbers reported in the 2001-2002 Report on Plans and Priorities.
Numbers in italic denote Total Authorities for 2001-2002 (Main and Supplementary Estimates and other authorities).
Bolded numbers denote actual expenditures and revenues in 2001-2002.
Numbers exclude the spending of proceeds from the disposal of surplus crown assets.
Due to rounding, figures may not add to totals shown.

Table 3 – Historical Comparison of Total Planned Spending to Actual Spending

HISTORICAL COMPARISON OF DEPARTMENTAL PLANNED VERSUS ACTUAL SPENDING BY BUSINESS LINE (MILLION OF DOLLARS)

			2001-2002		
Business Lines	**Actual 1999-2000**	**Actual 2000-2001**	**Planned Spending**	**Total Authorities**	**Actual**
Research and Technology Innovation	298.9	339.5	367.3	405.4	**378.0**
Support for Innovation and the National Science and Technology Infrastructure	163.6	165.5	155.2	182.4	**172.3**
Program Management	80.9	86.1	64.5	78.0	**90.0**
Total	**543.5**	**591.1**	**587.0**	**665.8**	**640.4**

Notes

Total Authorities are Main and Supplementary Estimates plus other authorities.

Figures above exclude the spending of proceeds from the disposal of surplus crown assets.

Due to rounding, figures may not add to totals shown.

Table 4 – Respendable Revenues

RESPENDABLE REVENUES BY BUSINESS LINE (MILLION OF DOLLARS)					
			2001-2002		
Business Lines	Actual 1999-2000	Actual 2000-2001	Planned Revenue	Total Authorities	Actual
Research and Technology Innovation	27.0	35.0	25.8	25.8	35.0
Support for Innovation and the National Science and Technology Infrastructure	26.0	28.2	28.9	28.9	31.2
Program Management	5.2	4.4	1.9	1.9	5.2
Total Respendable Revenues	**58.2**	**67.6**	**56.6**	**56.6**	**71.4**

Notes

In accordance with section **5.1 (e)** of the *National Research Council Act*, NRC is authorized to spend its operating revenues and therefore does not net-vote.

Total Authorities are Main and Supplementary Estimates plus other authorities.

Due to rounding, figures may not add to totals shown.

Refer to **Table 5** for **statutory payments**.

Table 5 – Statutory Payments

SPENDING OF REVENUES PURSUANT TO THE NRC ACT (MILLION OF DOLLARS)					
			2001-02		
Business Lines	Actual 1999-2000	Actual 2000-2001	Planned Spending	Total Authorities	Actual
Research and Technology Innovation	26.4	24.6	25.8	52.4	43.5
Support for Innovation and the National Science and Technology Infrastructure	27.4	24.2	28.9	38.9	29.4
Program Management	3.5	6.2	1.9	8.7	5.0
Total Statutory Payments	**57.3**	**55.0**	**56.6**	**100.0**	**77.9**

Notes

Total Authorities are Main and Supplementary Estimates plus other authorities. The total of **$100M** for **2001-2002** includes an amount of **$28.6M** carried forward from previous years.

Due to rounding, figures may not add to totals shown.

Table 6 – Transfer Payments

TRANSFER PAYMENTS BY BUSINESS LINE (MILLION OF DOLLARS)					
			2001-2002		
Business Lines	Actual 1999-2000	Actual 2000-2001	Planned Spending	Total Authorities	Actual
GRANTS					
Program Management	1.0	0.9	1.0	1.0	0.8
Total Grants	**1.0**	**0.9**	**1.0**	**1.0**	**0.8**
CONTRIBUTIONS					
Research and Technology Innovation	42.8	51.6	47.7	52.6	52.6
Support for Innovation and the National Science and Technology Infrastructure	97.2	95.9	85.0	96.4	96.4
Total Contributions	**140.0**	**147.5**	**132.7**	**149.0**	**149.0**
Total Transfer Payments	**141.0**	**148.4**	**133.6**	**150.0**	**149.8**

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

Table 7 – Resource Requirement by Organization and Business Line

COMPARISON OF 2001-02 (RPP) PLANNED SPENDING AND TOTAL AUTHORITIES TO ACTUAL EXPENDITURES BY ORGANIZATION AND BUSINESS LINE (MILLION OF DOLLARS)

	Business Lines			
Organization	Research and Technology Innovation	Support for Innovation and the National Science and Technology Infrastructure	Program Management	Total
Research Institutes				
Planned spending	367.3			367.3
Total authorities	*405.4*			*405.4*
Actuals	**378.0**			**378.0**
Industrial Research Assistance Program				
Planned spending		109.2		109.2
Total authorities		*123.6*		*123.5*
Actuals		**119.7**		**119.7**
Scientific and Technical Information				
Planned spending		40.2		40.2
Total authorities		*49.1*		*49.1*
Actuals		**44.6**		**44.6**
Technology Centres				
Planned spending		5.8		5.8
Total authorities		*9.9*		*9.9*
Actuals		**8.0**		**8.0**
Corporate Branches				
Planned spending			54.0	54.0
Total authorities			*64.5*	*64.5*
Actuals			**74.4**	**74.4**
Executive Support				
Planned spending			10.5	10.5
Total authorities			*13.4*	*13.4*
Actuals			**15.6**	**15.6**
TOTAL				
Planned spending	367.3	155.2	64.5	587.0
Total authorities	*405.4*	*182.5*	*77.9*	*665.9*
Actuals	**378.0**	**172.3**	**90.0**	**640.4**
% of TOTAL				
Planned spending	62.6%	26.4%	11.0%	100.0%
Total authorities	*60.9%*	*27.4%*	*11.7%*	*100.0%*
Actuals	**59.0%**	**26.9%**	**14.1%**	**100.0%**

Notes

Figures above exclude the spending of proceeds from the disposal of surplus crown assets.
Total Authorities are Main and Supplementary Estimates plus other authorities.
Due to rounding, figures may not add to totals shown.

Table 8 – Capital Spending

CAPITAL SPENDING BY BUSINESS LINE (MILLION OF DOLLARS)					
			2001-2002		
Business Lines	Actual 1999-2000	Actual 2000-2001	Planned Spending	Total Authorities	Actual
Research and Technology Innovation	39.8	54.7	69.0	59.0	63.2
Support for Innovation and the National Science and Technology Infrastructure	0.8	1.6	-	-	0.6
Program Management	3.4	4.8	7.2	8.0	3.2
Total Capital Spending	**44.0**	**61.1**	**76.2**	**67.0**	**67.0**

Notes

Total Authorities are Main and Supplementary Estimates plus other authorities.

Due to rounding, figures may not add to totals shown.

The above figures exclude revenues used for capital purchases.

Table 9 – Capital Projects

CAPITAL PROJECTS BY BUSINESS LINE (MILLION OF DOLLARS)					
				2001-2002	
Business Lines	Current Estimated Total Cost	Actual 1999-2000	Actual 2000-2001	Planned Spending	Actual
Research and Technology Innovation					
Aluminium Technology Centre	34.4				**3.6**
Aerospace Manufacturing Technology Centre	34.1		1.3	10.3	**5.4**
Gas Turbine Environmental Research Centre	19.3		0.2	9.1	**4.1**
Upgrade and Expansion of the Herzberg Institute of Astrophysics Facilities	9.6	3.1	5.6	0.3	**0.2**
E-Business Centre	9.1				**5.2**
Addition to Plant Biotechnology Institute Building	9.0	0.5	1.3	5.2	**5.2**
Renovations and Additions to Institute for Marine Dynamics	6.4				**0.4**
Biotechnology Research Institute Building Extension	5.0				**0.7**
Acquisition and Site-Remediation of CP Land (Montreal)	5.0				**0.8**
Brain Repair Centre - 4T Imaging Facility	4.2				**1.4**
Direct-Write Electron Beam Lithography	3.5				**2.6**
Fit-Up of Short Term Accommodations at University of Alberta for the National Institute for Nanotechnology	3.3				**3.3**
New Building to Dominion Radio Astrophysical Observatory	3.0				**2.0**
Construction of Prototyping Laboratory	2.4				**1.2**
Nano-Template Deposition Facility for Quantum Information Devices	2.1				**0.8**
Molecular Beam Epitaxy System	1.9		1.0		**0.9**
Montreal Centre of Excellence for Site Rehabilitation	1.4	0.3	0.1		**0.2**
Electron Accelerator for Ionizing Radiation Standards	1.4				**1.4**
Nanomaterials Processing Facility	1.4				**0.5**
Innovation Centre-Fuel Cell Fit-Up	1.3				**1.3**
Multi-Chamber Deposition and Analysis System	1.2		0.8		**0.3**
Imaging in Infectious Diseases	1.0				**1.0**
Fabrication and Functionalisation of Magnetic Nanostructural Materials	1.0				**1.0**
Upgrade of Core Bacterial Culture Facility	1.0				**0.5**
Support for Innovation and the National Science and Technology Infrastructure					
Addition to Centre for Surface Transportation Technology	2.0				**2.0**
CISTI E-Commerce	1.3		0.5		**0.2**
Program Management					
Sussex Drive Courtyard Renovations	2.0		0.3		**0.7**
M-6 Boiler Replacement	1.4		0.5	0.9	**0.9**
M-23A Renovations	1.2		0.5		**0.7**
Asbestos Removal - Building M-58	1.1				**0.5**

Table 10 – Contingent Liabilities

CONTINGENT LIABILITY (MILLION OF DOLLARS)			
List of Contingent Liabilities	**Amount of Contingent Liability**		
	March 31, 2000	**March 31, 2001**	**Current as of March 31, 2002**
Claims, Pending and Threatened Litigation			
Litigations	0.0	0.0	0.0
Non-litigations	0.0	0.0	0.0
Total	**0.0**	**0.0**	**0.0**

Section 4 Departmental Overview

Overview of NRC

The National Research Council Canada (NRC) is the Government of Canada's leading resource for scientific, research, development and technology based innovation in every region of Canada. It is a national organization with approximately 3,600 employees and 1,200 guest workers, a budget of $577 million and revenues of $71 million for 2001-2002. In addition, it is an integral part of the Industry Portfolio and the Canadian and international S&T community.

NRC has an enviable track record when it comes to providing value for Canadians. NRC is a catalyst for innovation principally through:

- Advances in scientific knowledge
- National & international networks, linkages and partnerships
- Technology transfer activities
- R&D assistance to Canadian companies
- New and improved technologies
- Creation of new companies and jobs
- Community-based technology cluster and innovation initiatives
- Scientific, technical & medical information
- Incubator facilities for young companies
- Standards, codes and measurement activities

Mandate

The *National Research Council Act* and the *Weights and Measures Act* set out the legislative framework that guides NRC.

Under the *National Research Council Act*, NRC is responsible for:

- undertaking, assisting or promoting scientific and industrial research in different fields of importance to Canada;
- investigating standards and methods of measurement;
- working on the standardization and certification of scientific and technical apparatus and instruments and materials used or usable by Canadian industry;
- operating and administering any astronomical observatories established or maintained by the Government of Canada;
- administering NRC's research and development activities, including grants and contributions used to support a number of international activities;
- providing vital scientific and technological services to the research and industrial communities. This mandate is discharged to a great extent through the operation of NRC-IRAP, NRC-CISTI and the CTN; and
- establishing, operating and maintaining a national science library and publishing, selling and otherwise distributing scientific and technical information.

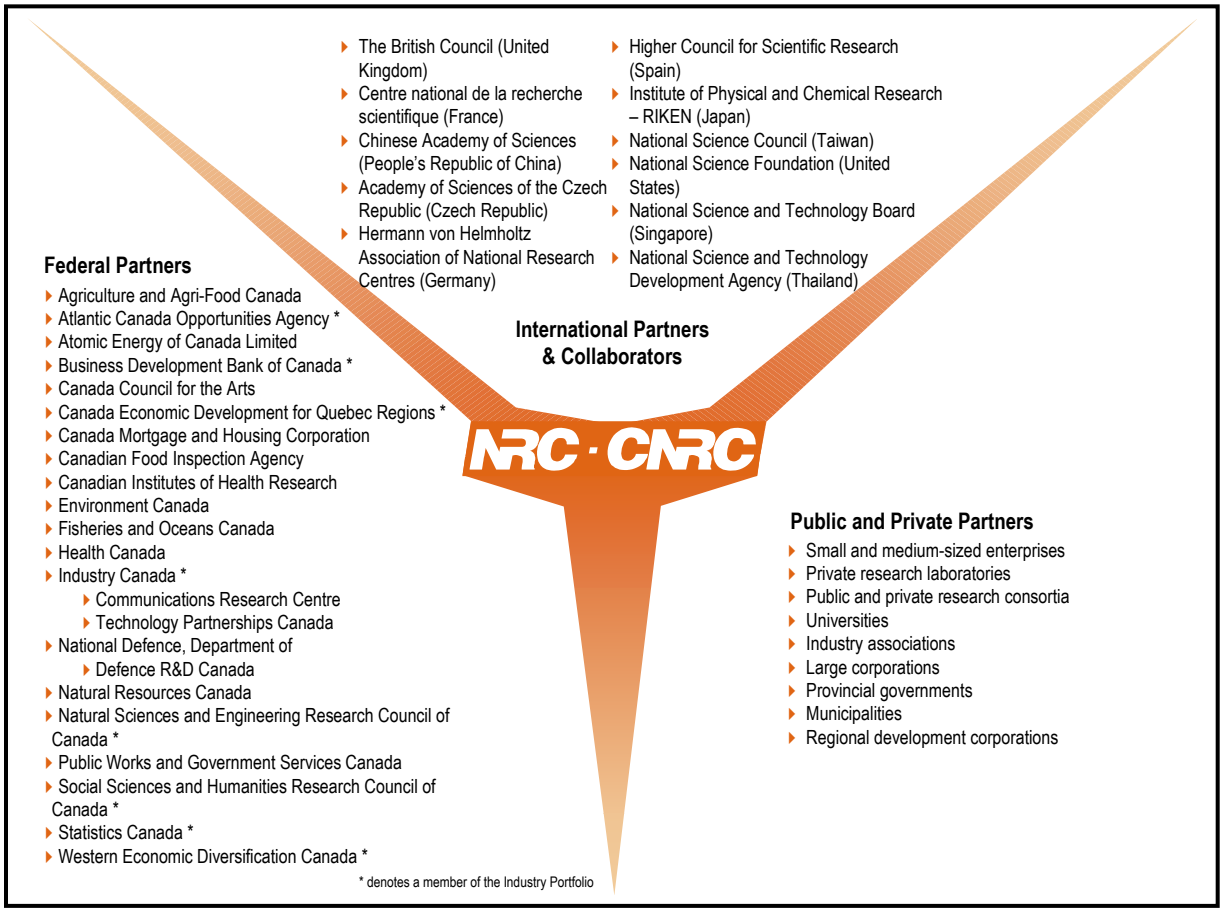
Under the *Weights and Measures Act*, NRC has a specific mandate relating to "the investigation and determination of standards and methods of measurements including length, volume, weight, mass,

capacity, time, heat, light, electricity, magnetism, and the investigation and determination of physical constants and the fundamental properties of matter."

Please consult http://lois.justice.gc.ca/en/ for more details about the NRC's legislative framework.

Strategic Partners

To fulfill its Vision, NRC works with a variety of partners and networks. The diagram below provides examples of NRC's key partners. Specific examples of the accomplishments achieved as a result of these relationships are documented in *Section 2: Departmental Performance* under *Performance Accomplishments*.



Agency Organization

NRC is divided into three business lines, which provide a balance between conducting research and development, offering technical and innovation support services to industry and the public, and supporting the organization with corporate services.

Strategic Outcomes and Business Lines

The following chart provides a crosswalk between NRC's three business lines and its five strategic outcomes. A description of NRC's Business Lines is on the following pages.

Table 3: Crosswalk between Strategic Outcomes and Business Lines

Business Lines*	Excellence and Leadership in R&D	Technology Clusters	Value for Canada	Global Reach	Outstanding People - Outstanding Employer
1	√	√	√	√	√
2	√	√	√	√	√
3		√	√	√	√

Business Line 1 – Research and Technology Innovation

Objective

To achieve sustained knowledge-based economic and social growth in Canada through research and development and innovation in key areas.

Description

The business line includes the research programs, technology development initiatives and the management of national science and engineering facilities along with research and collaborations with firms, universities and public institutions. These efforts all focus on key technological and industrial areas of Canada's economy where NRC has specific roles and recognized competencies, and where it has the ability to have an impact.

Associated institutes

- **Biotechnology** – Biotechnology Research Institute, Institute for Biodiagnostics, Institute for Biological Sciences, Institute for Marine Biosciences and Plant Biotechnology Institute
- **Information and Communications Technologies** – Institute for Microstructural Sciences and Institute for Information Technology (e-Business Centre)
- **Manufacturing Technologies** – Industrial Materials Institute (Aluminium Technology Centre), Institute for Chemical Process and Environmental Technologies, Integrated Manufacturing Technologies Institute and Innovation Centre
- **Aerospace Technologies** – Institute for Aerospace Research (Aerospace Manufacturing Technology Centre)
- **Astronomy and Astrophysics** – Herzberg Institute of Astrophysics
- **Construction** – Institute for Research in Construction
- **Molecular Science** – Steacie Institute for Molecular Sciences
- **Measurement Standards** – Institute for National Measurement Standards
- **Nanotechnology** – National Institute for Nanotechnology
- **Ocean Engineering and Marine Industries** – Institute for Marine Dynamics

BUSINESS LINE 2 – SUPPORT FOR INNOVATION AND THE NATIONAL SCIENCE AND TECHNOLOGY INFRASTRUCTURE

Objective

- To improve the innovative capability of Canadian firms through the provision of integrated and co-ordinated technological and financial assistance, information and access to other relevant resources; and
- To stimulate wealth creation for Canada through technological assistance, information and access to other relevant resources.

DESCRIPTION

The Support for Innovation and the National Science and Technology Infrastructure business line reinforces NRC's role as a major R&D participant within the larger Canadian science and technology infrastructure. This business line encompasses the dissemination of scientific, technical and medical information and the provision of innovation assistance to Canadian small and medium sized enterprises. NRC also maintains key engineering and technology-based facilities to support specific industrial sectors of the economy.

Associated programs and centres

- **Innovation Assistance to Firms** – Industrial Research Assistance Program
- **Scientific and Technical Information** – Canada Institute for Scientific and Technical Information
- **Technology Centres** – Canadian Hydraulics Centre, Centre for Surface Transportation Technology and Thermal Technology Centre (closed as of December 2001)

BUSINESS LINE 3 – PROGRAM MANAGEMENT

Objective

To provide efficient, client-focused services, which enhance NRC's effectiveness as an integrated, dynamic science and technology organization.

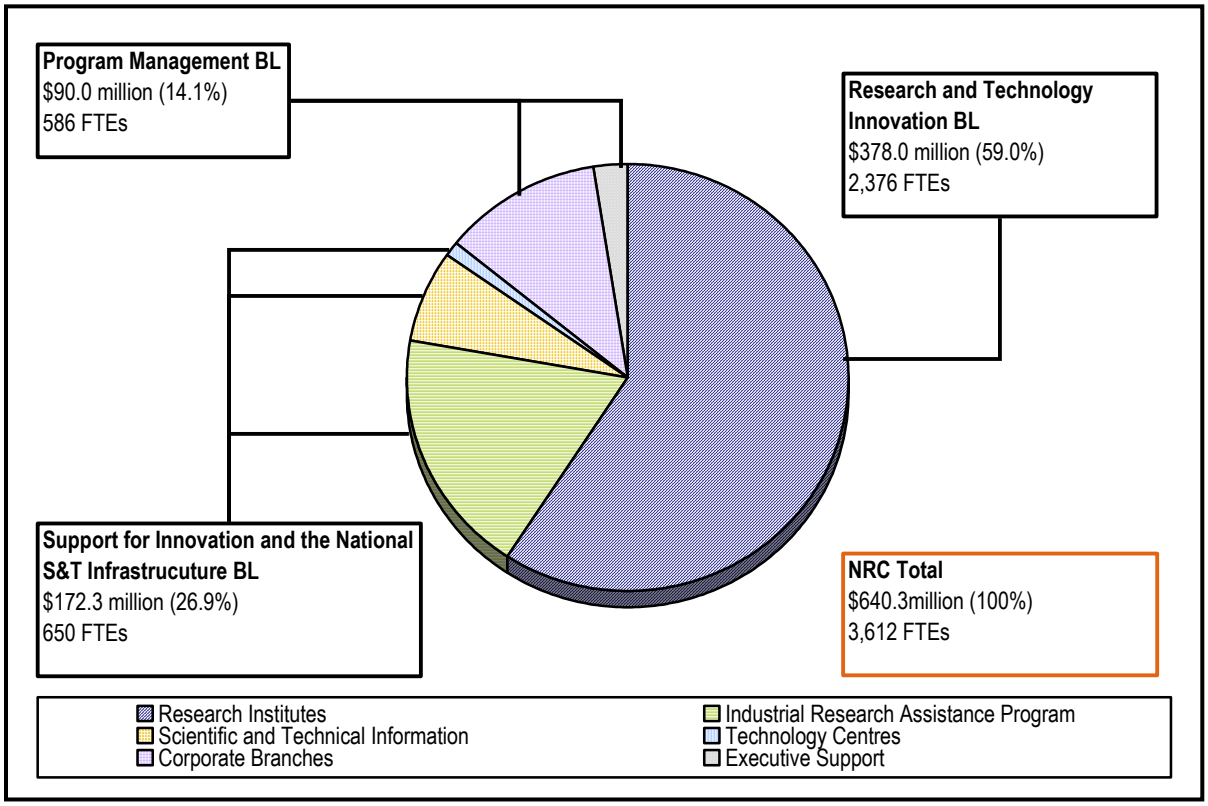
Description

The business line provides policy, program advice and executive support for the coordination and direction of NRC's operations and its Governing Council. It also supports and enables effective and efficient management of NRC's resources through its specialization in finance, information management, human resources, administrative services and property management and corporate services.

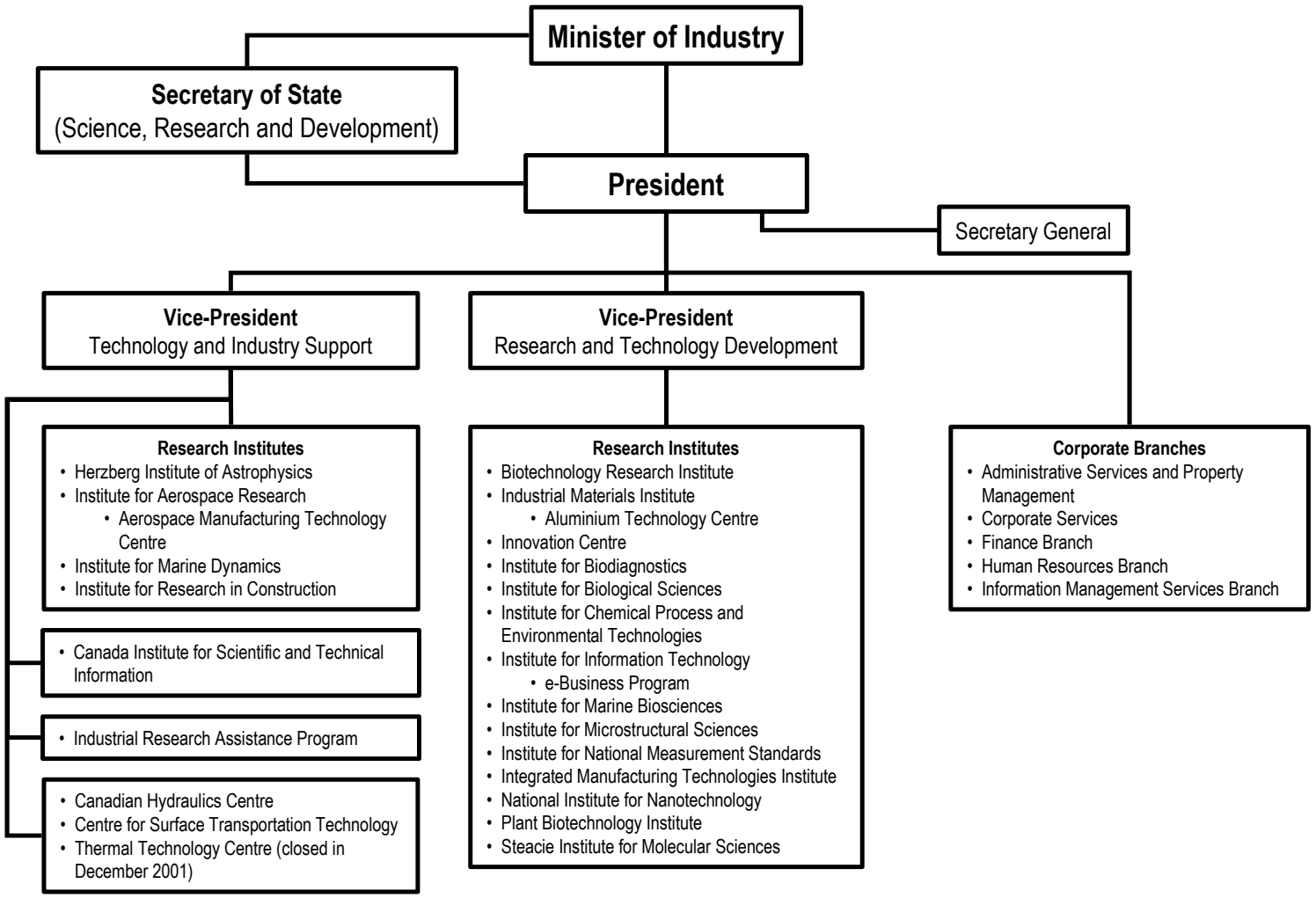
Associated corporate branches

- **Administrative Services and Property Management**
- **Corporate Services**
- **Finance Branch**
- **Human Resources Branch**
- **Information Management Services Branch**

Expenditure by Organization and Business Lines (2001-2002)



Organizational Chart of the National Research Council Canada



Appendix A
Management & Legislative Information

Senior Management and Corporate Information

President
Arthur J. Carty
(613) 993-2024
arthur.carty@nrc.ca

Secretary General and Executive Assistant to the President
Pat Mortimer
(613) 993-3731
pat.mortimer@nrc.ca

Vice-President, Research and Technology Development
Peter A. Hackett
(613) 993-9244
peter.hackett@nrc.ca

Vice-President, Technology and Industry Support
Jacques Lyrette
(613) 998-3664
jacques.lyrette@nrc.ca

Corporate Headquarters
1200 Montreal Road
Montreal Rd. Campus
Ottawa, Ontario
K1A 0R6

General Inquiries:
(613) 993-9101
Internet: http://www.nrc.ca/
e-mail: r&d@nrc.ca

Access to Information and Privacy:
(613) 990-6111
huguette.brunet@nrc.ca

DPR Contact:
Director, Planning, Policy and Assessment
Robert James
(613) 990-7381
rob.james@nrc.ca

Legislation Administered and Associated Regulations

NRC has responsibility for the administration of the:
National Research Council Act R.S.C., 1985, c. N-15, never amended

NRC has responsibility for calibration and certification of standards of measurements under the:
Weights and Measures Act R.S.C., 1970-71-72, c. W-6

NRC provides technical support to the Canadian Commission of Building and Fire Codes.

Appendix B
NRC Strategic Outcomes - Linkages

Linkages between NRC Strategic Outcomes and TBS' Canada's Peformance

Economic Opportunities and Innovation in Canada *Theme*

As Canada's foremost multidisciplinary R&D agency, NRC falls under the *economic opportunities and innovation in Canada* theme of the Canada's Performance 2002 Annual Report to Parliament and the two societal indicators *innovation* and *educational attainment*. NRC is aligned with the innovation societal indicator with its 18 research institutes, two technology centres, the Industrial Research Assistance Program (IRAP) and the Canada Institute for Scientific and Technical Information (CISTI). NRC is also aligned with educational attainment as it helps to develop skilled workers through graduate and undergraduate training programs.

Societal Indicator: Innovation

With the Government of Canada's commitment in the *Speech from the Throne* (January 2001) for Canada to become one of the top five R&D performers in the world and the release of *Canada's Innovation Strategy*, NRC is now more committed than ever to pursue its goals of fostering Canada's innovative capabilities through scientific research and technological development and innovation support programs. NRC's new five-year plan, *Vision 2006*, focuses on innovation; four of the five strategic pillars of *Vision 2006* are focused on innovation.

Related NRC's Strategic Outcomes:

- *Excellence and leadership in research and development* – By 2006, NRC will assume a leadership position in at least three new vital domains of scientific and engineering research needed for Canada to meet national challenges and capitalize on the opportunities of a global knowledge economy.
- *Technology clusters* – By 2006, NRC will contribute to the development of new, sustainable and competitive innovation clusters in at least ten Canadians communities.
- *Value for Canada* – By 2006, NRC will be recognized by its partners and government stakeholders as Canada's leading developer of new research and technology-based enterprises, and respected for its innovative S&T commercialization practices.
- *Global Reach* – By 2006, NRC will be recognized by its stakeholders for its contributions to a more effective Canadian innovation system that assures access to international facilities and research networks, provides opportunities for Canadians firms, and builds new research and technology alliances.

Related NRC's Programs and Initiatives:

- 18 research institutes, two technology centres (*See Appendix D for a complete list of NRC's Research Institutes and Technology Centres.*);
- Canadian Centre for Housing Technology;

- 3 Industry Partnership Facilities (Ottawa, Montréal, Saskatoon);
- Special Interest Groups (SIGs)
- the *Enterpreneurship Program*;
- Atlantic Canada Innovation Partnership;
- Canada Institute for Scientific and Technical Information
- Industrial Research Assistance Program; and
- Canadian Technology Network.

***Societal Indicator*: Educational attainment**

One of the goals set forth in *Canada's Innovation Strategy* is to develop the most skilled and talented labour force in the world. Since its inception, NRC has provided training opportunities to many of Canada's young scientists and engineers. Close to 900 students, each year, come to work with our research teams in our world-class facilities. Also many of NRC's scientists, researchers and engineers have received appointments as adjunct professors in Canada's universities.

Related NRC's Strategic Outcomes:

- *Outstanding People – Outstanding Employer* – By 2006, NRC will be regarded by staff and their peers as a major innovator in human resources management, as a place where outstanding people are encouraged and are able to make outstanding contributions to Canada, and as an outstanding employer offering a great place to work.
- *Excellence and leadership in research and development* – By 2006, NRC will assume a leadership position in at least three new vital domains of scientific and engineering research needed for Canada to meet national challenges and capitalize on the opportunities of a global knowledge economy.

Related NRC's Programs and Initiatives:

- IRAP's Youth Internship Program;
- Research Associate Program;
- Women in Engineering and Science; and
- NSERC Visiting Fellow Program.

Appendix C
Awards and Achievements

Awards and Honours

Arya, Prabhat – NRC-SIMS

- Science Chair, Department of Atomic Energy (India)

Barakat, Sherif – NRC-IRC

- President (2001-2004), International Council for Research and Innovation in Building and Construction

Boyd, Robert – NRC-IMB

- 2001 Maxxam Award, Canadian Society for Chemistry

Bueyrs, Bill – NRC-SIMS

- Gold Medal, Canadian Association of Physicists

Cembella, Allan – NRC-IMB

- Vice-President, International Society for the Study of Harmful Algae
- Chairman, Working Group on Harmful Bioom Dynamics – International Committee for the Exploration of the Sea

CF-18 IFOSTP Team – NRC-IAR

- von Karman Award for International Collaboration, International Council on Aeronautical Sciences

Dancik, Bruce – NRC-CISTI

- Award for Meritorious Achievement, Council of Science Editors

Dumouchel, Bernard – NRC-CISTI

- 2001 Award for Distinguished Service to Research Librarianship, Canadian Association of Research Libraries

Hesser, James – NRC-HIA

- Newton-Ball Award, Royal Astronomical Society of Canada – Victoria Chapter

Holdrinet, Eric – NRC-IRAP

- Prize from the Institute of Electrical and Electronics Engineers

Ingold, Keith – NRC-SIMS

- Honorary Fellow, Royal Society of Edinburgh

Kawrakow, Iwan – NRC-INMS

- Farrington Daniels Award, American Association of Physicists in Medicine

Kawrakow, Iwan Rogers, Dave (NRC-INMS) and Langemeyer, Clement (NRC-CS)

- FPTT Technology Transfer Award, Federal Partners in Technology Transfer

Lall, Santosh – NRC-IMB

- Elected Chair of the Nutrition and Production of Fish and Shellfish Committee – International Union of Nutritional Sciences

Liu, Hui C. – NRC-IMS

- Alexander von Humboldt Fellow, Alexander von Humboldt Foundation

Lockwood, David J. – NRC-IMS

- Honorary D. Sc, University of Canterbury (New Zealand)
- SPRINT Award, National University of Singapore
- Fellow, Electrochemical Society

Madej, Alan – NRC-INMS

- Senior, Institute of Electrical and Electronics Engineers

Mailvaganam, Noel – NRC-IRC

- Award of Merit, Canadian Standards Association

Marcotte, Dave – NRC-IAR

- Turning Goals into Reality Award – Revolutionize Aviation Goal, National Aeronautics and Space Administration

McKellar, Robert – NRC-SIMS

- 2001 Gerhard Herzberg Award, Spectroscopy Society of Canada

Meltzer, Johnathan – NRC-IBD

- Apotex Fermentation Inc. Award for Molecular Biology, University of Manitoba
- Arthur W. Ham Graduate Student Award, Canadian Association of Anatomy and Cell Biology

Monteiro, Mario – NRC-IBS

- Young Scientist Award, XIVth International Workshop Gastroduedenal Pathology and Helicobacter Pylori

Morley, Paul – NRC-IBS

- Biomedical Science Ambassador Award – Lay Category, Partners in Research

Narang, Saran – NRC-IBS

- P.C. Dutta Memorial Lecture Award, Indian Association for the Cultivation of Science

Paquet, Eric – NRC-IIT

- Recognitions Award – Digital Modeling for Design and Engineering, Society of Automobile Engineers

Ramachandran, Ramu (*Researcher Emeritus*) – NRC-IRC

- Fellow of the Royal Society of Canada

Roth, Gerhard – NRC-IIT

- 2001 Distinguished Service Award, Canadian Image Processing and Pattern Recognition Society

Seideman, Tamar – NRC-SIMS

- Fellow, American Physical Society

Smith, Ian – NRC-IBD

- Honorary D. Sc, Brandon University

Soldatov, Dima – NRC-SIMS

- Margarat Etter Award, American Crystallographic Association

Tse, John – NRC-SIMS

- Fellowship, Swedish Foundation for International Cooperation in Research and Higher Education

van den Bergh, Sidney (*Researcher Emeritus*) – NRC-HIA

- Honorary D. Sc, University of Victoria

Wong, George – NRC-INMS

- Distinguished International Member, Institute of Noise Control Engineering

Xue, Lijue – NRC-IMTI

- Nian Qiang Academic, Xiamen University

Yeung, Millan – NRC-IMTI

- Honoured by the Canadian Association of Mould makers for scientific and technical contributions.

Yung, David – NRC-IRC

- Fellow, International Society of Fire Protection Engineers and Editor-in-Chief of the Journal of Fire Protection Engineering

Zimcik, David – NRC-IAR

- President, Canadian Aeronautics and Space Institute

Notable Achievements

Attas, Matt et al. – NRC-IBD

- Best Poster, First International Conference on Advanced Vibration Spectroscopy (Turku, Finland)

Baskaran, Bas – NRC-IRC

- appointed executive board member of the Roofing Industry Committee on Weather Issues

Beaudoin, Jim – NRC-IRC

- appointed to the Selection Committee of the Canadian Science and Engineering Hall of Fame

Beraldin, Angelo – NRC-IIT

- awarded a 9- month Marconi Scholarship by the Italian Government
- awarded a 15-day Research Scholarship by the Italian National Research Council

Bezabeh, Tedros – NRC-IBD

- Success Award, Winnipeg Eritrean Community

Blouin, Alain et al. – NRC-IMI

- Best Application Conference Prize, 8th International Conference on Photorefractive Effects, Materials and Devices

El-Emam, Khaled – NRC-IIT

- ranked second in the world for citation according to the Journal of Systems and Software and one of the Top 15 Systems and Software Engineering Scholars for 1997-2001

Garcia-Rejon, Andres – NRC-IMI

- Fellow, Society of Plastics Engineers

Jilkina, Olga – NRC-IBD

- Best Poster Award, XVII meeting of International Society for Heart Research

Marple, Basil and Moreau, Christian – NRC-IMI

- assigned to editorial board of the proceedings for the International Thermal Spray Conference

Marple, Basil et al. – NRC-IMI

- Merit Certificate for Best Paper, International Thermal Spray Conference

Meltzer, Johnathan – NRC-IBD

- 1st Place, University of Oregon New Venture Championship

Rempel, Stephen – NRC-IBD

- 3rd Place, Showcase 2001 Research Paper Competition

Thin Film Design Team – NRC-IMS

- won 2 international thin film design contests at the 2001 Conference on Optical Coatings

Walker, Zoe (*Student*) – NRC-IC

- Micro Fuel Cell Project – Best Student Work Team Award, Atlantic Engineering Competition

Ye. Jian – NRC-IBD

- 2nd prize overall for best research paper at the Annual Meeting of the American College of Surgeons – Manitoba Chapter, 2001

Zhang, Zhiyi – NRC-ICPET

- designated as one of "500 Leaders of Sciences" by the American Biographical Institute

Appendix D
NRC Institutes, Branches and Centres

Biotechnology Group

Biotechnology Research Institute (BRI) - Montréal, Quebec
Director General: Michel Desrochers

The Biotechnology Research Institute (BRI) maintains advanced facilities to carry out collaborative research projects in molecular biology and biochemical engineering. BRI concentrates on collaborative projects with Canadian industry, particularly companies working in the pharmaceutical and resource sectors.
General Inquiries: (514) 496-6100 http://www.nrc.ca/bri/

Institute for Biodiagnostics (IBD) - Winnipeg, Manitoba
Director General: Ian Smith

The Institute for Biodiagnostics (IBD) is a dynamic environment with state-of-the-art facilities and equipment and, most importantly, a team of individuals committed to the goal of fostering research and excellence through innovation.
General Inquiries: (204) 983-7692 http://www.nrc.ca/ibd/

Institute for Biological Sciences (IBS) - Ottawa, Ontario
Director General: Gabrielle Adams

The Institute for Biological Sciences (IBS) does innovative research in neurobiology and immunochemistry of importance to the health and pharmaceutical sectors.
General Inquiries: (613) 993-5975 http://www.nrc.ca/ibs/

Institute for Marine Biosciences (IMB) - Halifax, Nova Scotia
Director General: George Iwama

The Institute for Marine Biosciences (IMB) carries out focused, innovative and strategic research, in collaboration with industrial, university and government partners, in Aquaculture and Genomics.
General Inquiries: (902) 426-6829 http://www.nrc.ca/imb/

Plant Biotechnology Institute (PBI) - Saskatoon, Saskatchewan
Director General: Kutty Kartha

The Plant Biotechnology Institute (PBI) is a leader in the metabolic modification of oilseeds to increase oil content and to create specialty plant oils for new markets. Similar research is altering wheat starch for novel uses and to meet new international markets. Investigation of metabolic pathways has also led to a significant reduction in anti-nutritional compounds in common commercial crops
General Inquiries: (306) 975-5568 http://www.nrc.ca/pbi/

Information and Communications Technology Group

Institute for Information Technology (IIT) - Ottawa, Ontario and Fredericton, New Brunswick
Director General: Andrew Woodsworth

The Institute for Information Technology (IIT) assists industry through collaborative research and development projects. The Institute works with companies individually and in groups, with product developers and lead users, with firms both large and small.
General Inquiries: (613) 993-3320 http://www.nrc.ca/iit/

Institute for Microstructural Sciences (IMS) - Ottawa, Ontario
Director General: Richard Normandin

The Institute for Microstructural Sciences (IMS) provides leadership, in collaboration with Canadian industry and universities, in the development of the strategic base for information technology; that is, in the development of enabling technologies related to future hardware requirements for information processing, transmission acquisition and display.
General Inquiries: (613) 993-4583 http://www.nrc.ca/ims/

Manufacturing Technologies Group

Innovation Centre - Vancouver, British Columbia
Director General: Maja Veljkovic

The NRC Innovation Centre develops core competencies relevant to long-term strategic technology needs of Canadian industry, with particular emphasis on integration with other players in the B.C. innovation community. The *Fuel Cell Technology Centre* (FCTC) established at the Innovation Centre acts as an R&D platform for the National Fuel Cell Initiative. The FCTC will support validation/testing of component and sub-component projects conducted at other NRC institutes. It will also provide the Canadian industry with the product development infrastructure required for business development. And it will offer means of demonstrating newly developed products and systems, of training personnel, and of interacting with other international programs
General Inquiries: (604) 221-3000 http://www.nrc.ca/icvan/

Institute for Chemical Process and Environmental Technologies (ICPET) - Ottawa, Ontario
Director General: Don Singleton

The Institute for Chemical Process and Environmental Technology (ICPET) develops chemical process technologies and value-added materials to help Canadian industries improve the commercial viability of their products, reduce costs, manage environmental performance and increase the efficiency of process operations.
General Inquiries: (613) 998-8192 http://www.nrc.ca/icpet/

Industrial Materials Institute (IMI) – Boucherville and Chicoutimi, Quebec
Director General: Blaise Champagne

The Industrial Materials Institute (IMI) is an internationally recognized R & D centre dedicated to the Canadian materials processing and forming industry, a focal point for partnerships, knowledge transfer,

technology development and technical support, and an open laboratory concept available to the key industry innovators
General Inquiries: (450) 641-5100 http://www.nrc.ca/imi/

Integrated Manufacturing Technologies Institute (IMTI) - London, Ontario
Director General: Georges Salloum

The Integrated Manufacturing Technologies Institute (IMTI) carries out focused, innovative and strategic research, in collaboration with industrial, university and government partners, in Virtual Manufacturing and Precision and Freeform Fabrication.
General Inquiries: (519) 430-7000 http://www.nrc.ca/imti/

Astrophysics

Herzberg Institute of Astrophysics (HIA) – Victoria and Penticton, British Columbia
Director General: James Hesser (*acting*)

The Herzberg Institute of Astrophysics (HIA) has the mandate from Parliament to operate astronomical observatories of the Government of Canada, and to ensure that the Canadian scientific community has appropriate access to these facilities. This is done through two domestic facilities: the Dominion Astrophysical Observatory (DRAO) in Victoria B.C. and the Dominion Radio Astrophysical Observatory (DRAO) in Penticton B.C.; as well as through collaboration in multinational facilities: the existing Canada France Hawaii Telescope (CFHT), the James Clerk Maxwell Telescope (JCMT) and the Gemini telescopes under construction in Hawaii and Chile. HIA also maintains the Canadian Astronomy Data Centre (CADC), which provides access to astronomy data from these telescopes and others such as the Hubble Space Telescope
General Inquiries: (250) 363-0040 http://www.nrc.ca/hia/

Aerospace

Institute for Aerospace Research (IAR) - Ottawa, Ontario and Montréal, Quebec
Director General: Bill Wallace

The Institute for Aerospace Research (IAR) continues to serve as the leading performer of aeronautical R&D in Canada. IAR maintains and develops the core competencies and the knowledge base critical to the needs of the Canadian aerospace community. IAR fosters innovation in the design, manufacture, performance, use and safety of aerospace vehicles and supports the development commercialization and implementation of leading edge technologies through world-class facilities and by networking nationally and internationally.
General Inquiries: (613) 993-0141 http://www.nrc.ca/iar/

Ocean Engineering and Marine Industries

Institute for Marine Dynamics (IMD) – St. John's Newfoundland
Director General: Mary Williams (*effective September 2002*)

The Institute for Marine Dynamics' (IMD's) mission is to provide innovative solutions and technical expertise in ocean engineering and ocean technology. IMD pursues research programs in ship

technology and offshore engineering. IMD works with industries and pubic sector agencies on projects relating to offshore oil and gas, ship design, marine operations and safety.
General Inquiries: (709) 772-2469 http://www.nrc.ca/imd/

Measurement Standards

Institute for National Measurement Standards (INMS) - Ottawa, Ontario
Director General: Janusz Lusztyk

The Institute for National Measurement Standards (INMS) draws together activities related to metrology to provide the foundation for Canada's National Measurement System, a crucial resource for Canadian enterprise.
General Inquiries: (613) 990-8750 http://www.nrc.ca/inms/

Construction

Institute for Research in Construction (IRC) - Ottawa, Ontario
Director General: Sherif Barakat

The Institute for Research in Construction (IRC) is Canada's foremost centre for construction technologies. IRC develops and maintains core competencies and the knowledge base critical to Canadian construction industry needs; supports the development, commercialization and implementation of leading technologies; and fosters the provision of a safe and sustainable built environment by developing building codes and standards.
General Inquiries: (613) 993-2443 http://www.nrc.ca/irc/

Nanotechnology

National Institute for Nanotechnology (NINT) – Edmonton, Alberta
Director General: Dan Wayner (*acting*)

The National Institute for Nanotechnology (NINT) is a key resource for an Integrated Nano-Structures Network in Canada. NINT will provide direct support to the network through an internship program for post-graduates and post-doctorate fellows, and by making its facilities available to other organizations so that they can conduct their own experiments or production.
General Inquiries: (613) 991-3390 http://www.nrc.ca/nanotech/

Molecular Sciences

Steacie Institute for Molecular Sciences (SIMS) - Ottawa, Ontario
Director General: Tom Jackman (*acting*)

The Steacie Institute for Molecular Sciences (SIMS) undertakes long-term multidisciplinary research in selected areas of molecular science with the potential to have an impact on key sectors of the Canadian economy. We work in partnership with researchers inside and outside NRC to develop innovative technologies in areas such as therapeutics, diagnostics, advanced electronics, telecommunications, precision manufacturing, optoelectronics, information sciences, and advanced materials
General Inquiries: (613) 990-0970 http://www.nrc.ca/sims/

Support for Innovation and the National Science and Technology Infrastructure

Canada Institute for Scientific and Technical Information (CISTI) - Ottawa, Ontario with offices across Canada
Director General: Bernard Dumouchel

The Canada Institute for Scientific and Technical Information (CISTI) is one of the world's major sources for information in all areas of science, technology, engineering and medicine. CISTI provides easy-to-use electronic information tools that enable clients to stay on top of new developments in their fields. CISTI is home of the NRC Research Press – Canada's largest scientific publisher.
General Inquiries: (613) 993-2341 http://www.nrc.ca/cisti/

Industrial Research Assistance Program (IRAP) - Ottawa, Ontario with offices across Canada
Director General: Margot Montgomery

The Industrial Research Assistance Program (IRAP)'s mandate is to stimulate wealth-creation for Canada through technological innovation and it mission is to stimulate innovation in Canadian small and medium-sized enterprises (SMEs).IRAP's objectives are to increase the innovative capabilities of Canadian SMEs and to become the national enabler of technological innovation for Canadian SMEs.
General Inquiries: (613) 998-0950 http://www.nrc.ca/irap/

Technology Centres

Canadian Hydraulics Centre (CHC) - Ottawa, Ontario
Director: Etienne Mansard

The Canadian Hydraulics Centre (CHC) develops and provides leading technologies for studying maritime structures, coastal processes, environmental hydraulics and cold regions engineering. CHC continues to establish itself as a Centre of Excellence for hydraulic studies that are relevant to Canadian Governments and Canadian and U.S. consulting firms. CHC is poised to address topics of climate change, energy efficiency, environmental impact assessment, water resources and quality, sustainable development and coastal environments.
General Inquiries: (613) 993-2417 http://www.nrc.ca/chc

Centre for Surface Transportation Technology (CSTT) - Ottawa, Ontario and Vancouver, British Columbia
Director: John Coleman

The Centre for Surface Transportation Technology (CSTT) enhances international opportunities for the Canadian transportation industry by providing vehicle engineering and testing expertise and facilities, particularly in the railway sector and increasingly in the defence sector. CSTT is becoming a pre-eminent service provider to Canada's internal defence sector by offering an array of services including projects critical to the deployment of Canadian Forces units in peacekeeping missions. As CSTT builds on its world leadership in wheel / rail interaction, CSTT is developing to a similar level of recognition in railway freight car structures and dynamic performance.
General Inquiries: (613) 998-9638 http://www.nrc.ca/cstt/

Corporate Branches

Administrative Services and Property Management (ASPM)
Director General: Subash Vohra
General Inquiries: (613) 993-2440 Subash.Vohra@nrc.ca

Corporate Services (CS)
Director General: Don Di Salle (*acting*)
General Inquiries: (613) 993-4769 Don.Di_Salle@nrc.ca

Finance Branch (FB)
Director General: Jean-Guy Séguin
General Inquiries: (613) 990-7471 Jean-Guy.Seguin@nrc.ca

Human Resources Branch (HRB)
Director General: Mary McLaren
General Inquiries: (613) 993-9391 Mary.McLaren@nrc.ca

Information Management Services Branch (IMSB)
Director General: Andy Savary
General Inquiries: (613) 991-3773 Andy.Savary@nrc.ca