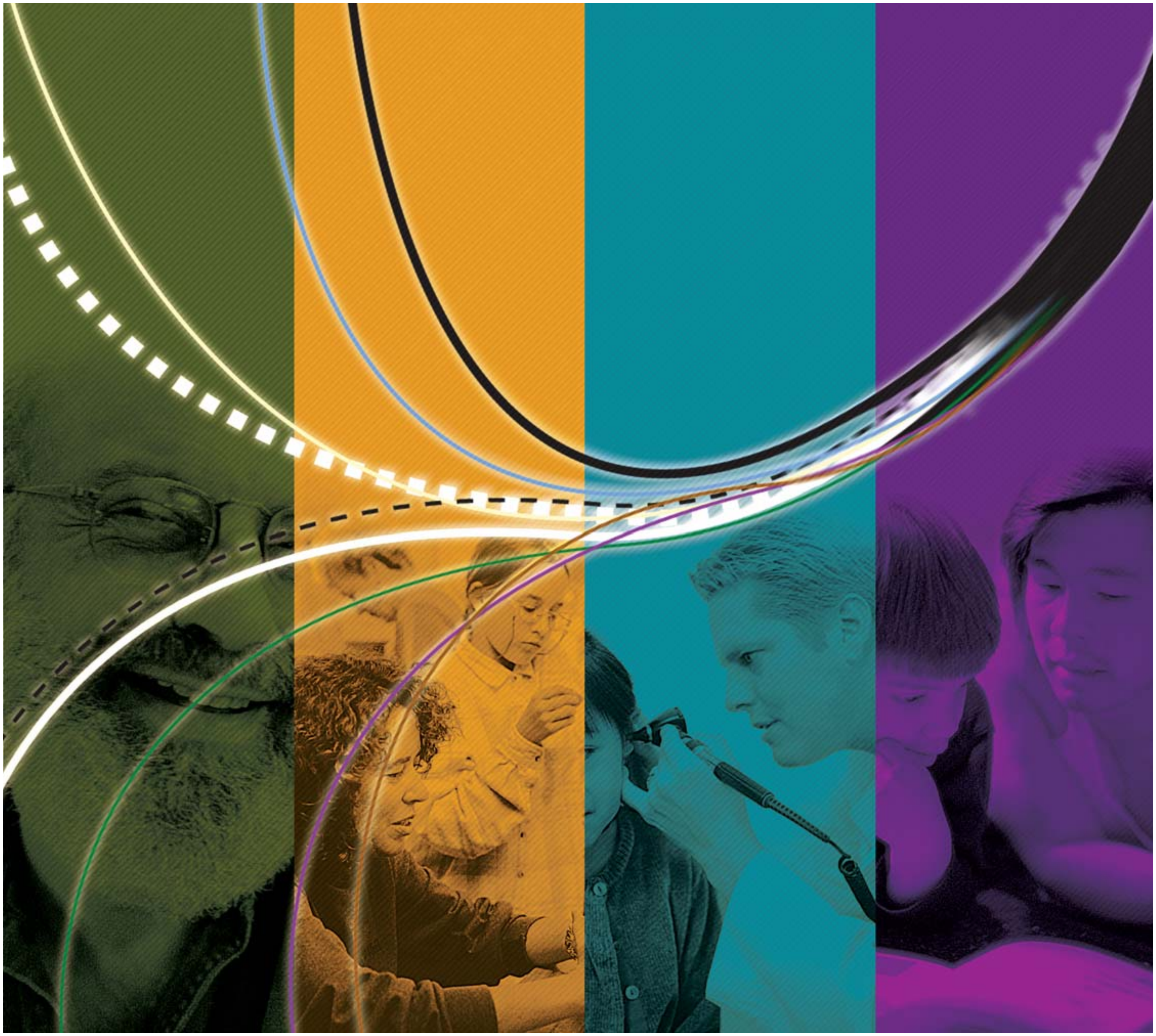

NETWORKS OF CENTRES OF EXCELLENCE

Annual Report 2002/2003

Investing in prosperity, achieving results

Canada

NETWORKS OF CENTRES OF EXCELLENCE
Annual Report 2002/2003
Investing in prosperity, achieving results

The Networks of Centres of Excellence (NCEs) mobilize research talent across Canada and apply it to creating social and economic benefits for all Canadians. The NCEs foster partnerships of business, education and government to accelerate the exploitation of knowledge, research and technology, and to speed their transfer to the marketplace and to the public.

National and international in scope, the NCEs include thousands of highly qualified personnel, from postdoctoral fellows to world leaders in the most sophisticated fields of research. With more than a thousand partners, they have contributed to significant advances in disciplines ranging from genetic research to child development and literacy. And, to prepare for Canada's future needs, the NCEs have contributed to the education, training and employment of thousands of university graduates.

The NCEs have made real differences to the lives of Canadians. The NCE 2002–2003 Annual Report illustrates in detail how their investments have paid off handsomely in economic and social benefits, and in Canada's quality of life.

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MESSAGE FROM THE CHAIR

Welcome to the 2002–2003 Networks of Centres of Excellence (NCE) Annual Report. Again this year, we are presenting the NCE Program's achievements in an online, interactive form that allows you to search according to your needs and interests. We have found that this is a very efficient way of delivering information about the NCEs to researchers, government, industry and Canadians at large, and we trust that you will find it interesting.

The Networks of Centres of Excellence Program is an initiative of the three granting agencies: the Natural Sciences and Engineering Research Council of Canada (NSERC), the Canadian Institutes of Health Research (CIHR) and the Social Sciences and Humanities Research Council of Canada (SSHRC) in partnership with Industry Canada. It is dedicated to the advancement of knowledge and the education of highly qualified people as vehicles for improvements in the quality of life and the growth of value-added economic activity in Canada

I am pleased to report that during 2002–2003, the Networks of Centres of Excellence continued to make notable contributions to Canadian research, as noted by an independent evaluation of the NCE Program by KPMG in 2002 which found that the NCE Program has transformed the way research on large-scale problems is conducted in Canada. Overall, the respondents to the KPMG study agreed that the networks made a difference in multi-disciplinary collaborative research, student training, partnerships with users, knowledge and technology transfer, and development of local and national critical mass of intellectual capacity to address problems of great complexity and large scale.

Networks achieved this by bringing together leaders in business, industry, research and government to create effective partnerships. Overall this year, the NCE Program supported 1,613 researchers in 68 universities. The program's partners included 624 companies, 184 provincial and federalgovernment departments and 232 agencies from Canada, and 298 international partners, making it a truly national and international program.

These achievements would not have been possible without the vision and hard work of the scientific directors and the chairs of the boards of directors who have contributed to forging partnerships among research leaders from all sectors and disciplines. I want to thank them for their invaluable contributions, and in doing so, I know I speak also for the NCE Steering Committee: Dr. Alan Bernstein, President of CIHR; Dr. Marc Renaud, President of SSHRC; and Mr. Peter Harder, Deputy Minister of Industry Canada.

Our mission at the NCE is to mobilize Canada's research talent in the academic, private and public sectors and apply it to solving important problems, developing the economy and improving Canadians' quality of life. We must also guarantee that Canadians receive the best possible return on their investment in the NCEs, and that the NCEs continue to deliver results both efficiently and effectively. In this regard, the numbers speak for themselves. Last year the NCE Program stimulated outside investments of over $69 million, including more than $33 million from private-sector companies. With the addition of the Program's own investment, the total dedicated to research, training and commercialization in 2002–2003 reached more than $147 million. The NCEs also nurtured the commercialization of research through 153 patents and licenses and the establishment of five spin-off companies in areas of high economic and social value. Equally important, the NCEs helped lay the foundations for Canada's future competence and prosperity by training 4,772 research staff such as postdoctoral fellows, students, research associates and technicians to carry our strategy into the new century.

In December 2002, the Honourable Allan Rock, Minister of Industry, announced an investment of $39 million over four years to continue the work of three NCEs: the Canadian Stroke Network, the Network in Aquaculture (AquaNet), and the Canadian Network for Vaccines and Immunotherapeutics. This investment will involve almost 300 researchers in universities and industries right across Canada and will contribute significantly to research, training, and knowledge and technology transfer in the health and aquaculture sectors.

We also continue to look to the future. The 2003 Competition for New Networks is well under way with seven groups of applicants invited to submit full proposals. A second competition, launched in January 2003, will help establish additional NCEs in 2005.

In concluding, I would like to thank the Honourable Allan Rock, Minister of Industry, for his support of the NCE Program. I believe that this program will continue to contribute to the lives of all Canadians through its dedication to our country's intellectual, social, economic and technological progress.

Thomas A. Brzustowski
Chair
NCE Steering Committee

THE NETWORKS OF CENTRES OF EXCELLENCE PROGRAM

The mission of the NCE program is to improve the economy of Canada and the quality of life of Canadians. It achieves its goals by funding networks that are national in scope and meet the program's criteria of excellence in research, training, knowledge advancement, technology exchange and exploitation, networking, partnerships and management.

Through its strong emphasis on partnership and collaboration, the NCE program helps move cutting-edge technologies from the laboratory to the marketplace and gives our entrepreneurs and businesses the resources they need to build the economy of the 21st century.

In doing so, the NCEs provide major social and economic returns on investment, for example in benefits to health care, to early childhood development, to literacy and to environmental protection. Indeed, without the involvement of the NCEs, such benefits might never be made available to Canadians. As a result, the NCEs have become a significant force in Canadian science, business and society.

NCE PROGRAM:

A Program Based on Excellence

Setting the goal

The NCE program mobilizes Canada's research talent in the academic, private and public sectors and applies it to achieving economic growth, sustaining job creation, advancing knowledge and improving the quality of life of Canadians.

Program Criteria

To ensure that the NCE program objectives are met, proposals for NCE funding are assessed against the program's five criteria of excellence:

- the excellence of the research program;
- the opportunity for developing highly qualified personnel;
- the networking and partnership possibilities;
- the opportunity for knowledge exchange and technology exploitation; and
- the quality of the management of the network.

During the term of their NCE grants, networks are also evaluated regularly against these criteria. The quality of research is considered first and NCE funding is continued only if the research is excellent. In other words, while research excellence is a necessary condition for the initial or continued funding of an NCE, it is not a sufficient condition, because the goals of the program are also reflected in the four additional criteria.

The NCE peer-review process

To make sure that only excellent research is funded and that all applications are treated fairly, the NCE program uses a peer-review system. Peer review is an assessment by impartial experts of research proposals in their specific fields.

For each competition, the NCE Steering Committee appoints a Selection Committee composed of international experts with broad expertise in the domains of the three granting agencies. The Selection Committee reviews the reports of the expert panels that evaluate each application and sends a priority-ranked list of networks to the NCE Steering Committee. The Steering Committee then decides which networks will receive funding.

In general, NCE competitions are open to all research areas. Before each competition, the get specific areas, taking into consideration:

- the amount of funding available;
- the broad areas already represented in the existing networks; and
- the need to promote or develop specific areas in accordance with national needs.

Organizations eligible to receive funds are universities, affiliated hospitals and research institutes, and post-secondary institutions that have a research mandate. Researchers and organizations that receive NCE funds must meet the general eligibility requirements of one of the three federal granting agencies administering the program. An industry consortium may receive funds to administer a network.

NCE PROGRAM:
A Results-Oriented Program

Investing in networks

The NCE program accomplishes its goal by investing in national research networks that will:

- stimulate leading-edge, internationally competitive research in areas critical to Canadian economic and social development;
- develop and retain world-class researchers in areas essential to Canada's productivity and economic growth;
- create nation-wide multidisciplinary and multisectoral research partnerships that integrate the research and development priorities of all participants;
- accelerate the exchange of research results within the networks; and
- accelerate the use of these results within Canada by organizations that can harness them for Canadian economic and social development.

A new model for research

The NCE program was designed to achieve its goals by stimulating collaboration and by removing the traditional barriers that separate university research, industrial exploitation and the public use of research results. For these reasons, the networks involve a high degree of networking and collaboration among participating researchers, and are expected to build strong partnerships with industry and/or government during the first years of their existence.

Managing outcomes

An important result is the creation of new knowledge and its use by industry, government and other groups to quickly exploit new knowledge generated by the high-quality research of the NCEs. Such exploitation contributes significantly to Canada's socio-economic development and helps meet the specific needs of these sectors.

In addition, the program strengthens Canada's research base by training new researchers in a multidisciplinary and multisectoral setting and by attracting and retaining experienced researchers.

From its very beginning, the NCE program has incorporated "outcome measurement" as part of its regular operations. Every year, the NCEs report on their activities and achievements in all areas, including excellence of research, the extent of their collaborations, the knowledge they have created and transferred to users, and the people they have trained and retained. These data are collected and reported globally for the overall program in each annual report. (For this year's data, please refer to the "Tables and Illustrations" section).

In 2002, the program reviewed all its "outcome indicators" and formalized their description and their linkages to NCE program goals in a document entitled the *Results-based Management Accountability Framework.* This document now contains over 35 indicators organized into seven key performance areas:

- leading-edge research;
- the level of networking and collaboration in research;
- partnerships with industry, government and other stakeholders;
- training of new researchers and retention of researchers;
- transfer and exploitation of knowledge and technology;
- increased productivity and economic growth; and
- improved quality of life.

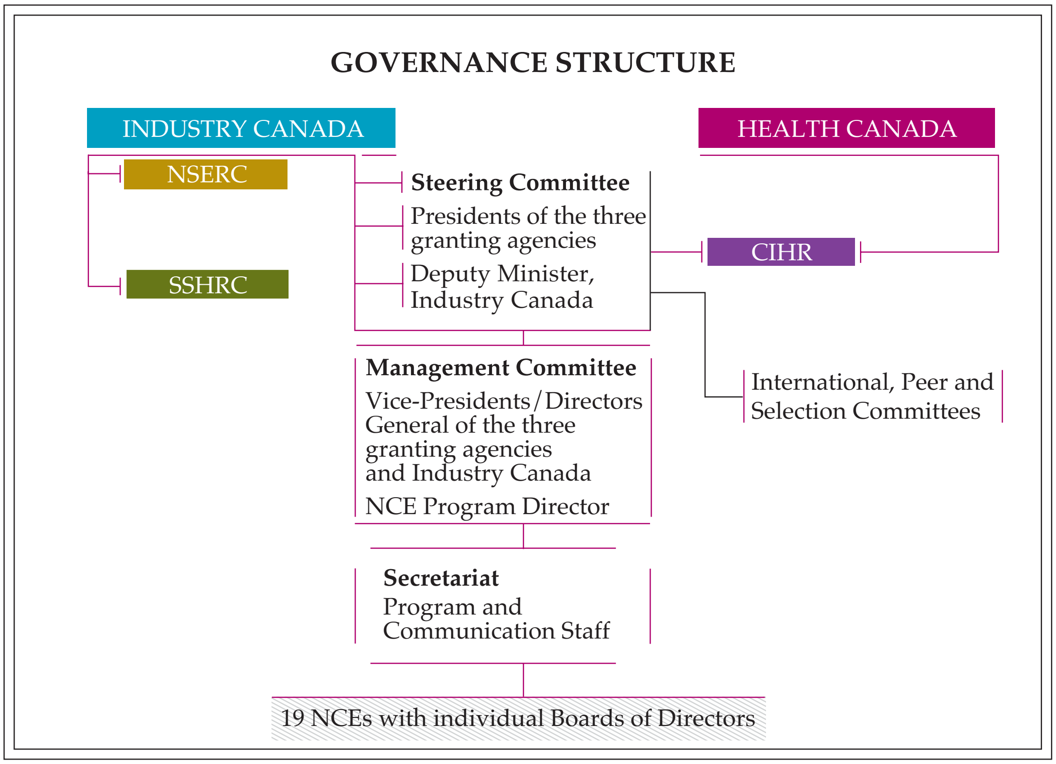
In addition, the program is regularly subject to independent external review. The most recent review, carried out in 2002, summarized the performance of the NCE program as follows: "Overall, the NCE appears to have been successful or very successful in meeting its overall goal and its four specific objectives."

NCE PROGRAM:

A Multi-Agency Program

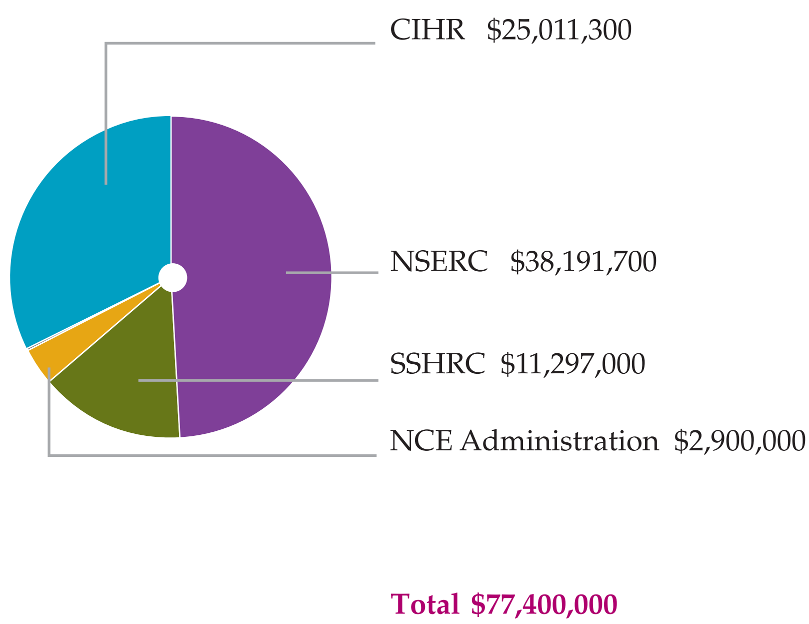
The NCE program is jointly administered by Canada's three federal granting agencies — the Canadian Institutes for Health Research (CIHR), the Natural Sciences and Engineering Research Council (NSERC) and the Social Sciences and Humanities Research Council (SSHRC) — in partnership with Industry Canada.

The program is managed by a Steering Committee that comprises the presidents of the three granting agencies and the Deputy Minister of Industry Canada. The NCE Steering Committee is assisted by the NCE Management Committee, which is composed of the granting agencies' Programs Vice-Presidents, the Industry Canada Innovation Policy Branch Director General, the NSERC Director of Policy and International Relations, and the NCE Program Director. The NCE Directorate is responsible for program management and communications



The NCE program is a permanent program of the Government of Canada, from which it receives $77.4 million annually. The funding is channelled through the granting agencies (NSERC, CIHR and SSHRC) to the NCE Program in the following proportion:

ADMINISTRATION OF NCE PROGRAM FUNDING



NCE PROGRAM:
Research Management

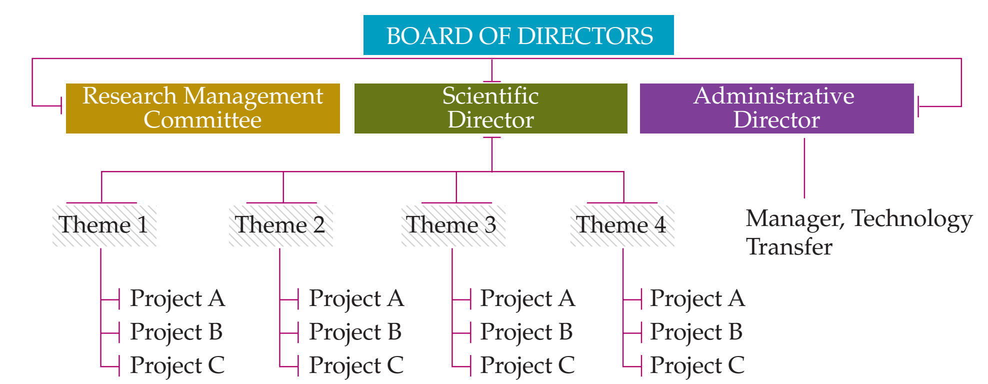
The NCEs, being a consortium of researchers, companies, universities, federal and provincial governments and other organizations, must successfully manage many diverse interests.

A Board of Directors is responsible for overall policy, management direction, and financial accountability of the network. It is accountable to the NCE Steering Committee.

The Scientific Director provides scientific leadership, promotes collaboration and often chairs the Research Management Committee, among other functions. The Network Manager directs daily business, ensuring control and accountability, and is responsible for internal and external communications. The host institution, normally a university, hospital or other partner, provides suitable space for the network's administrative centre.

Partnerships are the lifeblood of the NCEs. NCEs collaborate with government departments such as Environment Canada and the Department of Fisheries and Oceans; with educational institutions such as universities and hospitals; and with industries that range from paper manufacturing to microelectronics.

A TYPICAL NCE ORGANIZATIONAL CHART



YEAR'S HIGHLIGHTS

Building on the foundation of previous years' successes, the NCE program continues to deliver excellent returns on the investments it has made in research and in the commercialization of research. Here are some of the highlights of 2002–2003.

YEAR'S HIGHLIGHTS:

Socioeconomic Benefits for Canadians

An investment is judged by the quality and magnitude of its returns. By this standard, Canada's investment in its NCEs is worthwhile, indeed. Here are some notable examples from industry:

- The Canadian Bacterial Diseases Network has developed a new vaccine that could keep cattle healthier, thus saving North America's beef industry millions of dollars every year.
- A Micronet and McGill University spin-off company expects revenues from its new test equipment to more than triple by 2005. The new equipment will contribute to lower costs for microchip-based products.
- A protein biosensor, the result of a research program funded by the Protein Engineering Network, is being commercialized for pharmaceutical research. This technology will help speed the development of new drugs for a broad spectrum of medical disorders.

NCEs also bring intangible but very significant returns in the sphere of social well-being and quality of life.

- By providing pharmaceutical companies with comprehensive resources for clinical trials, the Canadian Arthritis Network is giving arthritis sufferers access to new therapies that they would not ordinarily receive.
- Telestroke, the first initiative of its kind in Canada, will improve the quality of life for many Canadians by reducing the incidence of stroke-induced disability.
- The Canadian Language and Literacy Research Network is working with educators and private partners to improve the literacy skills of the most disadvantaged Canadian children.

YEAR'S HIGHLIGHTS:

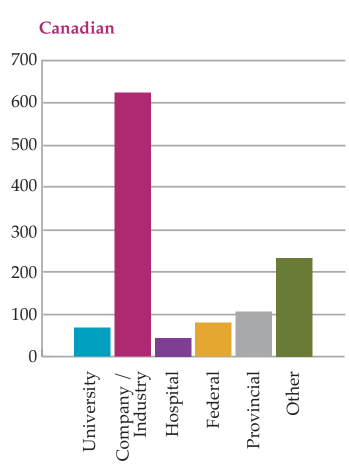
Leveraging Support: Partnerships

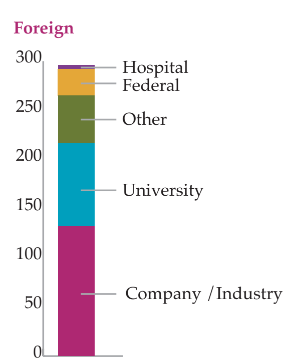
In 2002–2003, the NCEs supported 1,613 researchers in 68 Canadian universities. Across Canada, the networks partnered with 184 provincial and federal government departments, 44 hospitals and 232 other organizations, thus accelerating the use of research results by organizations that can employ them to benefit Canadians.

The networks also built partnerships with 756 Canadian and foreign companies to generate high-quality research that meets the needs of industry.

REGIONAL AND SECTORAL DISTRIBUTION OF NCE PARTNERS

Province / Territory	University	Company / Industry	Hospital	Federal	Provincial	Other	Total
Northwest Territories / Nunavut / Yukon	–	1	–	1	1	1	9
British Columbia	7	87	4	5	17	27	147
Alberta	4	68	3	2	16	26	119
Saskatchewan	2	4	–	3	6	3	18
Manitoba	2	14	–	1	8	3	28
Ontario	20	270	21	43	21	103	458
Quebec	21	127	15	11	20	42	236
New Brunswick	4	21	–	6	5	13	49
Nova Scotia	5	13	1	4	5	8	51
Prince Edward Island	2	4	–	1	1	2	10
Newfoundland and Labrador	1	15	–	2	5	4	27
Canadian	68	**624**	**44**	**79**	**105**	**232**	**1,152**
Foreign	85	**132**	**4**	**27**	**2**	**48**	**298**
Grand Total	153	**756**	**48**	**106**	**107**	**280**	**1,450**



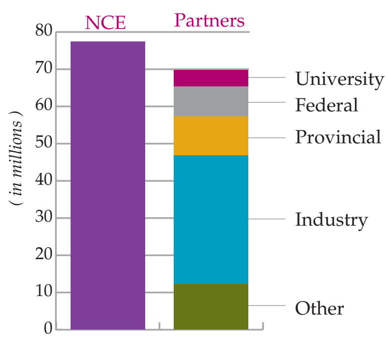


NCEs make a practice of leveraging support through industry partners. A typical example is a powerful new laser technology that promises a new era in operating room procedures, telecommunications and micro-manufacturing. It is being commercialized by a long-standing industry partner of the network that developed the technology.

In a second example, a venture-capital company is investing seed financing for microchip-testing technology. In a third, significant investments are being made to commercialize an advanced protein-bonding technology.

LEVERAGING SUPPORT

Source	Cash	In-Kind	Total
NCE	$77,400,000	$0	**$77,400,000**
Partners:			
University	$1,900,754	$3,164,633	**$5,065,387**
Industry*	$9,309,177	$24,139,798	**$33,448,976**
Federal	$3,778,801	$4,198,776	**$7,977,577**
Provincial	$9,357,689	$1,442,711	**$10,800,400**
Other	$9,469,200	$3,064,367	**$12,533,567**
Partners' Total	$33,815,622	$36,010,286	**$69,825,907**
Grand Total	$111,215,622	$36,010,286	**$147,225,907**



*Portion of the industry in-kind contributions include spin-off activities to test and validate new technologies from network research.

The chart below depicts the relationships of the networks to Canadian universities.

These 68 universities, colleges and research institutions, spread from Newfoundland to British Columbia, provide an essential part of the NCE foundation, including:

- the salaries of academic researchers;
- research facilities;
- support for network administration; and
- a pool of unique human-resources students and postdoctoral fellows trained by the networks.

British Columbia	AquaNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	MWPN	PENCE	SCN	SFM
Malaspina University College	✓																		
Simon Fraser University	✓	✓					✓	✓		✓	✓	✓		✓	✓				
University of British Columbia	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
University of Northern British Columbia																			✓
University of Victoria	✓	✓			✓	✓		✓			✓	✓		✓	✓	✓	✓		✓

Alberta	AquaNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	MWPN	PENCE	SCN	SFM
University of Alberta		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
University of Calgary		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
University of Lethbridge									✓	✓									

Saskatchewan	AquaNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	MWPN	PENCE	SCN	SFM
University of Regina		✓					✓			✓		✓		✓	✓				✓
University of Saskatchewan				✓	✓				✓	✓	✓	✓	✓	✓	✓		✓		✓

Manitoba	AquaNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	MWPN	PENCE	SCN	SFM
University of Manitoba		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓		✓
University of Winnipeg															✓				✓

Ontario	AquaNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	MWPN	PENCE	SCN	SFM
Brock University								✓		✓									
Carleton University		✓					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Huron University College								✓											
Lakehead University												✓				✓			✓
Laurentian University											✓								
McMaster University	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Nipissing University		✓																	
Queen's University	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Royal Military College of Canada		✓								✓	✓								
Ryerson Polytechnic University		✓								✓	✓			✓					✓
Trent University									✓										✓
University of Guelph	✓	✓	✓		✓			✓		✓	✓	✓			✓		✓		✓
University of Ottawa	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓
University of Toronto		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
University of Toronto Joint Centre for Bioethics					✓														
University of Waterloo	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
University of Western Ontario		✓	✓		✓		✓	✓	✓		✓	✓			✓	✓	✓	✓	✓
University of Windsor		✓					✓			✓	✓	✓		✓					
Wilfrid Laurier University	✓	✓					✓	✓		✓	✓			✓					
York University		✓			✓		✓				✓	✓			✓				

Québec	AquaNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	MWPN	PENCE	SCN	SFM
Concordia University	✓	✓						✓	✓		✓	✓	✓	✓	✓	✓			✓
École des Hautes Études Commerciales		✓													✓				
École Polytechnique de Montréal		✓	✓				✓			✓		✓	✓	✓	✓	✓			
Institut des sciences de la mer à Rimouski											✓								
Institut national de la recherche scientifique			✓				✓			✓	✓			✓					
Eau, Terre et Environnement											✓								
Énergie et Matériaux							✓							✓					
Géoressources / Centre Géoscientifique de Québec											✓								
Institut Armand-Frappier			✓							✓									
Urbanisation											✓								
McGill University		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Université de Montréal		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓
Université de Sherbrooke		✓	✓		✓		✓		✓		✓	✓	✓		✓				✓
Université du Québec à Chicoutimi																			✓
Université du Québec à Montréal					✓			✓			✓				✓				✓
Université du Québec à Rimouski	✓																		✓
Université du Québec à Trois-Rivières		✓									✓				✓	✓			✓
Université du Québec en Abitibi-Témiscamingue																			✓
Université du Québec en Outaouais							✓				✓								
Université Laval	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓			✓	✓

Institut National de la recherche scientifique

New Brunswick	AquaNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	MWPN	PENCE	SCN	SFM
Mount Allison University	✓						✓									✓			
Université de Moncton	✓							✓			✓								✓
University of New Brunswick	✓	✓					✓			✓	✓				✓	✓			✓
University of New Brunswick - Saint-John	✓																		

Nova Scotia	AquaNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	MWPN	PENCE	SCN	SFM
Acadia University								✓		✓									
Dalhousie University	✓	✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
Nova Scotia Agricultural College	✓									✓									
Saint Mary's University	✓										✓								
St. Francis Xavier University	✓				✓		✓	✓											

Prince Edward Island	AquaNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	MWPN	PENCE	SCN	SFM
Holland College										✓									
University of Prince Edward Island	✓							✓	✓	✓									

Newfoundland and Labrador	AquaNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	MWPN	PENCE	SCN	SFM
Memorial University of Newfoundland	✓							✓	✓	✓	✓	✓			✓				✓

YEAR'S HIGHLIGHTS:

Knowledge and Technology Exchange and Exploitation

At present, 6,779 highly qualified professionals — researchers in academia, industry, government and other organizations, research associates, postdoctoral fellows and graduate students — work in the NCEs, developing new ideas and turning them into marketable products and services.

In an important contribution to the cross-fertilization of research and technology, these NCE professionals authored 3,075 refereed publications in 2002–03. The networks filed 80 patents, of which 35 have been issued so far. In the area of licences, 17 have been granted while a further 21 are under negotiation. Five spin-off companies were also established.

YEAR'S HIGHLIGHTS:

High-Quality Training

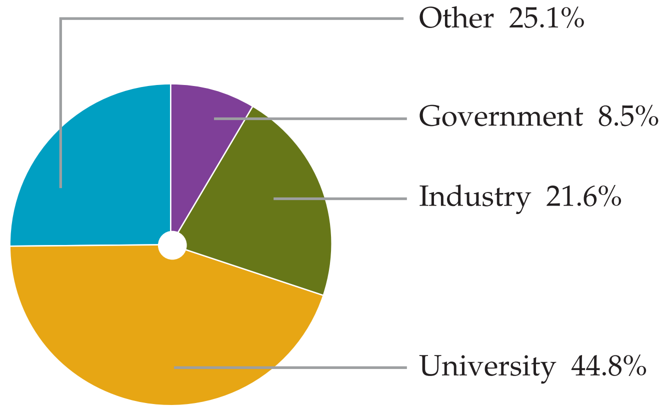
Among the most visible impacts of the NCE program is the training of highly qualified people who will maintain the competitiveness of Canada's economy. Each year, hundreds of graduate students find high-quality jobs in industry, bringing with them the best research training available and a clear understanding of the challenges facing Canadian companies in the global market.

The NCEs involve many young Canadians in research well before they graduate. The GEOIDE Network, for example, is preparing Canadian students for careers in geomatics, which is the science and technology of managing and using geographic information.

Training and keeping the skilled talent needed for the emerging geomatics industry is extremely important for Canada, so the early results of the GEOIDE students' network are very encouraging: 75 percent of Canadian students and 50 percent of students from abroad intend to stay in Canada following graduation.

The chart below shows that after their NCE training, 21.6% of students find work in an industry related to their field of studies while 44.8% continue working in an academic milieu. Government and other sectors are also employers of choices for NCE trained students.

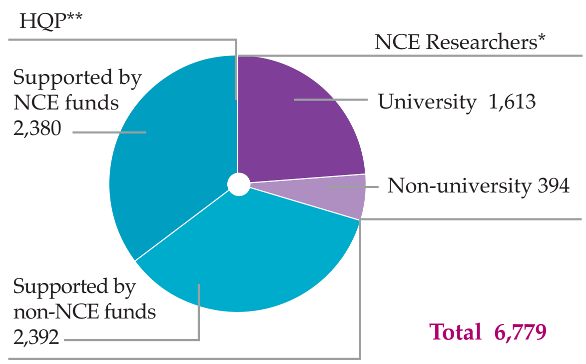
POST-NETWORK EMPLOYMENT BY SECTOR



As shown in the chart below, 6,779 professionals worked within the NCE program, including 4,772 highly qualified people such as research associates and technicians, and research trainees such as postdoctoral, graduate students and summer students.

REGIONAL DISTRIBUTION OF NCE RESEARCHERS AND PERSONNEL

	NCE Researchers*			HQP**			
Province / Territory	University	Non-university	Total	Supported by NCE funds	Supported by non-NCE funds	Total	**Total Personnel**
BritishColumbia	274	30	304	292	305	597	**901**
Alberta	246	13	259	340	351	691	**950**
Saskatchewan	31	8	39	25	29	54	**93**
Manitoba	31	12	43	55	62	117	**160**
Ontario	592	235	828	891	939	1,831	**2,658**
Quebec	314	76	390	559	574	1,132	**1,522**
New Brunswick	39	9	48	59	32	91	**139**
Nova Scotia	59	11	70	103	69	173	**243**
Prince Edward Island	9	0	9	18	5	24	**33**
Newfoundland	17	0	17	38	26	64	**81**
Total	1,613	394	2,007	2,380	2,392	4,772	**6,779**

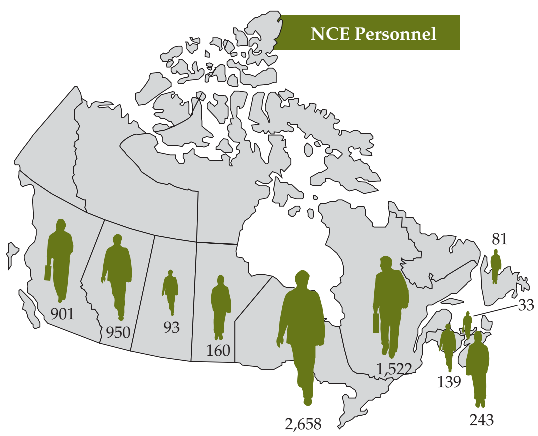


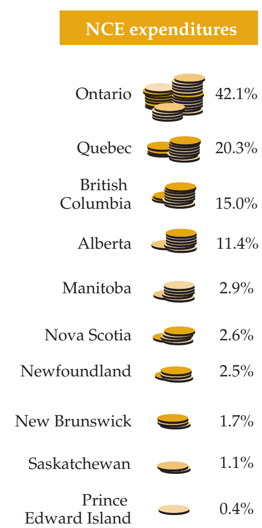
* An NCE researcher is a researcher from the academic, public or private sector responsible for certain aspects of a network-funded research project.

** Highly Qualified Personnel means research staff such as research associates and technicians, and research trainees such as postdoctoral fellows, graduate students and summer students

In 2002–2003, the participating institutions expended $79.2 million of NCE funds in direct research costs.

REGIONAL DISTRIBUTION OF NCE PERSONNEL AND FUNDS	NCE Researchers*		HQP**		NCE expenditures	
Province / Territory	Total	Percentage	Total	Percentage	Total	Percentage
British Columbia	304	15.1%	597	12.5%	$11,855,535	15.0%
Alberta	259	12.9%	691	14.5%	$8,998,919	11.4%
Saskatchewan	39	1.9%	54	1.1%	$887,392	1.1%
Manitoba	43	2.1%	117	2.4%	$2,293,634	2.9%
Ontario	828	41.2%	1,831	38.4%	$33,385,012	42.1%
Quebec	390	19.4%	1,132	23.7%	$16,081,725	20.3%
New Brunswick	48	2.4%	91	1.9%	$1,378,669	1.7%
Nova Scotia	70	3.5%	173	3.6%	$2,078,850	2.6%
Prince Edward Island	9	0.4%	24	0.5%	$314,192	0.4%
Newfoundland	17	0.8%	64	1.3%	$1,975,369	2.5%
Total	**2,007**	**100%**	**4,772**	**100%**	**$79,249,298**	**100%**





*An NCE researcher is a researcher from the academic, public or private sector responsible for certain aspects of a network-funded research project.

** Highly Qualified Personnel means research staff such as research associates and technicians, and research trainees such as postodoctoral fellows, and graduate and summer students.

The regional distribution of NCE funds shows only reported expenditures by each participatinginstitution for 2001–02.

The regional distribution of NCE funds are expenditures reported by each participating network institution in 2002–03. These expenditures are drawn against NCE funds provided in 2002–03 and carried over from previous years.

YEAR'S HIGHLIGHTS:
Choosing the Best Networks

The Mid-Term Review: Funding Renewal

In December 2002, the Minister of Industry, the Honourable Allan Rock, announced an investment of $39 million over four years to sustain the activities of three federal Networks of Centres of Excellence:

- **AquaNet — Network in Aquaculture**
  AquaNet sponsors 39 research projects devoted to improving the country's aquaculture industry through higher productivity, through sustaining the quality of the marine environment and through helping participants deal with the social and economic aspects of their enterprise.
- **The Canadian Network for Vaccines and Immunotherapeutics (CANVAC)**
  CANVAC is a network of leading Canadian scientists specializing in the fields of immunology, virology and molecular biology. CANVAC's researchers and partners are developing vaccines for the prevention and treatment of chronic diseases such as cancer, AIDS and hepatitis C.
- **The Canadian Stroke Network (CSN)**
  The Canadian Stroke Network was established to create a national consortium with the capacity to enhance our knowledge of stroke, to develop new treatment plans and medical technologies that will improve individual outcomes, and to help create policies that will benefit the country as a whole.

Launch of the 2005 Competition for New Networks

An open competition that began in 2003 will lead to the creation of new Networks of Centres of Excellence in 2005. Approximately $10 million will be available annually to support these networks. Researchers and their partners from the private and public sectors were invited to submit letters of intent, a process completed in September 2003.

The 2003 Competition for New Networks

The 2003 Competition for New Networks elicited 53 letters of intent, which were reviewed by the NCE Selection Committee.

The NCE Steering Committee invited the seven groups described in the table below to submit full applications by the deadline of March 7, 2003. Final selection of the new networks will be completed by the summer of 2003.

New networks are selected and funded on the basis of peer-reviewed competitions. Networks now compete for seven years of NCE funding, and a maximum of two seven-year funding cycles is available to each network.

Groups invited to submit full NCE applications by March 7, 2003

SCIENTIFIC DIRECTOR	NAME OF NETWORK	HOST INSTITUTION
Judah Denburg	Allergy, Genes and Environment Network (ALLERGEN)	McMaster University
Rickey Yada	Canadian Advanced Foods and Biomaterials Network (CAFBN)	University of Guelph
Francis Ouellette	Canadian Bioinformatics Integration Network (CBIN)	University of British Columbia
Tak Hang Chan	Canadian Green Chemistry Network (CGCN) — Towards a Bio-based Economy with Sustainable Materials and Renewable Technology (BIOSMART)	McGill University
Michael Sefton	Canadian Regenerative Medicine Network (CRM-Net)	University of Toronto
Louis Fortier	Network for the Cross-sectorial Study of the Changing Canadian Arctic (ArcticNet)	Université Laval
Raymond Laflamme	Quantum Information (QI)	University of Waterloo

The Selection Committee recommends the annual grant amounts to be allocated to each new network, and the Steering Committee makes the final decision on the funding. The NCE Directorate informs the applicants of the competition results.

The funding of existing networks is also reviewed at regular intervals to ensure that they are meeting the NCE program objectives. The existing networks are at various stages of their funding cycles, as described below.

Overview of Networks' Funding Cycles

Network Name	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
AquaNet	MT			RC				MT			RMF			
AUTO21		MT			RC				MT			RMF		
CAN			RC				MT			RMF				
CANVAC	MT			RC				MT			RMF			
CBDN			RMF											
CGDN			RMF											
CIPI			RC				MT			RMF				
CLLRNET		MT			RC				MT			RMF		
CSN	MT			RC				MT			RMF			
CWN		MT			RC				MT			RMF		
GEOIDE			RC				MT			RMF				
IRIS			RMF											
ISIS				MT			RMF							
Micronet			RMF											
MITACS			RC				MT			RMF				
MWPN														
PENCE			RMF											
SCN		MT			RC				MT			RMF		
SFM				MT			RMF							

- 1st funding cycle
- 2nd funding cycle
- RMF Funding
- Future funding if successful in mid-term review and/or funding competition

RC Competition for renewal of last funding cycle
MT Mid-term review
RMF Research Management Fund

YEAR'S HIGHLIGHTS:

The Annual Meeting

The primary objective of the NCE Annual Meeting is to enable the scientific leaders, network managers and the Chairs of the Boards of Directors of the 21 networks to share their knowledge, both among themselves and with the NCE Directorate, about best practices — the most efficient and effective ways to run their "institutes without walls."

This exchange of knowledge is of key importance to NCE scientific leaders and network managers who, because they operate their networks as research consortia, are faced with challenges such as:

- deciding whether to incorporate their network;
- handling intellectual property, licensing and start-up companies;
- dealing with performance indicators;
- coordinating multi-disciplinary institutional projects;
- moving research to licensable technology; and
- conducting their activities on the international scene.

They are also faced with the challenge of communicating the results of their research, not only to their researchers but also to the media, members of Parliament and the public at large. By using the Annual Meeting to share best practices, NCE leaders and managers can learn from each other and thus operate their networks with increased efficiency and effectiveness.

An equally important objective of the Annual Meeting is to offer the NCEs an opportunity to expand their array of partnerships and to promote themselves and the NCE program to local industrial, government andnot-for-profit sectors. This is done through a breakfast and panel discussion with the local business community. This year, the session was carried out in partnership with the Ottawa Centre for Research and Innovation (OCRI) and the Ottawa Life Sciences Council (OLSC). Its objective was to inform business people how they can help their businesses prosper through NCE partnerships. The keynote speaker was Dr. Jack Gauldie of the Canadian Network for Vaccines and Immunotherapeutics. Dr. Gauldie is also Chair of McMaster University's Department of Pathology and Molecular Medicine, and Director of the Centre for Gene Therapeutics in the Institute for Molecular Medicine and Health.

Panelists at the meeting were:

Dr. Peter R. Frise, P.Eng., FCAE
University of Windsor
Program Leader, AUTO21

Dr. Paul Morley
National Research Council
Deputy Scientific Director, Canadian Stroke Network

Dr. Shahram Tafazoli
President
Motion Metrics Inc.

BENEFITS

Through their research and entrepreneurship, the Networks of Centres of Excellence work to deliver economic and social benefits to Canadians. Some contribute in ways that affect people immediately — in medicine and education, for example. Others team with industry to bring new products and processes to the marketplace. Some are closely allied to government, while others are committed to basic research. But all, either directly or indirectly, have the potential to improve the lives of Canadians.

Benefits for Canadians

From medicine to farm management, the work of the NCEs affects the lives of Canadians today and in the future.

Benefits for Industry

NCEs make an essential contribution to Canadian competitiveness by helping our economy's products and processes excel in quality, efficiency and cost-effectiveness.

Benefits for Government

Governments at both the federal and provincial level are key stakeholders in the NCEs, and the research carried out by the networks can assist them in making decisions and developing policy.

Benefits for Research

Research of the highest quality is the foundation of progress. With top-class research leaders and superior research environments, the NCEs produce results that are unexcelled anywhere in the world.

Use the following chart to locate each Benefit Success Story and its corresponding page.

PG	32	34	36	46	38	40	42	44	48	50	52	54	56	60	62	58	64	66	68
	AquaNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	MWPN	PENCE	SCN	SFM
Benefits for Canadians		✓	✓	✓		✓		✓	✓	✓								✓	✓
Benefits for Industry	✓		✓	✓	✓		✓			✓	✓			✓	✓	✓			
Benefits for Government	✓			✓				✓		✓			✓					✓	✓
Benefits for Research				✓		✓					✓	✓	✓				✓	✓	

THE NETWORKS

There are 19 NCEs across Canada. You'll probably find at least one of them in your province or region.

AquaNet — Network in Aquaculture

Farming at sea: Atlantic researchers study the biological and economic benefits of ntegrated aquaculture

AUTO21 — The Automobile of the 21st Century

Survey finds high misuse of child seats: AUTO21 researchers launch program to protect a vehicle's smallest passengers

Canadian Arthritis Network

Trials of hope: Canada taking global lead in clinical trials for rheumatoid arthritis

Canadian Bacterial Diseases Network

Linking experts: New vaccine offers hope for Canadian beef industry

Canadian Genetic Diseases Network

Bringing scientists together: CGDN meeting leads to new hope for treating Legionnaire's Disease

Canadian Institute for Photonic Innovations

From scalpels to telecom: Canada takes lead in developing ultra-fast optical lasers for industry

Canadian Language and Literacy Research Network

Pinpointing success: Educators partner to raise literacy skills among Canada's most disadvantaged

Canadian Network for Vaccines and Immunotherapeutics

Global networking: Canadian group spearheads AIDS research project

Canadian Stroke Network

Pushing the frontiers: Innovative technology connects northern patients to experts in urban centres

Canadian Water Network

Managing Canada's farms: Researchers work with farmers to safeguard the environment and their livelihoods

GEOIDE — Geomatics for Informed Decisions Network

Canada's newest brain gain: Young researchers fuel Canada's lead in geomatics

Institute for Robotics and Intelligent Systems

Helping future research stars: New robotics program supports young academics with new ideas

ISIS Canada — Intelligent Sensing for Innovative Structures

Seeing inside structures: Fibre-optic sensing pays off in safer, longer-lasting structures

Mechanical Wood-Pulps Network

Whiter paper at lower cost: Irving Paper among first companies to adopt new bleaching process

Micronet — Microelectronic Devices, Circuits and Systems

Small machines for small chips: DFT Microsystems hits market running with Micronet support

MITACS — Mathematics of Information Technology and Complex Systems

MITACS and IRIS research spurs spin-off: Smart data mining helps insurance companies identify high risk drivers

PENCE — Protein Engineering Network

Fatalistic attraction: Canadian-developed biochip pushes science beyond the human genome

Stem Cell Network

A unique global resource: Canadian Web site provides one-stop source for stem-cell legislation and policy

Sustainable Forest Management Network

Responsible forest harvesting: SFM helps First Nations to balance economy and tradition

THE NETWORKS

Networks at a Glance

NETWORKS AT GLANCE

Domain
- Natural Resources and Environment
- Engineering and Manufacturing
- Health, Human Development and Biotechnology
- Advanced Technologies

Networks	Funding Period	NCE Award	Network researchers*	HQP**	Universities***	Industries***	Government departments/ agencies and others***	Total organizations
AquaNet	1999-2006	$3,600,000	122	255	25	47	38	110
AUTO21	2000-2005	$4,919,000	253	246	39	74	46	159
CAN	1998-2005	$4,318,000	118	154	22	35	48	105
CANVAC	1999-2006	$4,700,000	70	170	18	36	55	109
CBDN	1989-2005	$4,190,000	275	237	46	33	45	124
CGDN	1989-2005	$4,858,000	44	217	10	33	66	109
CIPI	1999-2005	$3,615,000	81	174	25	42	15	82
CLLRNet	2000-2005	$3,022,000	107	81	30	7	33	70
CSN	1999-2006	$4,700,000	66	211	23	10	29	62
CWN	2000-2005	$3,171,000	29	235	33	54	126	213
GEOIDE	1998-2005	$3,310,000	85	316	60	51	43	154
IRIS	1989-2005	$4,730,000	92	272	19	91	21	131
ISIS	1995-2006	$3,200,000	74	224	16	48	22	86
Micronet	1989-2005	$2,560,000	69	392	20	72	13	105
MITACS	1998-2005	$4,012,000	99	449	31	81	38	150
MWPN	1989-2002	$311,000	45	0	16	8	2	26
PENCE	1989-2005	$5,023,000	86	128	16	63	29	108
SCN	2000-2005	$4,496,000	184	341	15	19	23	57
SFM	1995-2006	$4,100,000	65	412	39	26	25	90

Network researchers: includes Canadians and foreigners
** HQP: means Highly Qualified Personnel including research staff (research associates and technicians) and research trainees (postdoctoral fellows, graduate and undergraduate students)
***Including Canadian and foreign organizations

N.B. In 2002-03, the NCE program awarded $580,000 to the Health Evidence Application and Linkage Network and $915,000 to the TeleLearning Network to wind down their operations, and $170,000 to the seven groups invited to submit full applications as part of the 2003 competition for new networks.

BENEFITS BY SECTOR INDEX

The work of the NCEs covers a wide range of sectors and disciplines. To explore the benefits that flow from particular areas of NCE research and development, use the following chart to locate each Benefit Success Story and its corresponding page.

PG	32	34	36	46	38	40	42	44	48	50	52	54	56	60	62	58	64	66	68
	AquaNet	AUTO21	CAN	CANVAC	CBDN	CGDN	CIPI	CLLRNet	CSN	CWN	GEOIDE	IRIS	ISIS	Micronet	MITACS	MWPN	PENCE	SCN	SFM
Aboriginal people																			✓
Advanced technologies							✓		✓		✓	✓	✓	✓	✓		✓		
Agriculture and agri-food	✓				✓					✓									
Aquaculture	✓																		
Automotive industry		✓																	
Biotechnology	✓		✓	✓	✓	✓											✓		
Child development and literacy								✓											
Civil infrastructure													✓						
Environment										✓			✓						✓
Forest products manufacturing																✓			✓
Health			✓	✓		✓	✓		✓								✓	✓	
Natural Resources	✓									✓						✓			✓

BENEFITS

Aquanet — Network in Aquaculture

Farming at sea: Atlantic researchers study the biological and economic benefits of integrated aquaculture

One of the world's leading teams developing open-ocean integrated aquaculture is showing that sea farmers can successfully grow finfish, shellfish and seaweed together.

Aquaculture operations, more commonly known as fish farms, are at an environmental and economic crossroad. Monocultures of finfish, shellfish or seaweed in coastal waters are showing their limitations in different parts of the world, in a way very similar to monoculture practices on land.

"We need to combine fed aquaculture (finfish) with extractive inorganic aquaculture (seaweed) and extractive organic aquaculture (shellfish) to balance each other, so that the nutrients from the salmon farms are converted into other crops that have a value," says Dr. Thierry Chopin, the principal investigator who is working with the federal government's Department of Fisheries and Oceans (DFO) on one of the world's leading projects on open-ocean, pre-industrial-sized, integrated aquaculture.

Launched in 2001, this "polyculture" project is located in the Bay of Fundy, near St. Andrews, New Brunswick, at commercial salmon farms operated by Heritage Salmon Inc., a partner in the Aquanet-funded research project. To create the polyculture operation, Dr. Chopin's team built on the existing infrastructure to integrate kelp and blue mussel production into the salmon farms.

"For me, one of the biggest advantages of this research with AquaNet is the multidisciplinary aspect at the scale of a commercial salmon operation," says Dr. Chopin, a professor of marine biology at the University of New Brunswick. "It was through AquaNet that I was able to put together a team of biologists, economists, social scientists, government regulators and industry partners."

The results are providing important insights into polyculture's potential. Additional nutrients from the salmon operation stimulated a 46 percent increase in the growth of kelp at the salmon farm, compared to kelp at a reference site. Similarly, the polyculture site's blue mussel growth was up to 100 percent greater than at reference sites, and the mussels reached commercial size faster.

"We now have enough data to say that polyculture makes sense biologically," says Dr. Chopin, noting that to date the project

The mussel taste test

Dr. Shawn Robinson, a co-investigator from DFO on the AquaNet integrated aquaculture project, wondered if blue mussels grown alongside salmon would taste fishy. The answer is critical to the commercial viability of polyculture – the practice of growing more than one species at the same location. In this case, mussel and kelp were grown alongside salmon.

"We performed scientifically designed taste tests with mussel connoisseurs. They couldn't distinguish our polycultured mussels from mussels from other sites," says Dr. Robinson.

In partnership with the Canadian Food Inspection Agency, the food safety component of the project is ensuring that the polycultured mussels and kelp do not pick up the therapeutants used in salmon farming. Two years of data show that they don't accumulate these chemicals and are safe to eat.

has trained nine graduate students in world-class polyculture research. “What we now need to show is that it makes economic and social sense.”

An economics student and a social-science student are working to do just that. Starting in the summer of 2003, with the support of the Atlantic Canada Opportunity Agency, they are studying the market and acceptability potentials of integrated aquaculture.

The AquaNet project also involves partnerships with two key Canadian companies involved in the development of seaweed products, Acadian Seaplants Limited and Ocean Nutrition Canada. Although there are as yet no commercial kelp harvesting operations in Canada, the industrial partners hope that this will change. They are helping to analyse the kelp grown at the polyculture site, comparing it with kelp from reference sites. The goal is to target profitable niche markets such as nutraceuticals, sea vegetables and feed ingredients for other aquacultured organisms.

The mission of AquaNet, Canada’s Network of Centres of Excellence for aquaculture, is to foster a sustainable aquaculture sector in Canada through high-quality research and education. Established in 1999, AquaNet is a collaborative research network involving universities, industry, government and non-government organizations.

www.aquanet.ca

BENEFITS

AUTO21 — The Automobile of the 21st Century

Survey finds high misuse of child seats: AUTO21 researchers launch program to protect a vehicle's smallest passengers

How safely are parents strapping their children into car seats? Not safely enough, according to researchers heading up an AUTO21 project looking into children and vehicle safety.

As an intensive care unit nurse, Dr. Anne Snowdon saw more than her fair share of children killed or seriously injured in car accidents. Vehicle collisions are the leading cause of death among young children in both Canada and the United States, and Dr. Snowdon is working to change that grim fact by teaching both parents and children the proper use of child safety seats.

"I have looked after an awful lot of kids who had been in vehicle collisions and did not survive," says Dr. Snowdon. "I watched families and parents across the bedside from me crumbling at either the loss of their child or the severity of their injuries."

Dr. Snowdon is an Associate Professor of Nursing for the University of Windsor. She and Dr. Janice Polgar, an Associate Professor in the School of Occupational Therapy at the University of Western Ontario, are the lead researchers on a four-year, $1.7-million research initiative, supported by AUTO21 and DaimlerChrysler Canada, to look at how parents use child safety seats.

Some 80 per cent of child safety seats are installed incorrectly, which can lead to lethal consequences. A common injury is "jack-knifing" – when the child's head and shoulders are violently thrown forward. Another injury, called "seatbelt syndrome" occurs when the lap belt pulls across the soft part of the child's abdomen, causing internal injuries.

As part of the research project, the team surveyed nearly 20,000 parents in the Windsor-Essex region on their knowledge and use of safety seats. The most startling discovery was that children aged between 18 months and four years are often at the greatest risk because parents prematurely move them from one safety system to another.

Designing Smarter Dummies

Ford Motor Company is lending its support to an AUTO21 project that's using computer "dummies" to better protect children in frontal collisions.

Led by Dr. Andrew Howard, an orthopedic pediatric surgeon at the Hospital for Sick Children in Toronto, the project uses computer-simulated child dummies to investigate how restraint systems can be improved to avoid the specific injuries children often receive in frontal collisions. The goal is to develop simulations that allow for rapid and inexpensive testing of design prototypes.

The project uses real-life case studies and numerical simulation to determine the accuracy of the computer program. Researchers anticipate that the model can be applied later to other types of collisions.

Ford is a key industry supporter of this project, providing more than $50,000 each year over the project's three-year duration.

"The three- and four-year-olds, for example, are being moved to lap and shoulder belts that were essentially designed for adults," says Dr. Snowdon. "Parents think that because their child weighs 40 pounds, it's okay."

The next phase of the project begins this fall with a targeted educational program for both parents and children. The pilot program includes a series of learning tools for children, such as a book and a "safety inspector" kit.

"The main problem is that children grow and develop and need new safety strategies, so parents need ongoing education," Dr. Snowdon explains. "We need a system that will carry parents and children forward and that's what this intervention study is about."

One of the main advantages of AUTO21 and the Networks of Centres of Excellence, says Dr. Snowdon, is that the program offers researchers and graduate students from multiple disciplines a rare opportunity to work together to solve complex problems. This project involves trauma surgeons, nurses, kinesiologists, occupational therapists, mechanical engineers and graduate students from four universities.

"Without the NCE, it would have been very difficult to design an intervention program that will have long-lasting impact on children's lives," she says. "The NCE is also helping train a new breed of researchers who get experience at the graduate level in working with students from several other disciplines."

The results of the intervention program are expected to form the basis of a program in provinces across Canada. DaimlerChrysler Canada plans to incorporate the results into its "Fit for a Kid" safety program.

"For me, this project is not so much about the research or the funding," says Dr. Snowdon. "It's about getting families to use a safety system in a way that prevents a terrible outcome for their child in a car accident."

www.auto21.ca

BENEFITS

Canadian Arthritis Network (CAN)

Trials of hope: Canada taking global lead in clinical trials for rheumatoid arthritis

When Dr. Ed Keystone saw the pain in the faces of his patients, he believed he could offer them hope. That hope arrived late in 2003, when Canada began offering pharmaceutical companies one-stop shopping for world-class rheumatology clinical trials.

It was in the late 1990s when a promising new generation of treatments for rheumatoid arthritis caught the attention and the imagination of a rheumatologist at Toronto's Mount Sinai Hospital. Called biologics, this new avenue of attack on this crippling disease prompted an explosion of clinical trials to test the effectiveness of the drugs.

"I realized that Canada had to compete in the world for these clinical trial studies, because we want our patients who are failing with conventional therapies to have access to new therapies that wouldn't ordinarily be available," says Dr. Keystone, who is also the Clinical Director of the Canadian Arthritis Network (CAN), one of the Networks of Centres of Excellence.

To attract the industry-sponsored clinical trials, Dr. Keystone and CAN spearheaded the creation of the Canadian Rheumatology Research Consortium (CRRC). Established in February 2003 with initial funding from CAN, the CRRC is a non-profit corporation in partnership with CAN. It will soon provide pharmaceutical companies with one-stop shopping for world-class rheumatology clinical trials. Dr. Keystone is its Chairman.

While there are clinical research consortia in other areas of medicine, Dr. Keystone emphasizes that the CRRC works uniquely closely with industry. For example, CAN facilitated a meeting with 15 Canadian pharmaceutical companies to assess their needs in a potential new consortium. As the CRRC attracts millions of dollars in additional research and development investment, it will be a significant boon for Canadian pharmaceutical companies. "We want to do this in partnership with industry," says Dr. Keystone, "and we want industry to win. We want our patients to win. And we want Canadian rheumatology research to win."

Already, 46 clinicians in eight provinces are involved with the CRRC, which became operational in late 2003. The consortium will offer pharmaceutical companies a single budget and a confidentiality agreement to cover all participating trial sites. It will operate on a competitive fee-for-service basis, with revenue going towards arthritis research.

The CRRC is also creating a national, clinical database of rheumatoid patients, providing investigators with unparalleled information for rapid and focused patient recruitment.

Clarifying the consent process

Patients considering clinical trials can face a daunting task when it comes to deciding whether to participate. "Consumer advocates have voiced their concerns about the language in clinical trial consent forms, which is very complex and often written in legalese, combined with difficult medical terminology," says Linda Bennett, Executive Director of the new Canadian Rheumatology Research Consortium (CRRC).

In an effort to improve the quality of rheumatology clinical trials in Canada, arthritis patients, industry and CRRC will explore ways to ensure that study participants have a clear understanding of all aspects of clinical research. This will improve the recruitment of patients into clinical trials, while ensuring that Canadian patients experience the best clinical trial practices in the world.

It will also ensure that Canadian patients across the country are made aware of clinical trial opportunities.

"The partnership between CAN and the CRRC has it all," says Linda Bennett, CRRC's Executive Director. "It engages basic scientists, academic and community-based rheumatologists, arthritis patients and industry partners. It really does bring together all stakeholders with an interest and expertise in rheumatoid arthritis."

The CRRC will not only improve the efficiency of rheumatology research in Canada. It will also improve its quality through site quality assurance and an accreditation system for all its investigators and site coordinators, a first for any Canadian consortium. The wealth of clinical expertise within CRRC will help basic scientists in their efforts to further understand the disease.

Rheumatoid arthritis is a painful inflammatory joint disease, affecting some 300,000 Canadians, two-thirds of them women. Half of those who develop the disorder can no longer work within 10 years of its onset.

www.arthritisnetwork.ca

BENEFITS

Canadian Bacterial Diseases Network (CBDN)

Linking experts: New vaccine offers hope for Canadian beef industry

Bioniche Life Sciences is one step closer to marketing a new vaccine that could save North America's cattle industry millions of dollars annually. It's an innovation that might never have happened had it not been for three university scientists and the Canadian Bacterial Diseases Network, which brought them together.

The Canadian cattle industry has weathered several storms in recent years, the most devastating of which has been bovine spongiform encephalopathy (BSE), or mad cow disease. But what most people don't know is that the North American cattle industry loses $1 billion annually because of bovine respiratory disease (BRD), commonly known as shipping fever. *Haemophilus somnus (H. somnus)* is one of the major pathogens associated with shipping fever and one of the leading bacterial causes of economic loss to beef producers. Vaccines for *H. somnus* have been on the market for 15-20 years, yet more cases appear every year.

"Clearly that's an indication that these vaccines need improvement in their ability to protect against respiratory infection," says Dr. Andrew Potter, a molecular bacteriologist at the University of Saskatchewan's Vaccine and Infectious Disease Organization (VIDO). Dr. Potter, who started the project, along with VIDO's Director Dr. Lorne Babiuk and Dr. Anthony Schryvers at the University of Calgary, have developed what they think could be the answer to the *H. somnu* problem.

Scattered across Western Canada, the scientists found each other through the Canadian Bacterial Diseases Network (CBDN), a Network of Centres of Excellence. "I met Andy (Potter) and Lorne Babiuk through CBDN meetings," says Schryvers. "That's what prompted us to explore using these receptor proteins in veterinary pathogens."

Schryvers came aboard through his long-standing interest in specific proteins that are involved in iron acquisition in pathogenic bacteria. He says they are ideal targets for vaccines because of the critical function they play as transferring-binding proteins. "We thought we had complementary expertise that would be needed to develop the vaccine," explains Potter.

Their goal was to identify which proteins the bacteria uses to acquire nutrients in the host — in this case, iron. The theory was that if cattle were vaccinated with these proteins and developed antibodies against them, bacteria would not be able to obtain this critical nutrient and would die.

What differentiates this team's vaccine from those already on the market is its use of recombinant DNA technology, which allows

H. somnus was originally identified decades ago as causing a neurological disorder in cattle called infectious thrombotic meningoencephalitis. Since that time, the organism has been associated with a number of other disease manifestations, including pneumonia, arthritis, myocarditis and septicemia. These are collectively referred to as bovine hemophilosis.

The cost of bovine respiratory disease extends beyond animal deaths. Other losses are sustained in the form of reduced weight gains, antibiotics and poor quality meat and hide products.

For Canada's struggling beef industry, a more effective vaccine could mean a savings of at least $25 million per year. "What it means for cattle farmers is essentially the availability of a tool to reduce economic losses," says Dr. Andrew Potter, a researcher at the Vaccine and Infectious Disease Organization.

large quantities to be made in a very pure form. The result is a safer product capable of inducing a better immune response than conventional vaccines.

A series of vaccine trials conducted over four-to-five years proved their theory. One of the two proteins they used — TbpB — is involved in iron acquisition and appears to be a protective antigen. A second protein, LppB, is a major protective antigen produced by all strains of *H. somnus* examined to date.

CBDN provided early-stage funding to demonstrate proof of concept for the work, which Potter says is "absolutely critical" and helped to protect the intellectual property. "No company is going to get involved if you can't show that it actually works."

Having proven that the vaccine works in a controlled setting with material produced in a research laboratory, the next stage is demonstrating that vaccine produced under commercial manufacturing conditions is effective in both small- and large-scale trials. Their commercial partner, Bioniche Life Sciences Inc. of Belleville, Ontario, will make the large number of doses needed to carry out these efficacy studies.

Potter adds that CBDN's expertise in technology transfer will help accelerate the vaccine's move into the marketplace. "Any time you deal with partnerships, especially with the commercial sector, there needs to be one body that can deal with the external interactions."

Schryvers agrees that the network was important in the discovery. "That's one of the values of CBDN, that these kinds of relationships develop over the years and you see some basic research actually get into application," he says.

The CBDN's managing director stresses, however, that the researchers deserve all the credit for the development. "They are really the ones who are going to take the technology further into developing a new vaccine," says Ying Gravel. "CBDN has funded the work, but ultimately it's a good thing that has gone out into the user sector to be developed into a real product."

www.cbdn.ca

BENEFITS

Canadian Genetic Diseases Network (CGDN)

Bringing scientists together: CGDN meeting leads to new hope for treating Legionnaire's Disease

Sometimes a great discovery begins by being in the right place at the right time. That's what happened in 1996, when Drs. Alex MacKenzie and Philippe Gros began sharing ideas at a scientific meeting of the Canadian Genetic Disease Network (CGDN) in Vancouver. They have since made a groundbreaking discovery in the battle against Legionnaire's Disease.

It was almost by chance that Drs. MacKenzie and Gros discovered that their different fields of study weren't so different after all. Dr. MacKenzie, a CGDN investigator at the Children's Hospital of Eastern Ontario, had identified a gene called Naip while screening for the gene that causes Spinal Muscular Atrophy, a fatal neurological disease in children. Dr. Gros, a professor in the Department of Biochemistry at McGill University, had been working on genetic susceptibility to Legionnaire's disease in the mouse. Their chance meeting in Vancouver sowed the seeds of what would become an important new discovery — that Naip5 plays a role in fighting Legionnaire's Disease.

A new research collaboration soon followed, involving Drs. MacKenzie, Gros and Silvia Vidal, a scientist at the University of Ottawa. Together, they determined that when a piece of DNA containing the Naip5 gene was inserted into mice, the mice became resistant to Legionella infection. Their results were published in the January 2003 issue of *Nature Genetics*.

"We have essentially discovered that a protein involved in the survival of neurons is also involved in the ability of macrophages (a part of the immune system that attacks bacteria) to control infection with Legionella," explains Dr. Gros. "With this new information, we hope to determine whether human Naip-related genes play a role in the pathogenesis of Legionnaire's Disease in people."

He adds that the Vancouver meeting presented an opportunity for him and Dr. MacKenzie to merge their two fields of study. "It's the ideal story of scientists being brought together, coming from different angles," says Dr. Gros, who is also a scientist at the McGill University Cancer Centre,

Gene discovery offers hope

CGDN researchers used a technique called "functional complementation" to identify Naip5, a gene associated with Legionnaire's Disease. Pieces of mouse chromosome 13 were inserted into mice that were susceptible to Legionella infection. When a piece of DNA containing the Naip5 gene was inserted into these same mice, they became resistant to infection.

"This shows that Legionella replication in mice is regulated by a host gene, and highlights the role of the host's genetic makeup in the infectious process," explains Dr. Silvia Vidal, a researcher at the University of Ottawa. "In the last few years, several host genes that provide protection against both viral and bacterial pathogens have been identified. We expect this process will accelerate with the development of better genomic technologies and the availability of the human and mouse genome sequences."

Legionnaire's Disease is a severe form of pneumonia that first appeared during a 1976 Legionnaire's Convention in Philadelphia, Pennsylvania. Approximately 10-15 per cent of these infections are fatal. It is typically trans-mitted to humans through aerosols produced by air conditioning cooling units, showers and faucets.

and the McGill Center for Host Resistance. “This definitely would not have come together without CGDN.”

Dr. Michael Hayden, CGDN Scientific Director and Director of the Centre for Molecular Medicine and Therapeutics in Vancouver, says one of the CGDN’s strengths is the informal collaborations it facilitates between scientists from across the country.

“One of the goals at CGDN is to foster collaboration among people, and this is an example of what can happen as a result of these chance meetings for informal interaction,” says Dr. Hayden, adding that CGDN-supported research has now led to the discovery of more than 50 genes linked to disease.

Not only was CGDN’s annual scientific meeting the launching pad for this discovery, which Gros calls a critical step to novel therapeutics in the future, but the network also funded the project from day one. It contributed approximately $75,000 (a partial figure) over the past 10 years, and supplied core facilities. The research project also received grants from the Canadian Institutes of Health Research and Innovation Quebec.

Looking ahead, the scientists say they need to better understand their discovery, including research into whether human Naip-related genes play a role in the pathogenesis of Legionnaire’s Disease in humans. “We’re still in the beginning stages, but it’s an exciting process,” adds Dr. Vidal.

www.cgdn.generes.ca

BENEFITS

Canadian Institute for Photonic Innovations (CIPI)

From scalpels to telecom: Canada takes lead in developing ultra-fast optical lasers for industry

Imagine a scalpel that cuts through bone or tissue so cleanly, it cauterizes instantly, leaving only minimal tissue damage. Canadian researchers are at the forefront of this new optical technology that is also making waves in telecommunications and manufacturing.

Breakthroughs in optical laser technology by researchers at Université Laval and across Canada are ushering in a new era in operating room procedures, telecommunications and micro-manufacturing — and further boosting Canada's global reputation for excellence in ultra-fast laser applications.

The ongoing research, funded by the Canadian Institute for Photonic Innovations (CIPI), has been making strides in developing extremely stable and compact femtosecond laser sources and amplified femtosecond systems that can be used in industrial applications.

Canada's first femtosecond laser is being commercialized by GAP Optique, a subsidiary of EXFO, a leader in test and measurement instrumentation for optical communications. The company is a long-standing affiliate of CIPI and one of the funding partners in the three-year research project, which began in 2002.

"I believe that in terms of price-to-performance ratio, this femtosecond laser is the best in the world," says Dr. Gregory Schinn, chief technology officer and director of the Research Division at EXFO. "We have already had a number of sales in Canada, based only on word of mouth. Now that the development cycle is finished, we are starting to market the product. So we're just at the beginning of the curve."

The laser design was optimized by Vincent Roy, a Ph.D. student supervised by Dr. Michel Piché at Université Laval. Laval has also been working closely with the University of Toronto, McMaster University and the University of Waterloo

Training Tomorrow's Engineers

Canada is training a new generation of experts in femtosecond laser technology through ongoing university research supported by the Canadian Institute for Photonic Innovations. In addition to the 24 graduate and undergraduate students who received training this year, the industrial partner in the project has funded two graduate student scholarships annually. EXFO also performs much of its lab work onsite at Université Laval.

"The students also provide our engineers with a fresh approach and intellectual stimulation," says Dr. Gregory Schinn, Chief Technology Officer and Director of the Research Division at EXFO. "It's very exciting to have exploratory research being undertaken within our internal R&D facilities. This is not the type of research normally funded by companies."

Project leader Dr. Michel Piché at Université Laval says the project has been a tremendous opportunity for the students to train for real-world applications and gain experience with a potential employer.

Dr. Schinn is particularly pleased with the collaboration. "In terms of openness, the general spirit of co-operation and trust and goodwill, it has been excellent. And there's a fairly high chance that commercially-useful work will come out of it."

to manipulate the laser pulses to meet the needs of various applications.

Femtosecond lasers are widely used in laboratories, but their cost and complexity have so far limited their industrial use. This new design introduces a device that is compact, reliable and applicable to industries such as medicine, dentistry, telecommunications and micro-machining. “The previous technology was expensive, difficult to operate and locked in the lab because of its size,” explains Dr. Piché. “A technician can take this laser on the road and bring it to the application. It opens up a world of new opportunities for diagnostics.”

Femtosecond lasers are able to deliver energy in extremely short bursts of light that can be focused onto areas smaller than the tip of a needle. With such concentrated power, it is possible to write 3D structures inside materials with submicron precision. One femtosecond is to one second what one second is to 31 million years.

Says Dr. Piché: “It is going to make test and measurement of the response times of telecommunication devices easier and more precise. To make faster links, we need faster components. This laser is a fundamental improvement in testing both components and networks.”

www.cipi.ulaval.ca

BENEFITS

Canadian Language and Literacy Research Network (CLLRNet)

Pinpointing success: Educators partner to raise literacy skills among Canada's most disadvantaged

How well Canada excels internationally in emerging fields such as nanotechnology, genomics and biotechnology largely depends on how well we train our youngest students in the most fundamental of curricula. It's what our grandparents liked to call the three "Rs":, reading, writing and arithmetic.

Too often, it is Canada's most disadvantaged citizens who perform most poorly in school. It's a trend that the Canadian Language and Literacy Research Network (CLLRNet) is working to reverse.

Two new research projects launched this year in partnership with the Society for the Advancement of Excellence in Education (SAEE) will study the best teaching practices for improving the literacy and numeracy skills of the most disadvantaged Canadians: Aboriginal peoples and youth-at-risk in low-income neighbourhoods. Researchers hope to unlock the mystery of why some students succeed, while others from the same disadvantaged background do not.

"The Aboriginal youth population is growing rapidly, so we need to think now about how we're going to equip Aboriginal kids with the skills they need to succeed in the global economy, and how to do this in a culturally sensitive way," says Helen Raham, executive director of SAEE, a non-profit education research agency based in Kelowna, British Columbia.

Aboriginal students generally score much lower in school than other Canadian students. Fewer than 60 percent graduate from high school, and about half do not meet the minimum expectations on literacy and numeracy tests in grades 4, 7 and 10.

However, Aboriginal students are excelling in some schools. The Improving Aboriginal Success project will study 12 schools in Manitoba, Saskatchewan, Alberta, British Columbia and the Yukon. The researchers hope to share best practices that can help students in other schools. A comprehensive report from the project will be released by May 2004.

Helping Children Learn

The Canadian Language and Literacy Research Network is a bold venture that brings leading scientists, clinicians, students and educators together with public and private partners to improve language and literacy skills among Canadian children. The Network not only generates original scientific research, but also looks for ways to apply the results of those findings into the classrooms that need them most.

Based at the University of Western Ontario, the Canadian Language and Literacy Research Network was established as a Network of Centres of Excellence in March 2001. Today, it involves more than 350 Canadian researchers, students and partners.

"A key role for the Canadian Language and Literacy Research Network will be to disseminate the Aboriginal project's findings to the broader community," says Raham. "This is a small study, but it could have a big impact on policy and practice and suggest areas for further research. Bringing it to the research community's attention, as well as to the attention of policy-makers, is very important."

In another project, CLLRNet and SAEE are helping teachers in low-income areas develop innovative literacy and numeracy programs. The School Improvement Grants program is designed to stimulate and support initiatives to raise achievement in public schools serving at-risk students and to assist the schools in documenting results.

SAEE researchers prepare a case study for each school's two-year project, while a CLLRNet research mentor helps teachers design, monitor and evaluate their projects. "We think this partnership is fantastic," says Susan Phillips, SAEE's assistant director. "The Canadian Language and Literacy Research Network brings research expertise, knowledge and support, and provides a large network of research capability."

SAEE is one of more than 75 public and private partners across Canada with whom CLLRNet works. Says CLLRNet managing director Dan Sinai: "We're open to collaboration, putting our science to work through flexible partnerships with professionals, educators and practitioners, to turn ripples of change into waves."

www.cllrnet.ca

BENEFITS

Canadian Network for Vaccines and Immunotherapeutics (CANVAC)

Global networking: Canadian group spearheads AIDS research project

The world is closer to an HIV vaccine, thanks to the efforts of the Canadian Network for Vaccines and Immunotherapeutics (CANVAC). A unique network of 74 Canadian scientists in the public, private and academic sectors, CANVAC is leading an international effort to develop a standardized measure of immune response, which is crucial to the development of an effective vaccine.

Researchers around the world are testing several candidates for an HIV vaccine in laboratories and clinical trials. While these scientists are keen to share data, there is no standard measure of the immune response stimulated by a vaccine, making it difficult to compare results.

Recognizing the importance of a standardized method, CANVAC began to recruit international partners. In July 2002, during an international AIDS conference in Spain, it attracted the support of two of the largest investors in AIDS vaccine research: the U.S. National Institutes of Health and the International AIDS Vaccine Initiative. Also supporting the initiative is BD Biosciences, a private-sector firm with operations in Mississauga, Ontario. Seven HIV vaccine-immune monitoring laboratories located in Canada, the United States and in Europe were chosen to participate in the first round of standardization.

"These groups had never sat at the same table to address this issue," recalls Dr. Aline Rinfret, associate scientific director of CANVAC. "Together, we drafted a strategy and agreed to participate in its execution."

Developing an HIV vaccine

AIDS is caused by the HIV (human immunodeficiency virus), which disrupts the body's immune system and impairs its ability to fight off disease. While researchers continue to develop drugs and therapies to treat patients infected with HIV, a concerted effort is also under way to develop an effective vaccine.

The aim of vaccination is to stimulate the production of an immune response strong enough to fight a specific infection. A healthy immune system mounts a strong, and usually effective, response when it detects a new virus or bacterium. A typical vaccine contains a disabled form of the target virus or bacterium, or only one of its key components. The development of a new vaccine has three stages:

- Researchers identify a way to produce a harmless form of the virus or of one of its components.
- Candidate vaccines are administered to a small number of people to determine how their immune system responds.
- Vaccines are administered to thousands of volunteers and their efficacy in preventing the targeted infection is carefully monitored over time.

Standardizing an efficient and accurate measure of the immune response to a vaccine enables researchers to determine which vaccines are most effective, particularly during phase-two trials, and allows them to concentrate human and financial resources on the most promising candidates in larger phase-three trials.

The strategy includes the development of a standardized intracellular cytokine staining assay. Cytokines are proteins produced by cells of the immune system and are one of the hallmarks of an effective response.

Results of the first round of standardization were presented at a conference in May 2003. "The good news is that support for a standardized test is growing," says Dr. Rinfret. "The bad news is that it may take many months to achieve meaningful comparisons between results from different laboratories."

CANVAC is ideally suited to lead the effort to standardize. Unlike agencies that fund only research, CANVAC participates in projects that are likely to develop marketable products or intellectual property that can be patented or licensed.

More than 15 viral vaccines have been licensed and marketed in North America, mostly against such diseases as hepatitis, influenza, polio, measles and smallpox.

www.canvacc.org

BENEFITS

Canadian Stroke Network (CSN)

Pushing the frontiers: Innovative technology connects northern patients to experts in urban centres

When it comes to saving a stroke-affected brain, every minute counts. That's why an emergency telemedicine program is revolutionizing health care for people living in remote communities in Northern Ontario. It's reducing the chance of disability and improving the quality of life for many Canadians.

The idea is simple: With the help of two-way video conferencing equipment, stroke patients in northern communities are transported to within electronic reach of a specialist in a Toronto hospital. From a console hundreds of kilometres away, a neurologist can talk to the patient or the patient's family, review the computerized axial tomography (CAT) scans of the brain, administer neurological tests or advise the attending emergency-room physician on the treatment.

"The longer it takes to diagnose and treat a stroke, the more brain function is likely to be lost," says Dr. Frank Silver of the Canadian Stroke Network, a national organization that links stroke experts across the country. "Telestroke offers a unique way of sharing specialized care in areas that don't have a full complement of sub-specialists."

Clot-busting drugs used to treat strokes are relatively new and must be administered within three hours after the first symptoms appear. That gives a neurologist little time to examine the patient's scan and conduct a neurological exam. The situation is particularly critical for people living in rural areas, where there are few neurologists.

Telestroke offers a solution. Remote emergency rooms use portable videoconferencing units equipped with a high-quality camera and a microphone to contact an on-call stroke expert. The northern patient is connected to a neurologist at the neurologists' home or at a hospital-based videoconferencing workstation and treats the patient "virtually" in collaboration with the attending emergency-room physician.

Telestroke pilot project takes off in Northern Ontario

Patients in North Bay and Sudbury are the first to test drive the Canadian Stroke Network's Telestroke care model. The Canadian Stroke Network provided $630,000 in funding toward program start-up costs, with the Ontario Ministry of Health and Long Term Care and the NORTH Network financing the balance.

The NORTH Network provides medical specialist consultations for patients and health education for health professionals in over 70 rural and remote areas of Ontario, using live, two-way videoconferencing and electronic medical devices to diagnose and treat patients. The network currently conducts close to 500 clinical consultations and about 100 educational events monthly.

Hospitals in North Bay and Sudbury are already providing this service, with more sites being planned. To date, a total of 15 consultations have been completed, with three going on to receive a tissue plasminogen activator, or clot-busting medicine. Volumes will increase as a public campaign raises the awareness of signs and symptoms of stroke, as well as the urgency of seeking medical attention at the appropriate health-care facility.

The program is supported by NORTH Network's round-the-clock help desk, a web-based physician-on-call roster and regular virtual rounds to facilitate learning among health-care professionals. Telestroke also has an ongoing evaluation component to examine clinical outcomes and patient and provider satisfaction.

"We want to help more people walk away from a stroke," says Dr. Silver. "Through initiatives such as Telestroke, the Canadian Stroke Network is working to reduce the impact of stroke, which is the number-one cause of adult disability in Canada."

In addition to acute care, telemedicine makes it possible to follow up with patients who have returned to their rural homes after treatment, saving patients and doctors the time and cost of travel. "It will provide northern residents with access to care previously available only to those living in urban centres," says Dr. Silver.

Telestroke is the first initiative of its kind in Canada, and one that is poised to make a real difference in the lives of those living in northern communities.

www.canadianstrokenetwork.ca

BENEFITS

Canadian Water Network (CWN)

Managing Canada's farms: Researchers work with farmers to safeguard the environment and their livelihoods

Growing public concern over run-off from livestock farms has prompted several municipalities across Canada to introduce new environmental regulations. It has also resulted in a progressive new research project supported by the Canadian Water Network to ensure that farmers have the tools they need to comply.

Nutrient management has become a critical agricultural issue, with several jurisdictions passing new rules governing how manure should be handled and managed on livestock farms. Finding practical ways to deal with this issue is the goal of a Canada-wide research project studying the social and economic effects of manure-management practices on farms. Supported by the Canadian Water Network (CWN) and led by Dr. David Rudolph of the University of Waterloo, the research will help evaluate the efficacy of new environmental regulations.

"Our work should give farmers tools for prioritizing the environmental risks that grow out of their livestock operations, and then show them how to minimize the greatest risks," says Dr. Rudolph, a hydrogeologist who is working with investigators and research associates from nine universities in five provinces and with collaborators from as far away as California. Their expertise spans the research spectrum, including economics, engineering, agriculture, statistics and risk management.

The project also includes participation from all three levels of government and from industry, consumer groups and non-government organizations. As well, livestock-commodities organizations and private companies have contributed funding for research. The CWN has brought the partners together often, both within and outside their specific research area. They have shared facilities and equipment, trained students in each other's laboratories and worked at each other's research sites.

Saving the family farm

Canada's economic health has always depended on agriculture, and the heart of agriculture has always been the family farm. In recent years, however, with the global demand for economic efficiency, industrial-scale farms are replacing family-run operations. Rapid changes in the business and practice of agriculture across Canada are unprecedented, especially in the livestock sector.

The public pressure that led to stricter environmental regulations has also changed farm practices and inadvertently threatened the future of the family farm.

"Small-scale farmers wonder how they can afford to satisfy all the new requirements," says Dr. David Rudolph, a hydrogeologist at the University of Waterloo. "We are looking for management practices that will allow the average farmer to maintain an economic base without being unduly hampered by environmental restrictions." He adds that new small-scale technologies could help preserve the economic viability of the family farm.

"We're especially proud of the fact that this is very practically-based research," says Dr. Rudolph. "Much of our work takes place on farms and involves farmers. Bringing in economics makes it unique scientific research."

With its cross-pollination of ideas and resources, the team has installed the first passive wastewater system on a dairy farm to treat milk-house wastewater and run-off. Researchers have disseminated their findings at several conferences and seminars, and in more than 20 publications. The results will be valuable to livestock farms across Canada.

The future looks bright for this collaboration. Two provincial ministries have invited Dr. Rudolph to participate in the advisory committee that will develop and implement Ontario's new Nutrient Management Act. Some of the technologies growing out of this research might also yield new market opportunities for Canadian manufacturers.

www.cwn-rce.net

BENEFITS

GEOIDE — Geomatics for Informed Decisions

Canada's newest brain gain: Young researchers fuel Canada's lead in geomatics

The GEOIDE Students' Network links geomatics students from across Canada and the world with top researchers from industry and university. It's a unique national program that's giving university students the skills and contacts they need to succeed here at home and abroad. These students are also providing Canadian companies with a competitive edge in the world's fastest-growing information technology market.

It's not often that students beat down the door to get into summer school, but enthusiasm was running high for a unique program offered in May by the GEOIDE Students' Network. For the 33 graduate students from Canada and abroad who participated, it wasn't just an opportunity to expand their knowledge of one of the hottest sectors in information technology. It also provided a rare opportunity to meet face-to-face with students, researchers and other professionals in geomatics.

"From the student's point of view, this is an incredible networking opportunity," says Sylvain Théberge, a graduate student and Coordinator of the GEOIDE Summer School. "We meet people working in all areas of geomatics and see what new ideas and approaches they bring. It's a whole different pool of knowledge."

Geomatics is one of the world's fastest-growing technology sectors, with Canada ranked second only to the United States in technology development and global sales. One of the sector's greatest challenges, however, is training and retaining the skilled talent needed to grow this emerging industry. It's one reason the GEOIDE Students' Network was established in February 2000. Early results are encouraging: 75 percent of

What Is Geomatics?

Geomatics is the science and technology of gathering, analyzing, interpreting, distributing and using geographic information. With its roots in surveying and mapping, the sector now encompasses a broad range of disciplines that are converging to create a detailed but understandable picture of the physical world.

Geomatics includes geodesy (precise measurements of Earth), photogrammetry (measurements taken from airborne photographs), remote sensing (measurements taken from satellite photographs), satellite positioning (to locate objects or phenomena on Earth), cartography, mapping, surveying, navigation, and Global Positioning Systems (GPS) and geographical information systems (GIS) that store, visualize and analyze spatial data. Geomatics also involves basic sciences such as mathematics, spatial statistics, information technology, physics and law.

The applications are broad and growing every day. Designers can now use a computer model that shows how people use public parks to choose the best location for parking, playgrounds, and picnic areas. Geomatics is helping the Coast Guard choose the best location for stations by pinpointing where maritime accidents are most likely to occur. Data from a hyperspectral satellite are helping resource companies find minerals and other natural resources. In agriculture, farmers are using a fluorescence sensor that measures the metabolic changes in plant structure caused by lack of water or minerals.

Canadian students and 50 percent of students from abroad are staying in Canada following graduation.

"It's all about supporting Canada's geomatics industry," explains Annie Laponsee, GeoSkills Program Leader at Geo-Connections, a national partnership initiative that teamed up with GEOIDE in organizing the summer school held in Victoria BC. "Our GeoSkills program has two main objectives: to foster the growth of the geomatics industry by promoting geomatics and geomatics careers, and to help those already in the industry to enhance their skills and knowledge. We contributed toward the cost of this summer school because it offers courses by renowned researchers that may not be available at each university."

The summer school also gives students the opportunity to learn about something outside their area of concentration and is useful in their research. As well, relationships made at the summer school may strengthen future research alliances among government, academia and industry.

"There's a certain camaraderie at the school and lifelong contacts are made there. It's just the right size and format for that," adds Laponsee, whose program sponsored five Canadian students and four professionals to attend the summer event.

For Marie-Josée Fortin, GEOIDE's Associate Scientific Director (2001–2002) and the Network Coordinator for the Student Summer School both in 2002 and 2003, the summer school also gives students valuable lessons in leadership, management and initiative – subjects not readily covered in a university curriculum.

"Here in Canada," she says, "we are the envy of other researchers. There are similar programs and organizations elsewhere, but the NCE has flexibility and GEOIDE's success is just a reflection of that."

he GEOIDE Students Network (www.geoide.ulaval.ca/gsn/) is part of the Geomatics for Informed Decisions Network (GEOIDE), a Network of Centres of Excellence based at Université Laval. GEOIDE links 24 universities, 27 government agencies, 40 companies and 12 not-for-profit organizations in collaborative researchprojects covering natural resources, the environment, marine transport and commerce, and health and social sciences applications.

GeoConnections (www.geoconnections.org) is a national partnership initiative led by Natural Resources Canada to develop the Canadian Geospatial Data Infrastructure (CGDI), making Canada's geospatial data, tools and services accessible to Canadians over the Internet.

www.geoide.ulaval.ca

BENEFITS

Institute for Robotics and Intelligent Systems (IRIS)

Helping future research stars: New robotics program supports young academics with new ideas

The Emerging Opportunities Fund is providing young university researchers with an opportunity to explore new ideas, while giving graduate students hands-on experience in the lab. It's also giving tomorrow's research stars a further incentive to stay in Canada.

Dr. Inna Sharf won't have her new space robotics systems laboratory at McGill University up and running until spring 2004, but she has already attracted interest from the Canadian Space Agency and industry heavyweight MD Robotics, developer of the Canadarm. Dr. Sharf is one of 31 university researchers to receive support this year from the Emerging Opportunities Fund (EOF) — a new, $900,000 program that helps top academic researchers who are in the first five years of their careers investigate exciting new ideas. The program is offered by the Institute for Robotics and Intelligent Systems (IRIS), a Network of Centres of Excellence managed by Precarn Incorporated.

"It's harder for newer researchers to get research funding," explains Dr. Sharf, who is developing a new lab at McGill's Mechanical Engineering Department to emulate the weightless environment of space. "Professors who are established and have a reputation usually have an easier time attracting money. For newer researchers, it's tough. The IRIS program helps us get established and build our credibility."

With the funding she received from the EOF in April, the associate professor was able to hire an engineering master's student to work full time on the new lab. The facility features a robotic arm that uses intelligent systems to grasp and manipulate a helium/air-filled balloon — emulating robotic manoeuvres that would happen in space with a free-floating object. The research could one day make it easier to remove space debris and repair satellites in orbit. The lab has received funding from the Natural Sciences and Engineering Research Council and the

Jump-starting new research at home

The Emerging Opportunities Fund (EOF) awarded more than $900,000 in its first two competitions in 2003. Researchers received up to $35,000 for one year for projects incorporating robotics and intelligent systems (technologies that perceive, reason, and essentially act like humans), which may one day lead to major breakthroughs for Canada on an international scale.

"We have people with PhDs and people with master's degrees going down to the U.S.," says McGill University researcher Dr. Inna Sharf. "So programs like the Emerging Opportunities Fund that help to increase research funding in Canada will help. A lot of it comes down to looking at what the opportunities are. Research funding is what allows you to build your labs and build your research programs."

For York University computer scientist Dr. Hui Jiang, the EOF is helping him build a system that will make it possible for humans to talk to robots using spoken dialogue. "This grant is helping me to establish my research program at York University in my early career stage. With its help, I am able to attract one post-doc fellow into my research group. I really appreciate it."

Canadian Space Agency, and now MD Robotics is interested in participating. Meanwhile, back on earth, another EOF recipient is building a robotic system that can play competitive pool against a human opponent.

"We would like to be the Deep Blue of the robotic pool world," says Dr. Michael Greenspan, referring to the supercomputer that competes against the world's top human chess masters. "We would like to get to the stage where we can beat the best pool players in the world using our robotic system. We think that's achievable within 5 to 10 years."

The system will include a set of cameras positioned above the pool table that will interact with the robotic pool cue to pinpoint the position of balls to within one millimetre. It's a technological marvel that, in addition to its potential entertainment value, will help to enhance the perception, planning, and action capabilities of intelligent systems and identify more effective robotic solutions.

"At this stage, the IRIS funding is being put almost exclusively towards research salaries of students to work on the vision component, which I think is the heart of the system," Dr. Greenspan adds.

A former researcher with the National Research Council's Institute for Information Technology, Dr. Greenspan joined Queen's University two years ago as an associate professor in the Department of Computer and Electrical Engineering and the School of Computing. He says the support he received in April from the IRIS EOF "fills a very useful niche in the funding spectrum. It allows you to investigate areas that you may not otherwise have the opportunity to explore."

www.precarn.ca

BENEFITS

ISIS Canada — Intelligent Sensing for Innovative Structures

Seeing inside structures: Researchers and public can now monitor Golden Boy's health online and in real time

Last fall, Manitoba's most well-known landmark was returned to its place atop the Manitoba legislative building. The Golden Boy was not only restored — it was also equipped with sensors, including fibre-optic sensors, that detect structural problems before they become critical.

Researchers now know immediately when the Golden Boy is in poor health. In 2002, the 85-year-old structure was removed from the dome of the Manitoba legislature after engineers discovered severe corrosion in the 5″ diameter steel support column which extends inside the statue from heel to chest. When the statue was returned to its perch in September, it had received more than a re-gilding and a new steel support column. It had become the country's first cultural icon to use fibre-optic monitoring.

Spearheaded by Dr. Aftab Mufti at ISIS Canada and with financial support from the Manitoba government, the monitoring project is designed to detect potential problems before they become critical. Instruments installed inside the statue on the support column measure the effects of wind, precipitation and temperature, particularly in the heel — the weakest point of the 1,650-kg statue.

"If the Golden Boy didn't have sensors, maintenance crews would have to periodically climb the dome to do visual inspections, or take the statue down for detailed assessment," says Dr. Mufti, president of ISIS Canada and a professor of civil engineering at the University of Manitoba. "Using this technology, decisions on whether to replace a structure can be based on real data. It will also better equip us for predicting how long a structure will last, and when it will require maintenance."

Two accelerometers at the top of the support column measure the vibration of the Golden Boy, and a combination of strain gauges and fibre-optic sensors at the column base measure wind stress effects. Temperature gauges help monitor climate effects on the support column. Wires for the

Standing tall and proud

ISIS Canada has embarked on a new research project to aid in safeguarding Canada's 350,000 veterans' grave markers from structural damage. The $85,000 project, with Veteran Affairs Canada and Public Works and Government Services Canada, is studying the feasibility of replacing steel reinforcements with fibre-reinforced polymers in the concrete beams and the grave marker connections to those beams. Fibre-reinforced polymers do not corrode like steel reinforcements. In a separate field trial, ISIS researchers will use fibre-optic sensors to monitor the structural health of these innovative structural systems in Brookside Cemetery in Winnipeg.

"At Brookside, there's quite a problem with soil settlement and the concrete beams, which are causing some of the markers to sink or tilt," says Doug Stephenson, a senior engineer with the Heritage Conservation Services unit of Public Works and Government Services Canada.

"The problems aren't unique to Winnipeg or this particular cemetery," he adds. "We would be looking at the potential of applying this solution to other cemeteries across Canada." ISIS Canada will prepare a report on its findings next spring.

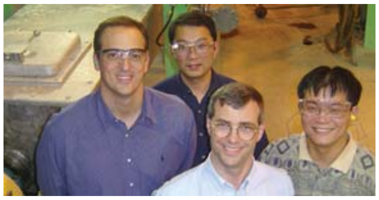
sensor system run down into the building dome and connect to a monitoring unit inside the building. Data from the unit are updated every five seconds and can be viewed online at:
http://130.179.57.204/ActiveSHM/GBmainpages/GBhome.htm.

The health monitoring system uses fibre Bragg grating (FBG) optical sensors developed by ISIS Canada. This same technology is used in about 40 structures in Canada, including the Confederation Bridge connecting Prince Edward Island to the mainland. ISIS is also monitoring the Portage Creek Bridge in Victoria, B.C. to measure the effect earthquakes have on the structure. In another ISIS project, researchers from the University of Toronto and University of Alberta are using FBG sensors to conduct remote monitoring of pipelines. This same technology can also be used in airplanes, buildings, ships and even nuclear reactors.

“Canada is well known internationally as a leader in this area,” says Dr. Mufti, who worked closely with Dillon Consulting of Winnipeg on the project. “Because of organizations like ISIS, Canada was an early adopter of fibre Bragg gratings. Not only does ISIS promote the use of new materials, it also makes it possible for experts in this field from across Canada to work together.”

ISIS is promoting the technology to contractors and engineering consultants, who Dr. Mufti says are “becoming very interested. By knowing what is going on inside of structures,” he adds, “we can better predict how long structures will last and when maintenance will be required.”

www.isiscanada.com



BENEFITS

Mechanical Wood-Pulps Network (MPWN)

Whiter paper at lower cost: Irving Paper among first companies to adopt new bleaching process

A new made-in-Canada bleaching technology is making paper whiter and lowering production costs at pulp and paper mills.

Like T-shirts and teeth, whitening paper requires bleaching. Adding hydrogen peroxide to paper to produce the desired effect, however, is a costly process. Now a new technology offers savings of up to $10 per ton by boosting hydrogen peroxide's bleaching power to produce paper two to three points brighter on the International Organization for Standardization (ISO) scale.

Called the PM Process, the technology was developed by Dr. Yonghao Ni at the University of New Brunswick (UNB) with funding support from the Mechanical Wood-Pulps Network and the Natural Sciences and Engineering Research Council. One of the technology's main advantages, according to a process engineer at Irving Paper, is that it doesn't require a lot of costly equipment to implement.

"It's a matter of rerouting some piping between a couple of different points in the process," says George Court of Irving Paper, a collaborative partner in the research. "Plus, by decreasing the amount of peroxide bleach that is required, we can keep running machines that might otherwise no longer be adequate."

Every year, about 20 million tons of Canada's high-yield pulp production are bleached to 70 per cent ISO or higher. If the PM Process technology were used in all applicable mills in Canada, UNB estimates the pulp and paper industry could save more than $10 million annually. It's an innovation that may never of happened without university research.

"There is not a lot of money around for research and development in this industry," says David Foord of UNB's Office of Research Services. "Most innovations are capital intensive, and equipping a mill with new tools means interrupting production runs."

Same brightness, less peroxide

In the papermaking process, transition metal ions in the pulp cause some decomposition of hydrogen peroxide, which is used for bleaching. As the decomposition produces chemicals that reduce brightness, stabilizers and sequestering agents are added, increasing the cost of the bleaching process. Doctors Ni and Li discovered that adding sodium hydrosulphite to a chelation removed most of the ions and led to considerable improvements in the performance of the hydrogen peroxide. They called this the Qy Process. Further work found efficiency also increased by stabilizing the remaining ions in the pulp before adding the peroxide. The improvement is known as the PM Process.

As part of its marketing efforts, the university has raised $100,000 to fund a sales pitch to some 50 mills. To date, Irving Paper is implementing the process and 10 other mills have requested batch studies. Discussions on mill trials are at various stages, and a local engineering firm, Neill and Gunter, is partnering with UNB to handle further business development and coordinate implementation.

According to Dr. Ni, there are more benefits to this collaborative approach than improving the papermaking system and reducing effluents.

"This type of project is great for students," says Dr. Ni, Canada Research Chair in Pulp and Paper Science and Engineering and director of the Limerick Pulp and Paper Centre at UNB. "They visit the mill, talk to people about their ideas and work on something that is used in the real world. They also get lots of practical inside information on the process and have access to equipment not available on campus."

Dr. Zhiqing Li, a graduate student who co-developed the technology with Dr. Ni, is proof of that. Irving Paper hired him as a process engineer. Two other students are working at other mills on collaborative projects.

The Mechanical Wood-Pulp Network reached the end of its funding cycle in March 2002 and is reinventing itself, with financial assistance from the Networks of Centres of Excellence (NCE) program, as PAPIER, a national organization of academic researchers focussed on improving the technological competitiveness of the Canadian pulp and paper industry.

Dr. Ni credits the NCE's financial support and its emphasis on university/industry collaboration for moving this research from the lab to the market. "We wouldn't have been able to do this otherwise," he says. "This research really focused on finding creative solutions to real-world problems."

www.wood-pulps.org

BENEFITS

Micronet — Microelectronic Devices, Circuits and Systems

Small machines for small chips: DFT Microsystems hits market running with Micronet support

DFT Microsystems has proven that venture capital can be found if you have a market-ready technology. The McGill University spin-off has raised $4.5 million to commercialize a new testing system for microchips — one with the same bells and whistles as bulky million-dollar machines, but at a fraction of the cost.

Not all early-stage research leads to a commercial product, but every so often you do hit pay dirt. Over the past year, DFT Microsystems has captured the attention of the venture capital community with a technology that has been over a decade in the making, with funding support from Micronet and the Natural Sciences and Engineering Research Council (NSERC).

Dr. Gordon Roberts, the James McGill Professor of Electrical and Computer Engineering at McGill University, along with his graduate students, has developed a powerful and cheaper alternative to the highly sophisticated machines that the semi-conductor industry currently uses to test analog/mixed-signal microchips.

Dr. Roberts explains: "With traditional electronic testing, you connect wires from the chip to the test equipment. We're switching it around. Instead moving the signal off the chip to test the equipment, I'm building the test equipment directly into the chip. I can't think of any other company out there that can make that claim in regards to analog measurements."

The result is that bulky, multi-million-dollar testing machines can be replaced by equipment that is a few millimetres in size and operates at the same speed as a chip's signal processes. Also, since up to 50 percent of the cost of chip production occurs at the testing stage, the technology offers the promise of cheaper microchip-enabled consumer products.

It would take several years of R&D before the technology would be ready for a commercial debut. For Dr. Roberts, the opportunity to move the system from the lab to the market arrived last year with his launch of two new companies — DFT MicroSystems Canada (DFT Canada),

Enabling microsystems innovation

Micronet is a Canada-wide network of investigators from universities, industry and government research organizations working cooperatively towards the development of the next generation of microelectronic systems. Its focus is one of pre-competitive research dealing with the development of Systems on a Chip for communications, information and instrumentation systems.

Micronet has an annual budget of about $4.3 million, which includes an award from the Networks of Centres of Excellence, industrial contributions and matching grants by the Natural Sciences and Engineering Research Council.

The NCE funds provide considerable leverage to the direction and industrial relevance of the research undertaken by Micronet's university investigators, who control an additional $7.5 million in research funding from alternate sources.

Over the last year, Micronet has continued to mobilize Canada's research talent in the academic, private and public sectors to strengthen the competitive ability of the Canadian microelectronics and information technology industries.

a Canadian corporation based in Montreal, and DFT MicroSystems, a Delaware corporation based in Philadelphia. Roberts is now President and Chief Executive Officer at DFT Canada, which counts several McGill engineering graduates among its staff, including many who have worked on Micronet-sponsored research projects.

The combination of proven technology and the calibre of its engineering talent helped convince a major venture capitalist that the company was a good risk. In October 2002, MSBI Capital of Montreal invested $420,000 in seed financing in DFT, and in July 2003 followed that up with an additional $4 million.

MSBI partner Chris Arsenault describes DFT as a company with a strong intellectual property base and one that "is gaining tremendous market traction for such an early-stage company. In addition to collaborating closely with the founders in setting up operations and attracting key individuals and strategic partners, MSBI is pleased to have been able to provide financial support beyond seed financing."

Dr. Roberts credits Micronet, NSERC and organizations like the Canadian Microelectronics Corporation for making it possible to develop the technology to a stage where venture capitalists would be interested in investing.

"When we talked to venture capitalists, their reaction is that we're not really a start-up. That's because we've developed a prototype that demonstrates our claim. We don't say to people that this is what we're going to do, because we're already done it. Our goal now is to sell it," says Dr. Roberts, who maintains a Micronet-sponsored research team at McGill.

DFT is expecting to make its first sale by the end of 2003 and for 2004 is projecting revenues of $2.5 million, growing to nearly $8 million in 2005.

"Because of groups like Micronet, the technological edge we have in Canada is enormous," says Dr. Roberts. "There's no question from a business point of view."

www.micronetrd.ca

BENEFITS

MITACS — Mathematics of Information Technology and Complex Systems

IRIS research spurs spin-off: Smart data mining helps insurance companies identify high risk drivers

Mathematicians, statisticians and computer scientists have developed a new mathematical technique for identifying high-risk drivers. It's a breakthrough that could save both the insurance industry and its customers millions of dollars each year.

Who says mathematics isn't relevant? It is for people with rising insurance rates. A team of researchers at Université de Montréal has devised a new statistical tool that could lead to lower insurance premiums for good drivers and higher profits for car insurance companies.

What began as a MITACS-sponsored research project has evolved into a new commercial product and a university spin-off that is helping insurers analyze copious amounts of data to more accurately predict who might have a car accident. For the majority of drivers who are considered low-risk, the payoff could be lower premiums.

Current statistical models have been difficult to apply to the insurance industry, which contains so much data and so many variables that it's difficult for statisticians to develop probability models that accurately predict how risky a customer may be. "The methods currently used in car insurance are not very discriminating, meaning the good drivers pay more than they should and the bad drivers pay less than they should," says Dr. Yoshua Bengio, a computer scientist at Université de Montréal and a principal investigator with MITACS. "We've come up with a way for the insurance company to decrease premiums for the less risky customers, which is the majority of people. Companies could then use this as a marketing tool to increase their market share and their profits."

Dr. Bengio is also the Chief Scientific Officer and one of four founders of Apstat Technologies Inc., a Université de Montréal spin-off that last year began marketing this new data-mining product to car insurance companies. The product stems from more than a decade of work by Dr. Bengio and his students.

Helping Computers Learn

Can machines learn? Apparently so.

A growing number of professors and students in Canada are specializing in statistical machine learning — an emerging discipline in which statisticians and computer scientists collaborate to develop techniques that enable computers to "learn" useful information from large amounts of data that contain numerous variables.

"It's about using different techniques for extracting useful information from data," says Dr. Yoshua Bengio, a MITACS researcher and Canada Research Chair in statistical learning algorithms at Université de Montréal.

In one MITACS-supported project, Dr. Bengio and his collaborators are developing statistical models that could help pharmaceutical companies reduce their drug development costs by better predicting which chemical compounds are potentially most likely to help a particular medical problem.

Adds Dr. Bengio: "It helps to have an organization like MITACS supporting research and students in an area where Canada ranks very strong internationally."

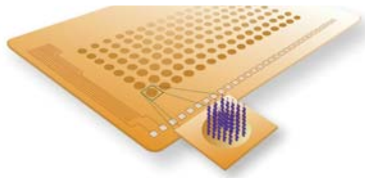
"Our initial research was done with two Networks of Centres of Excellence, MITAC and IRIS (Institute for Robotics and Intelligent Systems)" he says. "We later partnered with a large North American automobile insurer to transfer the technology. This is what prompted three of my students to start a company to commercialize similar techniques." Those students turned entrepreneurs are Charles Dugas (Chief Executive Officer), Nicolas Chapados (Executive Vice President) and Pascal Vincent (Chief Technology Officer).

The market potential for Apstat is huge. As Dr. Bengio points out, the insurance industry has been using almost the same mathematical techniques for decades.

Meanwhile back at the university, Dr. Bengio is working with a growing number of researchers, students and industrial partners to develop similar data-mining solutions for other applications, including drug discovery, statistical language modeling, and telecommunications marketing.

"This is a very rapidly growing field in universities across Canada. I credit organizations like MITACS not for only supporting this basic research, but also for encouraging us to find partners and look for ways to transfer our technology," he adds. "There's still this perception that mathematics can't be related to useful things, but that's wrong. Some of the things I do involve very complicated mathematics that lead to very important applications."

www.mitacs.math.ca



BENEFITS

PENCE — Protein Engineering Network

Fatalistic attraction: Canadian-developed biochip pushes science beyond the human genome

A unique protein-bonding technology created by Protein Engineering Network of Centres of Excellence scientists is being developed into an innovative tool for drug discovery. And a subsidiary of Helix BioPharma is taking it to the world market.

For Dr. Robert Hodges, protein chemistry is like love — he's looking for that unique bond. Luckily, he's found it, or rather made it, in two molecules called the E-coil and the K-coil. Whenever these two molecules meet, there's an irresistible attraction, and the two coils unite and intertwine like a coiled rope. Unmistakably, every time, it's exactly the same.

"That's the beauty of the system," says Dr. Hodges, the principal investigator in the design of this coiled-coil peptide system now at the heart of a new state-of-the-art biochip technology. The biochip is the result of a longstanding research program funded by the Protein Engineering Network of Centres of Excellence (PENCE).

In 1997, Helix BioPharma, a mid-sized Canadian pharmaceutical company, collaborated with PENCE to develop a unique, multi-purpose biosensor based on the coiled-coil technology. Protein biosensors, or biochips, are expected to play a pivotal role in the drug discovery and validation process by enabling high throughput, or rapid assessment of potential drug targets.

This ability to perform high throughput assessment of DNA is fuelling the genomic revolution, as typified by the Human Genome Project, which is identifying the 30,000 or so genes in human DNA. Biochips could play the same role in the emerging proteomics revolution. Although there are significant challenges in this new field, advanced approaches to proteomics, or the study of proteins, are delivering more insights into human health and disease and resulting in increased commercial interest.

"The PENCE model was absolutely perfect for taking this technology from basic research to commercialization," says Dr. Hodges, who led much of the research through his University of Alberta laboratory. "Because it's a national network, we were able to do what no university in Canada has yet been able to do. We took a project in McGill, combined it with a project at the University of Alberta and made something worth patenting. And when you have something worth patenting, you can attract industry."

The national approach has led to one licence agreement, four patents in the United States, two international patents and the creation of

Matching more than molecules

While Dr. Robert Hodges builds molecules that fit perfectly, he's also keen to create long-standing human bonds.

"Companies are getting patentable technology from our research, but they're also getting highly trained personnel," says Dr. Hodges, the former CEO and scientific director of PENCE and now a professor at the University of Colorado Health Sciences Centre.

PENCE, he notes, has created strong links between university and industry, links that will continue to act as corridors for technology transfer and commercialization. Several graduate and post-doctoral students, who were involved in the coiled-coil peptide research, now work for Helix BioPharma, including Dr. Heman Chao, the company's vice-president of technology. Dr. Chao's research has been published in Science and Nature and he is associated with a number of filed and pending patents for the company.

Sensium Technologies, a Helix subsidiary, which is taking biosensor technology into the marketplace. Sensium has attracted more than $5 million in initial investment.

The Sensium biochip relies on the fact that the E-coil and K-coil consistently bond in the same way and can be used as a sure-fire delivery and display system. With the K-coil attached to a surface, E-coils with a third molecule attached are added. In the resulting structure, the third molecule is exposed like a flag. What makes this highly organized and repeatable threesome the ideal biosensor is the potential to test the third molecule for reactivity to other molecules, such as antibodies.

Sensium's biochip will enable pharmaceutical industry researchers to quickly and efficiently assess the interactions of hundreds or thousands of molecules. This is especially important in the development of new pharmaceuticals, because identifying proteins in the body that can serve as drug targets is like trying to find a needle in a haystack.

Created in 1990, PENCE brings together more than 100 leading researchers from 21 Canadian universities, hospitals and research institutes to facilitate the creation of new technologies and foster the design of commercial protein products and services.

www.pence.ualberta.ca

BENEFITS

Stem Cell Network (SCN)

A unique global resource: Canadian Web site provides one-stop source for stem-cell legislation and policy

A unique Canadian Web site is offering the public, scientists, policy makers and patient groups fast and free access to the latest information on the ethical, legal and social issues surrounding stem-cell research. It is helping to keep the global community abreast of developments in this fast-moving field.

Canada is now providing policymakers and researchers from around the world with critical information they need to make informed decisions about stem-cell research. Funded by the Stem Cell Network, the StemGen Web site (www.stemgen.org) is a comprehensive bilingual database — the only one of its type — that provides quick and easy access to selected peer-reviewed publications, legislation, regulations and guidelines related to stem-cell ethics, gene therapy and cloning. It comprises information from Canada and around the world.

"Everything is, as we know, very much international now, and to pretend we're going at it alone, either scientifically or in terms of our understanding of the social impact (of stem-cell research), would be naïve. Learning from other countries is fundamental to the whole debate," says Dr. Bartha-Maria Knoppers, a law professor and researcher at Université de Montréal and the catalyst behind the new Web site.

StemGen includes position papers, reports and a review of current literature dating back to 2000 on topics such as germ line therapy, reproductive cloning, therapeutic cloning, somatic cell nuclear transfer (the technology that created Dolly the sheep) and research into chimeras (research tools that combine human cells with a live and developing animal host.)

Users can create their own bibliographies by entering key words — for example, "embryonic stem-cell research" — and retrieve information about what governments and health organizations have said on this subject around the world.

"What we're doing is providing people with immediate access to information that's out there, but that otherwise would take them a long time to get," says Dr. Knoppers, who also chairs the Human Genome Organization's international ethics committee.

Dr. Bartha Maria Knoppers is one of Canada's foremost legal experts on the ethics of stem-cell research. The catalyst behind Canada's new StemGen Web site, Dr. Knoppers is also leads the Stem Cell Network's Theme I on the ethical, legal, social and policy issues surrounding stem-cell science. The group includes seven of Canada's top ethicists and lawyers who are working together to guide investigators and the public through the rapidly unfolding world of stem-cell research.

A professional lawyer and researcher, Dr. Knoppers is a professor at Université de Montréal and holds a Canada Research Chair in law and medicine. She also chairs the International Ethics Committee of the Human Genome Organization and was a member of the International Bioethics Committee of the United Nations, Educational, Scientific and Cultural Organization (UNESCO), which drafted the Universal Declaration on the Human Genome and Human Rights (1993-97).

Addressing the broader public policy issues surrounding this fast-moving science has been a priority of the Stem Cell Network since its launch as a Network of Centres of Excellence in March 2001.

As Drew Lyall, the network's executive director explains, raising awareness of the ethical and legal issues was never meant to be an adjunct to the science. "It was viewed as an integral component of the research. It's part of what we're doing to move the international stem-cell effort forward and to ensure that decisions concerning stem-cell research are made on an informed basis."

"StemGen is an incredibly important part of our research program," adds Lyall. "Without doing the work on the ethics side, there's that lack of underpinning on the scientific side."

Over the coming year, the StemGen team plans to add new features to the Web site, including an interactive Q&A section (StemFAQ) and expanded archives (GenArchives), as well as a Spanish-language portal.

StemGen is hosted on a related site also developed by Dr. Knoppers and her team. HumGen (www.humgen.umontreal.ca) provides access to global information on the legal, social and ethical aspects of human genetics.

www.stemcellnetwork.ca

BENEFITS

Sustainable Forest Management Network (SFM)

Responsible forest harvesting: SFM helps First Nations to balance economy and tradition

With nearly 40,000 square kilometres of forest under their care, First Nations are among the largest stewards of Canada's natural resources. Balancing the economic potential of this asset with a people's traditional way of life is the focus of a unique collaborative research project in Alberta.

The Little Red River Cree in northern Alberta faced a difficult dilemma. Harvesting thousands of hectares of forest would bring economic prosperity to their small community — but at what cost to their traditional way of life?

Researchers from the Sustainable Forest Management Network (SFM) offered to help. They teamed up with band leaders to develop ground rules that would protect community values. The SFM research team, headed by David Natcher and Cliff Hickey, was motivated by SFM's goal "to develop criteria and indicators for Aboriginal Peoples and their social development."

The Little Red River Cree have been working with the federal and provincial governments for more than a decade to gain recognition and ensure protection of their constitutional rights to lands and resources. But economic self-sufficiency is only one band priority. Many community members, especially the elders, believe that commercial timber-harvesting clashes with the values and long-term interests of the First Nations' traditional way of life.

"This is clearly an issue for the elders, but even among the younger generation, there is growing concern about maintaining a traditional Cree way of life," says Natcher, an assistant professor of anthropology at the University of Alaska. "And in most cases, we found that both the younger and older generations recognize the importance of economic development.

To help accommodate both values, the SFM Network stepped in with its 21st study for the Little Red River Cree since the partnership began in 1995. Community workers and researchers interviewed community members, documented community use of the forest and recorded recommendations for changing commercial forest operations.

The economic and cultural struggle over the forest

The roughly 2,500 members of the Little Red River Cree live on three separate reserves in the Lower Peace River region of north-central Alberta. Under Treaty 8 (1899), band members have the right to hunt, trap and fish in all seasons on unoccupied Crown lands.

Some 75 percent of the Little Red River Cree are under 30 years old — a ratio that is expected to rise significantly in the next few years. About 85 percent of the workforce is unemployed and 70 percent of all community members receive social assistance. Few local wage-earning opportunities exist. Add in the high cost of commercial foods, and it is easy to see why continued reliance on traditional woodlands is critical for the economic, social and cultural sustainability of the community.

This co-operative effort resulted in six new ground rules that would:

- modify management operations to minimize damage to wildlife;
- modify forestry operations to ensure community access to lands and resources;
- protect areas of biological, cultural or historical significance as identified by community members;
- recognize and protect aboriginal and treaty hunting, fishing, trapping and gathering rights;
- increase forest-based economic opportunities for community members; and
- increase the involvement of community members in decision-making.

Specific measures for each of these ground rules will help determine whether they are being followed. “We appreciate these joint efforts,” says Little Red River Cree Chief Johnsen Sewepagaham. “The new criteria and indicators provide a vision of change, clear recommendations and ways of helping our people achieve cultural and economic sustainability.”

Hickey agrees. “Community leaders and forestry planners can now understand at a glance what they should be doing. All of them can literally look out their window every day and see first-hand if the plans they developed together are actually working.”

Natcher and Hickey stress that while these ground rules are not perfect, at a basic level they are a transparent approach to decision-making that creates accountability and allows for ongoing evaluation to accommodate change — both human and natural.

www.ualberta.ca