

The College Advantage:

Private Sector Innovation &
Highly Qualified Personnel

Report to the Director

Higher Education Research and
Development Policy Directorate
Industry Canada

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Executive Summary

- Since 2002 there has been a dramatic increase in the capacity of colleges to conduct applied research in support of Canada's innovation agenda. This capacity has been demonstrated through a wide range of applied research and innovation activities.
- Canadian colleges are playing an increasingly important role in augmenting the innovative capacity and competitiveness of Canada's SMEs, and providing key transformational changes for business, industry, and individuals alike. In response to "market pull", colleges are increasingly focused on solving problems for small local businesses and helping them to survive and thrive by adopting new technologies and launching new and improved products and processes.
- Canada's colleges are frontline players in addressing the changing technological and skills requirements of the 21st century Canadian marketplace. Applied research activities extend and enhance the college mandate to produce current, well prepared workers by providing rich learning activities for today's students to experience real world challenges, hands-on training with leading edge technologies, contact with industry, and advanced skills training in all sectors of the economy.
- Colleges are active participants in an ever-expanding pan-Canadian array of networks, associations, and consortia established in every region of the country.
- Colleges have successfully obtained research funding through government sources and through private sector partnerships, thereby adding capacity and consistently demonstrating both short term benefits and the potential for longer term economic benefits.
- Since 2002 Canada's colleges have been developing helpful indicators that can be used in the future to enhance accountability by gauging the impact of their applied research and innovation activities.
- *Canada's Advantage* focuses strategically on research in areas that are in the national interest from a social and economic perspective. Colleges are conducting research in all of the targeted areas, including environmental science and technologies, natural resources and energy, health and related life sciences and technologies, information and communications technologies, as well as other critical areas such as manufacturing technologies.
- With respect to applied research and innovation, *colleges are currently operating at their full capacity, based on their available resources*. Colleges have now turned a corner, and are poised to further expand their applied research and innovation activities. With additional resources in the form of growth capital, colleges can reach the point of critical mass where momentum becomes self-sustaining and fuels further growth. At this time, a combination of government investment (in the form of stable, long-term financial support and equitable access to funding opportunities) coupled with increased private sector participation (through expanded college/SME collaborative partnerships) can provide the leverage point to maximize return on investment, to increase value, and to unleash the full potential of Canada's *College Advantage*.

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TABLE of CONTENTS

Executive Summary	2
1. Introduction	5
2. College Capacity: Provincial & Territorial Profiles	7
• Newfoundland & Labrador	7
• Nova Scotia	11
• PEI	14
• New Brunswick	15
• Quebec	16
• Ontario	22
• Manitoba	32
• Saskatchewan	35
• Alberta	36
• BC	41
• Yukon	45
• Northwest Territories	47
• Nunavut	48
3. Associations and Networks	51
4. Funding Agencies	55
5. Measures of Impact	60
6. Conclusion: The College Advantage	64
Contacts	70
Endnotes	74

1. INTRODUCTION

Canada's prosperity in the 21st century will depend increasingly on our ability to innovate. In the new global economy, Canada can and must do more to turn knowledge into sources of competitive advantage. Currently, Canada's private sector, especially with respect to SMEs, lags behind international competition in R&D investment, output, and competitiveness. To address this challenge, our institutions of higher learning need to play an increased role not only in generating knowledge but also in working collaboratively with business and industry to *apply* knowledge, to turn ideas into innovations that improve our economic competitiveness and provide solutions to our environmental, health, and social challenges.¹

Fortunately, we have a readily accessible advantage in our pan-Canadian system of over 150 colleges* situated in approximately 1000 communities in all regions of the country. These uniquely Canadian institutions have a long history of working closely with employers in their communities to provide highly-skilled, work-ready graduates. With their close ties to business, industry, and community partners, Canada's colleges are ideally situated to play an increasingly significant role in supporting private-sector innovation, extending the practical application and commercialization of Canadian R&D, and growing the base of highly skilled workers needed to thrive in a constantly evolving technological economy.²

Since 2002, when an initial inventory of applied research capacity was undertaken by the Association of Canadian Community Colleges (ACCC) and Industry Canada³, a dramatic growth in colleges' research capacity and performance has occurred in all regions of the country. Applied research is now regularly included in college mandates, mission statements, and strategic directions, and offices and leadership positions have been established along with internal seed grant funds. At provincial and regional levels, enabling legislation has been enacted, linkages, networks, consortia, and collaborative partnerships have been established, and external funding sources have been expanded at the provincial, regional, and national levels. This Report documents how colleges in every region of the country are utilizing this momentum in capacity building to support private sector innovation, to provide employers with highly qualified workers, and to apply knowledge to solve real world problems in priority areas for the benefit of all Canadians.

* *College*, for the purpose of this report, is used as an omnibus term representing the wide range and diversity of publicly funded non-university postsecondary institutions in Canada. In practice, these uniquely Canadian institutions are variously referred to as: community colleges, colleges of applied arts and technology, technical institutes, university colleges, institutes of technology and advanced learning, polytechnical institutes, and collèges d'enseignement général et professionnel (CEGEPs).

Purpose & Scope

The purpose of this Report is to conduct a comprehensive state-of-the-field review of existing bodies of knowledge in order to provide Industry Canada with the updated information needed to assess the role that colleges are currently playing in the overall innovation spectrum and the extent to which their capacity is being fully utilized. This pan-Canadian appraisal is intended to help inform decisions regarding Industry Canada's role in leveraging the capacity of colleges to support the goals of *Canada's Advantage*, whether through new initiatives or expansion of current initiatives. This study is guided by four key objectives:

- to illustrate the form, nature, structure, and scope of innovation activities currently performed at Canadian colleges
- to demonstrate the growth of local (college), provincial, regional, and national capacity through networks, consortia, and infrastructures that support college/SME innovation activities
- to review the metrics and indicators currently being developed to measure the impact of college/private sector innovation partnerships
- to identify factors that might be inhibiting further collaboration between industry and the college sector.

Methodology

This report provides an update to the *Survey of College and Technical Institutes' Applied Research and Development Activity* (Corkery, 2002) and *Provincial and Territorial Profiles: Community Colleges and Technical Institutes* (Corkery, 2002). An extensive documentary analysis was conducted of material in the public domain, including documents, publications, reports, legislation, guidelines and policies, research, and conference presentations relevant to the current research capacity and performance of Canada's colleges in all regions of the country. Resources reviewed for this study include national, regional, provincial, and local college documents and websites related to legislation, funding agencies, infrastructure, partnerships, etc. Discussions were held with representatives and stakeholders across the country in order to provide a comprehensive state-of-the-field report on the current applied research and innovation capacity of the college system.

2. COLLEGE CAPACITY: Provincial and Territorial Profiles

The purpose of this section is to provide:

- an update of the 2002 provincial and territorial profiles
- a pan-Canadian demonstration of dramatic increases in capacity and performance
- a brief overview of each provincial/territorial college system
- numerous examples of collaborative research projects, including available information on topics, public and private sector partners and funders, faculty and student participation
- examples selected to demonstrate the range and diversity of college research activity: small/large projects, urban/rural locations, public/private partnerships, range of sectors: health, environment, energy, IT, and others
- finally, following the template of the 2002 profiles, updates are provided on provincial legislation, operating grants, R&D programs, and faculty agreements.

NEWFOUNDLAND & LABRADOR

College of the North Atlantic

College of the North Atlantic (CNA) is Newfoundland and Labrador's public college, with 17 campus locations and 12 learning centres throughout Newfoundland and Labrador, and one international campus in the Middle East State of Qatar. In 1999 CNA was given a mandate by its Board of Governors to engage in applied research and innovation along with its on-going mission of postsecondary instruction and advanced training. The new mandate extended the College's role from a teaching-only institution to a teaching-and-research institution. Since 2002, the capacity of Newfoundland & Labrador's colleges to support private sector innovation has been dramatically increased through developments in legislation and infrastructure.

In 2004 CNA established an **Office of Applied Research (OAR)** to strengthen its capacity as a key player in community and regional innovation. By leading the pan-provincial **College Research and Innovation Network**, the OAR serves industry and community needs through coordinated activities including: generation of new knowledge, clustering and partnerships, research grants management, intellectual property and technology transfer. The Network is supported by the strategic inclusion of public and private partners, technology industries, regional universities, etc., and has entered into partnerships with NRC-IRAP, Industry Canada, HRDC, and has received funding from CFI, ACOA, AIF, IRIF, and many others. The Office of Applied Research has:

- been operating a multi campus research program totalling an approximate budget of \$14 million.
- developed policy and procedure structure for CNA as a world class research system
- secured NSERC eligibility for CNA as a research college

- signed collaborative partnerships with National Research Council of Canada (NRC-IRAP) for on-going industry support program.
- signed a multi-million dollar collaborative research agreement with Cape Breton University and University of New Brunswick
- launched a faculty research development plan which now supports over 20 faculty proposals in areas of strategic importance.
- fostered a culture of applied research in the college system and expanded applied research activity from 2 campuses in 2004 to 10 campuses in 2008.
- contributed to provincial and regional policy framework for research and innovation.

Over the past 5 years, CNA has extended support to over 100 local and regional SMEs in problem solving, product development, innovation, IP development, technology transfer, etc. This contribution is significant in terms of keeping many SME's alive in an economically challenged region where staying in business alone is a challenge in the face of dwindling demographics and fluctuating economic indicators. The following list provides examples of CNA partnerships supporting public and private sector innovation:

- ***Petroleum Applications of Wireless Systems***, a multi-million dollar initiative jointly operated by CNA, University of Cape Breton, and University of New Brunswick, is engaged in developing a fully automated wireless control system for oil and gas installations.
- ***Geospatial Research Facility*** is a multi million dollar research initiative conducting a comprehensive assessment of terrestrial resources in Newfoundland and Labrador using the most modern mapping, sensing, and data collection techniques.
- ***Agriculture Centre of Excellence***. This training and research facility supports Newfoundland and Labrador's agriculture industry in its endeavour to develop and diversify, realize opportunities, and maximize the province's potential for long-term growth and sustainability.
- ***Manufacturing Technology Centre (MTC)*** provides manufacturers and entrepreneurs with access to CNA's applied research and advanced technological capabilities. Through MTC, CNA has developed, with multiple funding partners, numerous IP-covered technologies with significant commercialization potential, including several products currently available for licensing. These include:
 - ***Burin Wave Power Pump: Wave Powered Pumping of Seawater for Onshore Use and Electrical Generation***. This innovative project aims at harnessing ocean wave energy into onshore commercial applications. This renewable energy device uses the energy inherent in ocean waves for on-shore applications and electrical power generation.
 - ***Remote Viewing Welding Helmet***. This modified welding helmet is a significant improvement over existing welding helmet design, allowing the operator to view voltage and current being drawn by the machine during welding process, without interrupting the welding process and without turning around to other read out panels.
 - ***Nomex Clothes Dryer***. This is an innovative warm air dryer designed for drying Nomex heat and flame resistant clothing after cleaning. Nomex fabric is used in a variety of uniforms including firefighter, oilfield worker, race car driver and military pilot coveralls. This design offers significant improvement over existing designs in terms of clothing capacity, operating efficiency, and fabrication cost.

- **Target Recording Training Pistol.** This is a low cost and safe training option for civilian, police, and military training regarding the use of firearms. The system utilizes an adaptable mounted camera arrangement that may be attached to many existing firearms or plastic replicas. Once installed and operated, the system records target images while shooting, providing feedback on the accuracy of shots taken by the user in a variety of training situations.
- **Electrochemical Etching of Aluminum Plates.** An innovative process for cost effective electrochemical etching of aluminum plates has applications ranging from production of complex and highly detailed signs to deep etched logos for vacuum forming.
- **Capacitive-Thermal Hybrid Sensor.** This state-of-the-art technology based on inferential flow measurement offers improved, innovative, cost effective ways of measuring component ratios and flow rates of multiphase fluids. The device has application in oil and gas pipelines, chemical, biological and food plants.

Marine Institute

The Fisheries and Marine Institute (MI) is a specialized technical institute of Memorial University and a member of ACCC. This unique hybrid centre of advanced marine training and applied research has a long history of working with partners across Canada and internationally to provide highly qualified workers for the oceans related industries through training and credit transferability in a spectrum of marine related courses, programs, diplomas, and degrees. MI is an internationally recognized oceanic institute, setting the global standard in education, training, innovation and research. The main campus and its complex of facilities is the setting for education and research in the areas of fisheries technology, agri-seafood processing, quality management systems, marine simulation, marine communications, safety, and navigation.

With a legislated mandate to contribute to applied research and technology transfer, MI undertakes activities that are industry-driven and collaboratively cost-shared with industry partners. MI's applied research functions, focused on technology transfer in support of the marine industries, are facilitated through numerous activity centres:

- **Canadian Centre for Fisheries Innovation (CCFI)**, funded by federal and provincial governments, supports applied research and technology transfer activities for the fishing industry and funds expert assistance in aquaculture, harvesting, and processing, with the aim of increasing and enhancing clients' productivity and profitability. CCFI's activities also support resource conservation research, equipment development, and marine biotechnology.
- **Centre for Aquaculture and Seafood Development (C-ASD)** has built a high level of applied scientific and technical expertise to enhance the competitiveness of the province's aquaculture and seafood processing sector. C-ASD services a full range of industrial clients, from owner/operator start-up companies, to large, national corporations in the areas of applied research, product and process development, technology transfer and advisory services, and support for education and training. C-ASD also manages and operates an ultra modern aquaculture research facility and two pilot plants.
- **Centre for Sustainable Aquatic Resources (C-SAR)** provides applied research to meet the needs of the harvesting, processing, and aquaculture sectors of the seafood

industry, as well as research in support of coastal zone management and environmental aspects of ocean resources. C-SAR houses the world's largest flume tank and addresses the specific needs of fishers and fishing gear manufacturers by undertaking industrial research and development and technology transfer in support of selectivity and conservation. This advanced facility provides the basis for research, consulting, and technical services to the marine industry on a global basis.

- **Centre for Marine Simulation** delivers applied research services for the marine transportation industry by providing and conducting controlled studies in simulated shipboard environments that are impossible or too expensive to conduct with actual sea trials. The facilities are also used for research into marine safety, behavioural research, port development studies, vessel management techniques, testing of operators, crew familiarization, and development and testing of equipment and operational procedures.

- **Offshore Safety and Survival Centre** is actively expanding the knowledge base and improving technology associated with offshore safety and survival and emergency response. Facilities include a simulated ship structure, a fire field, a survival tank for instruction in emergency rescue from ships, oil rigs, and helicopters, and lifeboat/rescue capsules, fast rescue crafts, and a sea going vessel.

- **School of Ocean Technology**, with a dual mandate to provide advanced training and to undertake applied research and development. With the recent integration of the Canadian Centre for Marine Communications (CCMC) the applied R & D foundation for the new School is built on the substantial repository of the expertise, facilities, creative energy and working relationships that have been established by CCMC over the past 19 years. CCMC has played a key role in applied research and industrial outreach through financing, development, and marketing of marine technologies, and has served as technical and business partner for a range of collaborators from small companies and maritime administrations to multinational corporations and governments worldwide. The applied research program also sponsors dissemination projects such as *SmartBay*, the *Journal of Ocean Technology*, and the *Ocean Innovation Conferences*.

- The Marine Institute also operates **two sea-going research and training vessels** involved in research concerning impacts, location, and retrieval of lost gillnets; research into the behaviour and catch ability of snow crab in response to different types of pots and baits; assessment and testing of new environmentally friendly gear and equipment; assessment of impacts of various gear on the environment; seabed mapping; and studies into plankton, water quality, data transmission, and underwater acoustics.

- **Fisheries Conservation Chair**, initially funded by the NSERC, the Provincial Fisheries Department, the Department of Fisheries and Oceans, and Fishery Products International. The chair carries out an independent fisheries research program, to complement and scrutinize government programs, and to provide an integrated focus for fisheries research.

- **Office of Industrial Assistance** (OIA-IRAP) helps small and medium-sized Canadian firms build their capability in technology and innovation. OIA-IRAP offers direct technical assistance, access to the latest technological advances, expertise, facilities, and resources, as well as cost-shared financing of innovative technical projects.

- **Marine Institute International** (MII) has built extensive knowledge and understanding of international development issues, agency structures and priorities. With partnership as a key dimension, MII uses the expertise of MI's 300+ personnel for project

implementation. To date MII has secured more than 85 funded projects in over 35 countries; approximately 130 MI personnel have been engaged internationally.

Legislation, Operating Grants, R&D Programs, Faculty Agreements, Future Directions. The provincial *Act Respecting a Provincial College* is silent in terms of addressing the college's role in performing R&D. However, in 1999 CNA extended its mandate through its strategic framework to include applied research, thus transforming CNA from a teaching-only institution to a teaching-and-research institution. Marine Institute has a legislated mandate to conduct applied research and technology transfer activities. More recently the provincial government has amended its Industrial Research and Innovation Fund (IRIF) to accommodate CNA as an eligible receptor. This fund was previously dedicated to Memorial University's R&D needs only. Since 2004, CNA has been operating over 20 R&D projects in strategic S&T sectors (IT, environment, energy, engineering, physics, chemistry) with an approximate budget of \$13 million. Major funding sources for these projects include CFI, AIF, NRC, and IRIF. The college's collective agreement does not explicitly address R&D, but CNA has launched a faculty research development plan which now supports over 20 faculty proposals in areas of strategic importance. Following a significant output in product development in the manufacturing sector, CNA is considering incubating its own technology commercialization unit to promote its innovations, products, and services in the global marketplace.

NOVA SCOTIA

Nova Scotia Community College (NSCC)

Nova Scotia Community College's applied research and innovation program supports economic development and trains highly skilled workers at 13 campuses, including the Institute of Technology in Halifax, Aviation Institute in Dartmouth, Annapolis Valley Centre of Geographic Sciences, and the Nautical Institute & School of Fisheries. NSCC's mission is to enhance Nova Scotia's economy and quality of life through education and innovation. The college supports research in environmental, economic, software, health, and geomatics technology fields through multiple public and private sector collaborative partnerships

In 1999 NSCC determined that applied research was within its mandate and formed a natural extension of the college's role in the economic and social development of the province. Subsequently, NSCC was successful in obtaining infrastructure funding through CFI's first national competition, leading to the establishment of the Applied Geomatics Research Group (AGRG) in the Annapolis Valley. Further research funding from other sources has grown to over \$25 million. In collaboration with dozens of private sectors partners, NSCC has obtained research funding from AIF, ACOA, DNR, DND, PWGSC, DFO, DFW, WVDA, SNBA, SAIC, ACPI, Environment Canada, ESRI, NSERC, SSHRC, CIHR, Parks Canada, Scotia Weather Service.

NSCC has also achieved an extensive record of successful collaboration with private sector enterprises and other postsecondary educational institutions in Atlantic Canada.

The following “success stories” illustrate some of research projects with which NSCC faculty and students are currently engaged.

Applied Geomatics Research Group (AGRG).

Founded in January 2000 with support from CFI, AIF, and ACOA, AGRG is a global leader in the application of state-of-the-art geomatics technology and is designed to conduct vital environmental research, to enhance the region’s applied research capacity and expertise, to attract national and international business and private investment, and to train the next generation of highly skilled research scientists and technologists. AGRG, selected as one of the “NSERC-6” projects in the College and Community Pilot Program, has used the resultant enhanced capacity on approximately 50 different research projects, including.

- ***Coastal disaster management.*** AGRG is the lead researcher in a \$5 million project, sponsored by ACOA, to create a coastal disaster management decision support system that can effectively identify coastal hazards caused by storm surge, waves, and erosion. The project is now at the stage where the commercialization of the techniques is a reality, and is being implemented by AGRG's commercial partners.
- ***Wireless Network for Environmental Monitoring Project.*** Another example of technology transfer through AGRG is this major research initiative focusing on the development of a wireless network of remote environmental monitoring stations in the Annapolis Valley. Researchers at AGRG have installed a network of 14 meteorological stations and loggers throughout the region. Adding wireless capabilities to the sensor network will allow researchers to efficiently access, process, and integrate meteorological data with other data sources to help produce weather forecasts, landscape descriptions, or visual models for use by vineyard owners, farmers, and meteorologists.
- ***AJAX and LiDAR.*** In several short term projects, small local companies have had problems solved with economic benefit using the technology available at the college. Adoption of asynchronous java (AJAX) technology through AGRG led to increased business for a provincial internet provider. Another partner had been completely unaware of LiDAR (Light Detection and Ranging) technology that can create multi-dimensional topographic maps; an AGRG project provided the company with new exploration tools to make more accurate business decisions, reduce costs, and reduce risk by determining the optimum location to place their next gravel operation.
- ***Green Power.*** AGRG is working with Green Power Labs Inc., a Dartmouth-based solar energy assessment and consulting company, to provide detailed information to individual home owners, businesses, and power utilities interested in solar power. With AGRG’s assistance, a Green Power Labs client won a large contract from Ontario Power Authority to build a 10-megawatt solar power station.
- ***Environmental Technologies to Enhance Wild Blueberry Production.*** AGRG was a collaborator on the Remote Sensing Component of the "The Environmental Technologies for Wild Blueberry Production" project. This five year project is operated and funded collaboratively through public and private sector partners including: Atlantic Innovation Fund (AIF), Agriculture and Agri-Food Canada's Environmental Technology Assessment for Agriculture (ETAA) Program, Nova Scotia Agricultural College, Oxford Frozen Foods Ltd., and Bragg Lumber Company.

- **Remote Sensing Component.** NSCC studied the use of airborne remote sensing technologies in combination with ground-based technologies in differentiating vegetation types in blueberry fields, employing Compact Airborne Spectrographic Image and digital aerial photography as well as ground data collection using Analytical Spectral Device (ASD) FieldSpec® spectrometer. A spectral library with over 400 classification signatures was created to assist commercial partners in evaluating expansion plans for increased blueberry production.

Infant Incubator Project. Mechanical Engineering Technology students at NSCC's Institute of Technology are partnering with the medical technology industry in hands-on research in the development of a neonatal incubator for use in the IWK Health Center's Magnetic Resonance Imaging (MRI) scanner. The challenge was to build an MRI-compatible neonatal incubator for premature neonates who are vulnerable to hypothermia because of their low body mass and cannot maintain a safe body temperature for the duration of a MRI scan. A design proposed by two NSCC students, now at the animal testing stage, is close to producing a marketable solution to a real world problem. Interest in commercializing the invention has been expressed by Innovacorp, who has provided the College with early stage commercialization funds to evaluate its commercial possibilities. An upcoming market analysis will provide clearer indication of the potential for this innovative equipment, and interest has been shown by a number of private companies in the medical manufacturing field.

Legislation, Operating Grants, R&D

The *Community Colleges Act* gives authority to Boards of Governors to run colleges. It is silent on the colleges' role in carrying out R&D, but does not preclude colleges from pursuing applied R&D. NSCC receives block funding from the province, but the province does not specify how these funds must be used; NSCC is free to allocate their resources as they wish. NSCC's Board uses its operating budget to support research by providing \$340,000 per year (\$170,000 for research staff; \$170,000 for an Office of Applied Research, Director, and Manager). The Board provides an additional \$350,000 over three years for capital costs. General policy for research is under the office of the Director of Applied Research, who is also responsible for the published policies on research, including Intellectual Property. The Collective Agreement for NSCC's faculty is silent on the role of faculty in research.

PRINCE EDWARD ISLAND

Holland College

Holland College is PEI's publicly funded Anglophone community college, delivering practical, industry-driven, advanced skills training programs at 13 locations across the province. In building its applied research capacity, Holland College has included "applied research" and "technological adaptation" in its statement of beliefs, established the position of Director of Applied Research, and is in the process of gaining NSERC-eligibility. The College, along with other Atlantic Universities and Colleges, has also become part of the Springboard consortium which fosters technology innovation, and transfer. Within this consortium, Holland College will have an established Industrial Liaison position, assigned to the Applied Research department, and networked with Industrial Liaison officers in the 18 member network.

Culinary Institute

Holland College was the first college in Atlantic Canada to offer an applied degree and the first college in Canada to offer an Applied Degree in Culinary Operations. Thanks to investments from the federal government, the province of PEI, Cavendish Farms and Holland College, the Culinary Institute of Canada, Canada's Smartest Kitchen has become a reality. This Food Product Development Lab will assist the province's \$1 billion/year food sector, to develop and test value-added food products for local producers and processors using PEI ingredients. This collaborative partnership helps the provincial food industry adapt and compete in a competitive market, while providing employers with highly skilled workers knowledgeable in state-of-the-art food technology, as illustrated by the success of Culinary Institute students who recently won the 2007 *World Junior Culinary Grand Prix* at the World Culinary Olympics in Germany.

Justice Knowledge Network

Holland College, in partnership with the Canadian Police Knowledge Network, has received \$13.3 million since 2002 from Atlantic Innovation Fund for development and application of innovative e-learning security training environments for law enforcement/correctional services. Focusing on client-driven issues, the Justice Knowledge Network integrates research results directly into the development of its products which are disseminated via industry journals and conference presentations.

Legislation, Operating Grants, R&D Programs, Faculty Agreements

There have been no changes since 2002. The Act governing Holland College continues to be silent on R&D. Operating grants do not support college R&D efforts; Holland College receives block funding which it can allocate to any activity, at its discretion. The province does not have programs that support R&D at community colleges. Faculty agreements are silent on the topic of R&D and technology transfer.

NEW BRUNSWICK

New Brunswick Community College (NBCC) / Collège communautaire du Nouveau-Brunswick (CCNB)

The New Brunswick Community College/Collège communautaire du Nouveau-Brunswick network consists of 11 campuses, six of which are designated as Anglophone and five as Francophone. NBCC/CCNB has operated as a special agency through the Department of Post-secondary Education, Training and Labour, but significant legislative changes will be announced in the near future. Various Centres of Excellence have been developed by the CCNB:

- Centre of Excellence in Information Technology (CEI/CEIT)
- Atlantic Canada's Woodworking Centre of Excellence (CEBO/WCE)
- Atlantic Centre for Excellence in Tourism (CETA/ACET)
- Metal Innovation and Technology Transfer Centre (CITTM/MITTC)
- New Brunswick School of Fisheries
- Centre of Excellence in Agricultural and Biotechnological Sciences (CESAB)

CCNB has received a CFI grant of \$187K, is NSERC-eligible, and has conducted various applied research projects through collaborative partnerships. A sampling of CCNB and NBCC projects includes:

Bio-Ethanol Production from Potato Waste. CCNB's Centre of Excellence in Agricultural and Biotechnological Sciences has partnered with the New Brunswick Department of Agriculture, Fisheries & Aquaculture, the New Brunswick Innovation Foundation and McCain Foods in an applied research project to determine the suitability of using potato waste from steam peel and potato culls for the production of bio-ethanol. The outcome of this research is not only providing potential companies interested in building an ethanol facility with information required to make important business decisions, but is also providing the local potato industry with a place to dispose of their waste potatoes that could be used to produce a value-added product, instead of disposing of them in a land fill.

Production of Lactic Acid from Potatoes and Grains for Biopolymer and Plastic Production. The CESAB is also involved in a small scale project funded with \$165K from NB Agriculture Council and NB Innovation Foundation to evaluate the potential to produce lactic acid from potatoes and grain.

Inter-professional Education for Collaborative Patient-Centered Chronic Disease Care. This \$750K partnership between NBCC, Dalhousie University Faculty of Medicine, Health Canada, and Atlantic Health Science Corporation is aimed at developing a sustainable model of health care education to equip students to work in inter-professional teams in patient-centered practice.

Legislation, Operating Grants, R&D Programs, Faculty Agreements. Prior to 2008, legislation governing NBCC/CCNB did not address R&D or technology transfer. While there were no significant allocations for R&D within the NBCC and CCNB budgets, both NBCC and CCNB could choose to direct some funding to support R&D initiatives. Faculty agreements are still silent on this topic. However, significant legislative changes are expected to be announced in the near future. These changes will affect the mandate, operating grants, R&D programs, and the role of applied research in the future direction of NBCC/CCNB.

QUEBEC

Collège d'enseignement général et professionnel (CEGEPS) lie at the heart of Quebec's unique post-secondary education system. Students entering CEGEPs from secondary school take a core curriculum and follow either a 2 year general studies program (transferable to university) or a 3 year professional skills program (comparable to college certification programs in other provinces). Currently there are 48 public CEGEPs (represented by Fédération des cégeps) and 24 collèges privés (semi-publicly funded private colleges). In 1993 the province made research an official part of CEGEPs' mission.

College Centres for Technology Transfer (CCTT)

In 1983, Quebec established the first College Centre for the Transfer of Technologies (CCTT) under the Quebec CEGEP Act. These unique institutions are incorporated by and report to their respective CEGEP Board, with the mission of providing technical assistance, applied research, information, and training to support regional economic development by transferring knowledge and innovations to SME clients. Currently there are 35 CCTTs, with 5 additional CCTTs approved for launch in 2008; 34 are associated with CEGEPS, and one CCTT is associated with a collège privé. Each CCTT operates within its own area of specialization.

- CCTTs are staffed by 500 experts, including technicians, engineers, PhDs, scientists
- 20% of CCTTs positions are filled by college faculty through a provincial faculty release program
- 8 CCTTs are currently NSERC-eligible, 4 in process
- CFI has provided \$10 million to fund 21 projects at 10 CCTTs

In 2006-2007 the Quebec government allocated \$8.8 million in annual funding to support CCTTs, and has recently announced an additional \$12.6 million over 3 years to establish new CCTTs and to broaden the networking between CCTTs and other stakeholders in the innovation spectrum. Funding of CCTTs involves a high degree of cooperation between provincial ministries: MELS (Ministry of Education), MDEIE (Ministry of Economic Development), and other ministries share capital costs on a 54/33/13 basis, while operating costs are shared on a 60 (MDEIE)/40(MELS) basis. Each CCTT receives up to \$250K/year for the first 3 years (\$150K from MELS, \$100K from MDEIE) and, subsequent to successful evaluation, up to \$300K/year (\$200K from MELS, \$100K from MDEIE) thereafter. Additional funding for faculty release time is provided through PART, the research technology branch of MELS. This faculty release program has recently been dramatically increased; in *An Innovative and Prosperous Quebec: Quebec Research and Innovation Strategy* (2007), the Quebec government notes that “releasing CEGEP lecturers from their teaching duties is an essential condition to ensure the survival and consolidation of CEGEP research.” To this end Quebec has dedicated an additional \$6 million dollars over three years (in addition to the \$12.6 million increase noted above) specifically for “enhancement of the CCTT program through expanded release of more CEGEP teachers to participate in research activities at CCTTs.”⁴

CCTTs also have access to provincial and federal infrastructure and operating grants, and are currently engaged in projects worth \$28.6 million over 3 years. Financial assistance is also available for SMEs working with CCTTs in the form of:

- federal R&D tax credit (SR&ED: Scientific Research and Experimental Development Tax Credit Program).
- 40% provincial tax credit refunds, obtained through a user-friendly 2-page reporting form
- provincial refund programs returning up to 50% of project-related expenses to a maximum of \$50K.

All CCTTs must submit to periodic evaluation, and submit an annual audit report to the provincial government; significantly, a single report has been designed that meets the requirements of both sponsoring ministries. To date, economic results from CCTT investment can be illustrated by outcomes such as the following (as of 2005):

- over 3000 clients, of which 65% were SMEs, 17% large private sector companies, 16% public sector partnerships
- Revenues from clients: \$30 million
- Provincial infrastructure grants awarded: \$23 million
- 1500 students involved in CCTT research activities
- 435 employment positions created (88% in client companies, 12% in CCTTs)
- 1999-2003: 11 new enterprises launched

According to the Quebec government's 2005 financial statement, the CCTT system generated \$3.1 in revenues for each \$1 in base funding from the province.⁵

The following list identifies the current 40 CCTTs:

AGENCY	REGION	ATTACHED TO	FIELD OF APPLICATION
Centre collégial de transfert en biotechnologies (TransBIOtech)	Chaudière-Appalaches	Cégep de Lévis-Lauzon	Biotechnology
Centre technologique des résidus industriels (CTRI)	Abitibi-Témiscamingue	Cégep de l'Abitibi-Témiscamingue	The environment (development of industrial wastes)
Centre collégial de transfert de technologie en foresterie (CERFO)	Capitale-Nationale	Cégep de Sainte-Foy	Forestry
Centre d'expérimentation et de développement en forêt boréale (CedFob)	Côte-Nord	Cégep de Baie-Comeau	Forestry (boreal forest)
Service d'innovation et de transfert technologique pour l'entreprise (SITTE)	Chaudière-Appalaches	Cégep Beauce-Appalaches	Industrial mechanics
EQMBO-Entreprises inc. Centre d'aide technique et technologique	Centre-du-Québec	Cégep de Victoriaville	Furniture and milled wood
Centre collégial de transfert de technologie en oléochimie industrielle (OLEOTEK)	Chaudière-Appalaches	Cégep de Thetford Mines	Oleochemistry
Centre de technologie minérale et de plasturgie inc. (CTMP)	Chaudière-Appalaches	Cégep de Thetford Mines	Plastics processes and minerals

Centre de productique intégrée du Québec inc. (CPIQ)	Estrie	Collège de Sherbrooke	Computer-integrated manufacturing and industrial data processing
Centre de robotique industrielle inc. (CRI)	Chaudière-Appalaches	Cégep de Lévis-Lauzon	Computer-integrated manufacturing, robotics and vision
Centre de transfert de technologie en musique et son -Musilab inc.	Centre-du-Québec	Cégep de Drummondville	Music and sound technologies
Innovation maritime	Bas-Saint-Laurent	Cégep de Rimouski	Marine technologies
Centre collégial de transfert de technologie des pêches (CCTP)	Gaspésie—Les Îles-de-la-Madeleine	Cégep de la Gaspésie et des Îles-de-la-Madeleine	Marine technologies (fisheries)
Centre spécialisé de technologie physique du Québec inc. (CSTPQ)	Bas-Saint-Laurent	Cégep de La Pocatière	Physical technologies
Centre de développement des composites du Québec (CDCQ)	Laurentides	Cégep de Saint-Jérôme	Composite materials
Institut en transport avancé du Québec (ITAQ)	Laurentides	Cégep de Saint-Jérôme	Advanced transportation
Centre d'innovation en micro-électronique du Québec (CIMEQ)	Laurentides	Collège Lionel-Groulx	Electronics and microelectronics
Centre spécialisé en pâtes et papiers (CSPP)	Mauricie	Cégep de Trois-Rivières	Pulp and paper
Centre national en électrochimie et en technologies environnementales Inc. (CNETE)	Mauricie	Collège de Shawinigan	The environment and industrial chemical and biotechnological processes
Centre intégré de fonderie et de métallurgie inc. (CIFM)	Mauricie	Cégep de Trois-Rivières	Metallurgy
Cintech agroalimentaire inc. – Centre d'innovation technologique agroalimentaire	Montréal	Cégep de Saint-Hyacinthe	Agri-food
Centre de transfert technologique en Écologie industrielle (CTEI)	Montréal	Cégep de Sorel-Tracy	The environment (development of industrial residual material)
Centre technologique en aérospatiale (CTA)	Montréal	Collège Édouard-Montpetit	Aerospace
Groupe CTT Group - Centre des technologies textiles et géosynthétiques	Montréal	Cégep de Saint-Hyacinthe	Textiles and geosynthetics
Centre d'études des procédés chimiques du Québec (CEPROCQ)	Montréal	Cégep Maisonneuve-Rosemont	Chemical processes
Centre de transfert technologique de la mode (CTTM)	Montréal	Collège LaSalle	Fashion
Centre de photonique du Québec (La Pocatière), Centre de technologie physique et de photonique de Montréal (CEPHOM)	Montréal and Bas-Saint-Laurent	Cégep de La Pocatière, Cégep André-Laurendeau et John-Abbott College	Optics and photonics
Institut des communications graphiques du Québec (ICGQ)	Montréal	Cégep d'Ahuntsic	Graphic communications
Centre de géomatique du Québec inc. (CGQ)	Saguenay—Lac-Saint-Jean	Cégep de Chicoutimi	Geomatics, data processing and software
Centre de production automatisée (CPA)	Saguenay—Lac-Saint-Jean	Cégep de Jonquière	Computer-integrated manufacturing and industrial mechanics

Centre de recherche et de développement en agriculture (CRDA)	Saguenay–Lac-Saint-Jean and Montérégie	Cégep d’Alma	Agriculture
Centre de développement des bioproduits (Biopterre)	La Pocatière	Cégep de la Pocatière	Bioproducts
Énergie éolienne en milieu nordique (CORUS)	Murdochville	Cégep de la Gaspésie et des Îles	Industrial wind power
Institut de technologie des emballages et du génie alimentaire (ITEGA)	Montréal	Collège de Maisonneuve,	Packaging, Food engineering
Service de recherche et d’expertise en transformation des produits forestiers (SEREX)	Amqui	Cégep de Rimouski	Forest products
Centre collégial de transfert de technologie en télécommunications (C2T3)	Trois-Rivières	Cégep de Trois-Rivières	Communication
Centre collégial de transfert en imagerie numérique et médias interactifs (CIMMI)	Sainte-Foy	Cégep de Sainte-Foy	Interactive media
Centre d’excellence en maintenance industrielle (CEMI)	Sept-Iles	Cégep de Sept-Iles	Industrial Maintenance
Centre des technologies de l’eau (CTE)	Montréal	Cégep de Saint-Laurent	Water
Institut international de logistique de Montréal (IILM)	LaSalle	Cégep André-Laurendeau	Logistics

Réseau Trans-tech

Réseau Trans-tech was established by its member institutions in 1995 as a network linking and representing all of Quebec’s CCTTs. As of March 2008, 5 new centers were provincially approved, bringing the CCTT membership in the Réseau to 40. Réseau Trans-tech’s mission is:

- to promote synergy among its members with a view to stimulating the economic development of all regions of Quebec
- to contribute to the development of its members
- to represent its members in dealings with government, scientific, and business organizations, and other stakeholders
- to explore and expand partnership opportunities.

To this end, Réseau Trans-tech adopts and advocates positions and actions in areas of common interest, and provides its members with informational, educational, promotional, and representational services. Recently Réseau Trans-tech received \$1.2 million for 3 years from MDEIE to enhance the networking capacity between CCTTs and SMEs.

Association pour la recherche au collégial (ARC)

ARC was established in 1988 with a mandate to:

- promote the development of research at the college level
- promote and defend the interests of college researchers
- facilitate the implementation of research policy, plans, and procedures
- bring together, inform, and encourage those interested in the development of college research.

ARC functions as a forum for contact and discussion on college-level research. As a professional association, ARC fosters the development of research throughout the college system. In fulfilling its mandate ARC conducts a range of activities, including:

- publication of 4 newsletters per year
- dissemination of position papers on research issues
- awarding of annual competitive prizes to students, institutions, and faculty for exceptional research activities
- hosting activities and conferences
- sponsoring meta-research projects

A recent major initiative at ARC is the production and dissemination of *Developing an Institutional Research Plan* (2007), a set of resource documents aimed at assisting colleges to define and achieve their research mission and objectives through establishment of institutional plans as well as policies on research ethics and integrity.

CCTT Success Stories

- **Centre d'innovation en microélectronique du Québec (CIMEQ) – Collège Lionel-Groulx.** For the past 23 years CIMEQ has been a leader in the global, multi-billion dollar Building Automation and Intelligent Transportation Systems (ITS) markets. CIMEQ is Quebec's leader in ITS by combining microcontrollers, Global Positioning Systems (GPS), wireless communications, and CANbus™ technologies. CIMEQ also develops Building Automation control modules that minimize energy consumption through embedded technologies such as 32-B ARM™ microcontrollers, fuzzy logic, neural networks, Echelon LonWorks™ and BacNet™. Over the past 10 years, CIMEQ has assisted more than half a dozen companies to adapt building controls and energy management technologies and protocols that combine to provide powerful and cost-effective solutions to SMEs in this globally competitive market.

- **TransBioTech - CEGEP Levis-Lauzon, Levis.** This NSERC-eligible CCTT, one of the NSERC-6 pilot projects, has become one of Quebec's major biotechnology transfer enterprises, providing access to innovative bio-receptor technologies used by food and pharmaceutical companies. Transbiotech's laboratories meet Health Canada bio-confinement level 2 standards, and are accredited by the Canadian Council on Animal Care. Located within the technology complex of CEGEP Levis-Lauzon, Transbiotech actively involves 5 teachers and numerous students who complete research projects or remunerated training through co-op positions. Partners include the Society for Economic Development, Canadian Forest Service, Bioxel Pharma, and an international veterinary pharmaceutical company. TransBiotech is a member of the Canadian Technology Network and the AgBioCentre Business Incubator Network. TransBiotech exemplifies the dramatic return on investment that colleges can generate, in this case by developing and transferring an innovative platform of bio-receptor technology that is being used by food and pharmaceutical companies throughout the province to improve their competitiveness in the global biotechnology market. Simultaneously, the TransBiotech CCTT at Levis-Lauzon CEGEP provides advanced skills training for the next generation of science and technology workers.

- **Quebec Centre of Composite Development (QCCD) - CEGEP de Saint-Jérôme.** CEGEP de Saint-Jérôme has received over \$2 million in CFI funding and is NERC-eligible. In partnership with Feel Good Cars (Toronto, ON) QCCD has developed six zero-emission electric vehicle prototypes. In the current \$200K project QCCD built an initial model by converting a diesel-powered European vehicle, and delivered six prototypes delivered to the partner's sale and marketing branch. The partner then

mandated QQCD to transfer the development of the vehicle from the production stage to the industrial development stage. As a result of the region's unique expertise in electric vehicle engineering and manufacturing, the client decided to locate their assembly line in close proximity to this CCTT.

- **Centre for Textile and Geosynthetic Technologies (CTT Group) - CEGEP St. Hyacinthe CCTT.** Founded in 1987, this CCTT (known as the CTT Group) has grown to a workforce of 45, with a customer base of more than 300 companies in the textile, geosynthetics, and polymer sectors. In collaboration with Canadian and international universities and research centres, CTT Group develops innovative "intelligent" textile-based products such as geotextiles, nonwovens, geosynthetics, and protective clothing. Their Commercial Development Services (CDS) division helps companies increase their competitive capabilities and seek out new business opportunities. The CTT Group is also a key source of information for its members and clients through its *Textile Journal*, and through a database of thirty specialized journals. Industry partners include: Filspec, Belt-Tech, Bermatex, MW Canada Ltd, Lincoln Fabrics, Solmax International, Titan Textile, Texel, Regitex, Martin Stedfast, Consoltex, Fintex, Mechanical and Processes, Medifit Marketing, PGI Difco, Doubletex. Institutional partners include: Seaway Yarns/CTA (Ontario), Clarian Féd. Textile du Canada, Hydro-Québec, Fédération des syndicats textiles et vêtements (CSD), Comité sectoriel de main-d'œuvre de l'industrie textile du Québec, TUAC, Préventex, École des Technologies Supérieures, and Industry Canada.

ONTARIO

At this time Ontario has 24 colleges of applied arts and technology, with campuses in over 100 communities offering a wide range of 1, 2, and 3-year diploma, certificate, and postgraduate certificate programs. Since 2002 applied research capacity and activities have increased dramatically, driven in part by enactment of the *Colleges of Applied Arts and Technology Act* (2003) which extended college mandates to include applied research activities. Extensive infrastructure and capacity in support of research activities already existed in the Ontario college system, but expanded dramatically subsequent to enactment of this enabling legislation. The significant increase in capacity building and applied research activity since 2002 can be illustrated in a number of ways. Specific inclusion of “applied research” in college mandates, mission statements, and strategic plans is now a common feature of Ontario colleges, as are variously named college offices and centres of applied research, innovation, commercialization, etc. The following list further illustrates these ongoing developments in applied research infrastructure, capacity, and activity:

- all 24 Ontario colleges have representation on the Colleges Ontario Heads of Applied Research Committee
- 16 colleges have established or are in the process of establishing policies on research ethics, integrity, academic freedom, financial accountability
- 7 colleges have obtained NSERC eligibility; 9 are in the process
- 10 colleges are members of Colleges Ontario Network for Industry Innovation (CONII)
- 7 colleges have completed 14 projects with \$6.8 million funding from CFI
- 15 colleges have completed 8 projects with \$3.6 million funding from Ontario’s College Research Development Fund
- 3 colleges have completed 4 projects with \$1.5 million funding from Ontario Innovation Fund
- 11 colleges have completed 22 projects with \$6.3 million funding from Ontario Community College Infrastructure Program

Colleges Ontario/Heads of Applied Research (HAR)

HAR is a subcommittee of Colleges Ontario’s Coordinating Committee of Vice-Presidents. Its mandate is to promote applied research and innovation at all 24 Ontario colleges and to assist Ontario colleges as they become involved with or expand applied research activities. HAR is working to:

- foster collaboration between colleges and employers
- increase applied research and technology transfer capacity that responds to employer problems and delivers commercial outcomes
- enhance local entrepreneurial culture
- develop a rich base of highly qualified personnel

In promoting forward-looking provincial research and innovation policies, HAR has contributed significantly to the drafting of numerous Colleges Ontario documents and submissions, including *Applied Research and Innovation: Ontario Colleges – An Underutilized Resource* (2004), *Catalysts of Economic Innovation: Building on the Applied Research Capacity of Ontario Colleges* (2006), and the current draft of *Mobilizing College/Institute Applied Research and Innovation Activities* (2008).⁶

Colleges Ontario Network for Industry Innovation (CONII)

CONII is a network of 10 colleges dedicated to helping business and industry become and stay more competitive in a rapidly changing global economy. Industry-driven in its innovation and commercialization initiatives, CONII is funded through a 3-year, \$3.5 million grant from the **Ontario Research Commercialization Program** of the Ontario Ministry of Research and Innovation. The CONII network currently includes the following colleges: Algonquin, Centennial, Conestoga, Fanshawe, George Brown, Humber, Niagara, St. Clair, Seneca, and Sheridan. CONII's goal is to develop projects with SMEs that support their applied R&D needs, make effective use of college faculty expertise and resources, and provide college students with real-world learning opportunities that enhance their skills and marketability. CONII provides services including proof of principle, prototyping, testing, and commercialization, focusing on eight sectors:

- alternative and renewable energy
- environmental technologies
- health and life sciences
- information and communication technologies
- digital media
- viticulture and agri-business
- construction, manufacturing, and materials
- hospitality and tourism

Each CONII member college has developed IP policies and supports exploitation of IP to sustain a strong Canadian economy and to improve the quality of life of all Canadians. As a provincial college research capacity-building initiative, CONII enhances Ontario's competitiveness in the global marketplace by helping SMEs solve technical problems, adapt new technologies for the marketplace, develop new or improved products and processes, speed up the R&D process, and move products to market more effectively.

The following representative sample illustrates the range and diversity of applied research and innovation partnerships at Ontario colleges:

Algonquin College:

Algonquin College has established an **Office of Applied Research & Innovation** with a Director, three part-time Project Managers, a part-time Industrial Liaison Officer (shared with UOttawa, Carleton and UQuebec en Outaouais (UQO)), and a part-time student Admin Assistant. Policies are in place regarding research ethics, integrity, and financial accountability. Algonquin is NSERC-eligible, has received CFI and OCE funding, and is a member of CONII and the Ottawa-Gatineau University-College Regional Innovation Alliance. **Algonquin Innovations** provides internal research funding for 1-year \$10K faculty-led projects and 3-6 month \$4K student-led projects, and sponsors an annual Algonquin Applied Research Day in early April. Current student research activities include: development and testing of Cyberpsychology, a 3-D virtual reality phobia treatment project funded by NSERC and UQO; Algonquin Mechanical Engineer School students were finalists in OCE's 2007 Discovery Day for their Black Walnut Harvester applied research project; Applied Technology faculty and students demonstrated their

next-generation UPS project, done in collaboration with the industrial sponsor, SeeWind,, to the federal Environment Minister.

Projects conducted during the 07/08 academic year include an adjustable dummy that is used to test wheel chair stability, a novel optical system with commercial promise and a robot docking station to which a robot can go for battery recharging without human intervention. All of these projects are being done in conjunction with industrial or institutional partners.

Cambrian College:

Northern Environment Heritage Institute (NEHI) specializes in research related to integrated resources management and ecosystem restoration

Sustainable Energy Centre, currently in development, will provide a living laboratory for Cambrian's new Energy Systems Technology program. Students in the program will be able to instrument and monitor the Energy Centre, its energy devices and building products, and analyze and report on energy efficiencies, ease of installation, durability, and cost reduction factors.

Northern Centre for Advanced Technology Inc. (NORCAT). Established in 1995 with the support of the Ontario government, NORCAT has evolved into an internationally-recognized advanced technology research centre with partnerships extending from its northern Ontario base to more than 10 countries. NORCAT's 32,000 sq. ft facility currently supports a wide range of applied research centres, including:

- Prototype Development Centre
- Occupational Health and Safety Environmental Resource Centre
- Ontario Centre for Ground Control Training
- NORCAT Underground Centre
- Multimedia Production Centre
- Book Publishing Department
- Computer-Aided Technology Centre
- Northern Construction Centre
- Industrial Training Department
- Contractor Safety Orientation Training Centre for underground operations at Vale Inco, Xstrata, and Kidd Creek mines.

Centennial College

Applied Research Centre (ARC). Established in 2004, this collaborative research facility houses an active research team staffed by a Research Director, two academic research managers (for the School of Community and Health Studies and the School of Engineering and Applied Health Sciences), a manager of the Centre for Innovation (technology transfer office), and three support staff. ARC is currently involved in externally funded applied research projects with contributions from all three levels of government, non-governmental organizations, foundations and associations, and a variety of industry and community partners. A few highlights of ARC's current research projects include:

- **IDEAS (Interprofessional Disaster Action Studies)**: creating and evaluating an interprofessional undergraduate course in disaster preparedness. Engaging medicine, nursing, pharmacy, allied health, police, EMS, social work, and media in online

educational gaming and full-scale high-fidelity simulations. IDEAS' simulated hospital and labs also serve as a test bed for new technologies and processes in emergency and disaster management. Financial contribution: Health Canada and industry partners

- **Reducing Refrigeration Peak Demand with a Self-Organizing Control System:** validating controller performance and energy consumption in a commercial building. The industry partner is REGEN Inc, and the project is supported by Colleges Ontario Network for Industry Innovation (CONII) through a contribution from the Ontario Government, Ministry of Research and Innovation.
- **Parent-delivered Massage Program in Paediatric Oncology:** developing and piloting a parent-delivered massage educational program (on DVD) at the Stollery Children's Hospital in Edmonton. Anticipated outcomes: to reduce stress and anxiety in the parent and cancer-related symptoms in the child. Supported by the Sick Kids Foundation National Grants Program.
- **Integrating Tailored Health Education for Patients in Clinical Practice** through the creation of culturally intelligent online videos for patient education and self-care, for vulnerable populations with chronic illness, with a variety of community partners and supported by the Canadian Council of Learning.
- **IN-CAM Outcomes Database:** the creation, hosting and testing of an international database of outcome measures for research in complementary and alternative health care, <http://www.outcomesdatabase.org>, in partnership with University of Calgary, McGill University and funded by the Lotte and John Hecht Memorial Foundation
- **TeleHomeCare (THC):** a collaborative project employing new technologies to provide remote healthcare to chronically ill patients. Partnerships include CANARIE, OIT, Toronto East General Hospital, East York Community Care Access Centre, Comcare Health Services, and AmericanTele-Care. THC has served 144 patients in the East York community, delivered 3,700 technology-enabled visits by nurses, and reduced the number of emergency department visits made by these patients. THC is now exploring commercialization opportunities.

Conestoga College

In-Mold Plastic Temperature Measurement. Funded collaboratively through private sector Polymer Technologies, Inc. and Ontario Centres of Excellence (OCE), this study involved faculty and students in an investigation of two key process variables in plastic production. Students participated in the literature review, research problem definition, identified a suitable prototype mold, the position of the sensors, and defined testing procedures for the client. Based on the results of this private/public sector applied research partnership, a new process-control strategy for plastic injection machines has been proposed for commercial development.

Industrial Safety Glove Assembly Automation. Another private/public sector collaborative research partnership involved Marzo Glove Inc. and OCE in a faculty-led investigation of innovative production processes to automate a process for sewing leather gloves. Previous attempts to automate the process have so far proven impossible but this pilot project has achieved 75% glove closure. Conestoga College and Marzo Glove Inc. have recently agreed to continue developing the technology and further research and

testing will begin shortly. The successful outcomes of this project will increase production efficiency while minimizing worker-related repetitive motion injury.

Vertical Axis Wind Turbine. A team of 4th year Integrated Advanced Manufacturing Technology students participated in an applied research project with private sector Ventax Inc. to produce a mid-sized vertical wind turbine power generator that will help meet increasing demands for renewable energy. The students' design incorporated twin rotors for maximum efficiency, grid and net metering capability, and an alternate option for battery storage.

Integrated In-Suite Ventilator (ISV) for Multi-Unit Residential Buildings (MURBs). ISVs currently on the market may not be suited to higher wind and stack induced pressures in high rise buildings. The objective of this proof of concept project was to provide guidelines to potential ISV manufacturers. Sponsored by Natural Resources Canada and Ontario Innovation Trust, this applied research project involved faculty and students from Conestoga's Architecture - Project and Facility Management applied degree program. Students were employed over the course of the project and gained advanced skills training in energy conservation through developing and testing innovative ISV subsystems with improved performance, increased energy efficiency, and reduced construction costs. Two prototype designs were developed and provided to a local manufacturer with the goal of commercializing this energy efficient technology.

Fanshawe College

Travels with Gulliver. Students and faculty at Fanshawe's School of Contemporary Media are working with Amherst Shore Productions in the development of a children's educational TV series revolving around the travels of a talking dog named Gulliver. Faculty and students are applying media innovations in multi-media design, shooting, and digital post production editing and have created a demonstration CD to illustrate the program concept to prospective purchasers. As *Gulliver's Travels* moves into full production, Fanshawe students will apply their skills as interns in real world situations under the direction of industry professionals.

Housing the Three Little Pigs. Students in Fanshawe's Building Technology program are applying advanced materials and technology skills through their participation in the Three Little Pigs research project, a \$7 million joint University of Western Ontario/insurance industry venture. The goal of this ongoing research project is to find better ways of building and renovating houses in the light of rising costs from natural disasters such as hurricanes and tornados. More than 90 Fanshawe students participated in designing and constructing a fully functional four-bedroom, brick house located in a specially-designed hangar at the London International Airport. This applied research project is determining how natural storms and precipitation affect durability, as well as examining the growth of mould, which was a significant problem following Hurricane Katrina.

The Air Up There. In addressing the problem of airborne pollutants, particles, and chemicals, a four-year study led by faculty in Fanshawe's Faculty of Technology broke new scientific ground in air quality research by tracking short-term variations in air quality using state-of-the-art environmental monitoring equipment. Another significant aspect of this project was an examination of health impacts on persons with breathing problems, in this case, COPD patients. Fanshawe researchers worked with chief respirologists from two London teaching hospitals, local public sector environmental and

health officials, and private sector scientific equipment distributors who provided significant technical support. This project was funded through a collaborative partnership involving CFI, OIT, TD-Canada Trust Friends of the Environment, the ELJB Foundation, Lehder Environmental Services, and ETech, part of the Ontario Centres of Excellence. Twelve co-op students from Fanshawe's Environmental Technology Program, who were hired over the duration of the project, received advanced skills training through hands-on experience in air quality monitoring using state-of-the-art technology. In addition to the obvious benefits to patients, government and regulatory agencies, and the general public, the equipment manufacturers gained valuable information about the performance of their instruments in the field and were able to make modifications that led to cost savings and overall product improvement.

George Brown College

Sobeys/GBC Compliments Culinary Centre, Ontario's first comprehensive applied research partnership with a major Canadian grocery chain (Sobeys Inc. and its Compliments brand) is integrated into George Brown College's Hospitality and Culinary Arts Program. The Compliments Culinary Centre has conceptualized new products, developed and tested consumer friendly recipes, and conducted multisensory product evaluations and trends research for Sobeys Inc. As a key partner in developing product concepts for this private label brand, the Compliments Culinary Centre regularly recruits the College's Chef School students as participants in multi-sensory evaluations of new products before launch, providing both educational benefits to students in research design and relevant data to Sobeys Inc. The Centre develops recipes that simplify daily meal making, while literature reviews and field testing identify or confirm key food trends – from the introduction of ethnic traditions in product line-ups to healthier trends toward smaller portions and less meat. The Compliments Culinary Centre also plays a prominent role in Sobeys Inc.'s innovation in the use of interactive media to assist Canadian consumers in shopping and meal preparation. This \$5.2 million partnership not only supports private sector innovation, but provides enhanced student experiences in product development and testing in real world situations.

Electronic Pen for Childrens Rehab. A collaboration between faculty in the Centre for Advanced Engineering Technologies, Bloorview Kids Rehab, Siemens Canada, and several industrial design partners has led to development of an early prototype of an electronic pen with commercial applications as a diagnostic tool for children with cerebral palsy and muscular dystrophy.

Child Car Safety Testing. Faculty and students in the School of Design partnered with the University of Windsor, Auto 21, and Magna to develop an educational marketing plan for Magna's prototype child safety booster seat. Through Magna Aftermarket Inc. the students' designs were incorporated into Magna's marketing campaign which extended through Ontario public schools and police education programs. Magna's booster seat, incorporating George Brown's marketing plans, is now sold in 16 countries.

Assessing bread cooling technologies. Faculty and students in the Mechanical Engineering Technology Design program are learning real world research skills in a collaborative partnership between George Brown, Ontario Centre of Excellence, and Rudolph's Specialty Breads. In order to investigate the extent to which technology designed to cool pastries can also be used to cool bread, students are engaged in a

systematic analysis of Rudolph's testing methodologies, including theoretical analysis and experimental design.

Georgian College

Since 1995 Georgian College's 55,000-square-foot **Industrial Research Development Institute (IRDI)** has featured state-of-the-art labs and an industrial-scale shop floor providing a wide range of engineering services and innovations to the manufacturing sector. Most research challenges are brought to IRDI by specific manufacturers. IRDI is leading the way in the development of more powerful analytic tools, and offers five areas technological innovation: metal stamping, plastics, machining, tribology, and hydro-forming. Applications of Georgian's free expansion hydro-forming test system have enabled manufacturers to better understand the opportunities and challenges associated with this innovative technology. IRDI is certified by the International Fabricators & Manufacturers Association as an Education Centre, sharing expertise through a series of comprehensive workshops and seminars. Researchers, technicians, technologists, faculty, and students work together in value-creating groups to develop and design solutions and prototypes to increase Canada's competitive edge in the global marketplace.

Humber College Institute of Technology & Advanced Learning

Evaluation of the Impact of an Educational Intervention to Address Incivility in the Workplace. Humber School of Health Sciences was approached by a private sector long term care facility that requested an educational intervention in response to a problem of incivility among non-registered staff and registered nursing staff. A partnership was formed in which, through the participation of four faculty, Humber (1) delivered an educational intervention program to teach participants strategies to reduce inter-personal conflict and stress, and (2) engaged in an internally funded pilot research project to evaluate the impact of the educational program on employee's experience of workplace incivility and possible relationship to incidents of resident aggression.

Development of Flour Silo Inventory Control System. A bakery with three flour silos approached Humber with problems related to management and storage of their inventory. Addressing this real world small business problem, faculty and students in the School of Applied Technology engaged in a research project to devise a low-cost, effective method to determine the amount of flour present in an enclosed silo for inventory control and re-ordering purposes. This applied research project provided cost-savings to a local small enterprise that did not have sufficient resources to research this problem, real world problem solving and advanced research skills training for Applied Technology students, and increased the currency of faculty in state-of-the-art monitoring methods and technologies.

Waterproof F-type connectors for drop cable installation. A market exists for connectors that do not need specialized tools to install onto coaxial cables, requiring only a standard hex wrench. Humber is preparing for establishing potential partnerships involving OCE, CONII, and BMEP to test samples of a viable design for three sizes of coaxial cable in compliance with electrical, mechanical, and environmental standards. A faculty member and three students, in collaboration with personnel at this, will engage in bench marking, patent search, and conceptual design using state of the art CAD equipment.

Web Based RFID Software Drivers. This project will involve Humber faculty and students working with a private contractor in the creation of a graphic user interface using innovative browser enabled applications for Radio Frequency Identification (RFID) data collection in difficult to reach areas for remote clients.

Lambton College

Centre of Excellence for Process Manufacturing. As a major Canadian hub for the petroleum industry, Lambton's research centre provides a "pilot scale" facility for international petro-chemical companies. Recent collaborative partnerships and projects include:

- Process Control & Simulation Research Lab, with public and private funding partnerships involving CFI, OIT, U. of Toronto, ORION, Lakeside Controls, Prosum Solutions, Manley's Basics and Dell Computer
- Founding member of Southwestern Ontario Bioproducts Innovation Network (SOBIN)
- Hydrogen Fuel Cell Research & Deployment Project through Sarnia/Lambton Economic Partnership
- Advanced Materials Engineering Research Lab with private and public partners Lanxess and OIT
- Collaborative UWO/Lanxess/OCE graduate student project

Niagara College

Centre for Advanced Visualization has been a long-standing partner of a major multi-national engineering firm, Parsons Engineering, who has worked with the College for over five years to develop visualization solutions for projects that Parsons is competing for and/or undertaking in land-use planning. Niagara has developed fifteen innovative 3D land use models for Parsons, including bridges, traffic simulations, buildings, and plazas. The results of this collaboration have increased Parson's ability to compete and win new business as well as contribute to an increased understanding by the public of proposed land use solutions and their impact on the surrounding locales. The complex and specialized technology developed by Niagara College is being adopted by global innovators as an effective tool to design and communicate land use planning scenarios and will help business and municipal partners compete more effectively in a global arena. This project received funding support from CFI, OIT, and was one of the NSERC-6 CCI Pilot Projects. The CCI pilot program enabled Niagara to develop a complimentary specialized centre, the **Augmented Reality Research Centre** combining GIS, real time databases, and high performance computing to develop precision agriculture software tools for the broad-based agricultural sector in the Niagara Region.

Niagara Culinary Institute. The organic nature of cork, a problematic wine closure system, is estimated to affect 2-7% of all wines and has been responsible for up to \$10 billion in lost annual revenues over the past 20 years. Faculty and students at Niagara College's Culinary Institute are engaged in an applied research project (*Consumer Perceptions of Screw Top Wine Closures*) that includes self-directed demographic and attitudinal surveys, and evaluative blind sensory tasting in collaboration with Henry of Pelham winery.

Niagara College Teaching Winery (NCTW) supports applied research and innovation for the wine industry which plays a significant role in the economic growth of the Niagara region where over 100 wineries compete in the national and international marketplace. Examples of NCTW applied research projects include:

- ***Frost damage assessment for vineyards.*** Almost all wineries in the Niagara Region experience winter injury to vineyards. The Niagara College vineyard and surrounding areas were surveyed and analyzed using high resolution GPS, GIS, Triangulated Irregular Network (TIN), and Slope and Contour analyses. Through partnerships with Huebel Farms Winery, Seeger Farms Winery, and with funding provided through the Niagara College Innovation Fund and CONII, this project, valued at \$30,000, involved one professor and provide three viticulture students with real world problem solving and advance research skills training over the 3 year project.
- ***Searching for cold hardy vines:*** In addition to harsh winters, a bacteria known as Crown Gall has become a decisive factor for sustainable viticulture in Ontario's wine areas. Niagara College Teaching Winery has started a strategy of selecting winter hardy clones that are free of bacterial pathogens affecting vitality and with the strength to withstand cold temperatures. A three-year study is developing pathogen-free clones that will be planted in a base vineyard. In Year One, tested pathogen-free base materials of over 100 vines have been produced as candidates for further study.

Seneca College

Mon Ami™ is an innovative, patent pending Assistive Device for enhancing independent living of elderly and individuals with physical disabilities; no other device with such a wide spectrum of functionality currently exists in the marketplace. With the involvement of three faculty and six students in real world problem solving and advanced skills training, Seneca contributed user-interface testing, facilitated a client needs assessment, and conducted product availability analysis, Proof of Principle testing, early user trials, development and evaluation of remote access interfaces, development of add-on devices, interactive Web applications, and translation of Mon Ami™ interactions into French. With a cash and in-kind value of \$640,000, the project was conducted through the Tech Readiness/Business Partnership Program and included public and private sector funding partnerships with Health Technology Exchange (HTX), Communications and Info Technology Ontario (CITO), Ontario Centre of Excellence, IRAP, and Tertec Enterprises Inc. Home installations of Mon Ami™ in the GTA area began in 2007, and Tertec has received an order for 1,500 units for seniors' homes in Germany.

Porous Pavement Demonstration Project. Seneca College was instrumental in forming a collaborative partnership to study the long term performance and effectiveness of permeable pavement and bio-retention swales for storm-water management. Public and private funding partners include: Ontario Ministry of the Environment, Ontario Ministry of Research and Innovation, Fisheries and Oceans Canada, Great Lakes Sustainability Fund, Environment Canada, Regional Municipalities of Toronto, York and Peel, Oak Ridges Moraine Foundation, Toronto Region Conservation Authority, Pat and John McCutcheon Charitable Foundation, Interlocking Concrete Pavement Institute, Cement Association of Canada, and Wal-Mart Canada. Three faculty and four students gained real world experience in problem solving and advanced research skills training through participation in this applied research project.

Creativity Assistive Tools for Games Network. Hosted by Seneca, this R&D network develops innovative leading-edge technologies with commercial applications; the network comprises University of Western Ontario, Simon Fraser University, and Credo Interactive, with funding from Department of Canadian Heritage.

WiMax Broadband Research Project. Funded by CONII as a Proof of Principle project, and in partnership with private sector partner Redline Communications, this investigation is testing the application of a WiMax link capable of providing broadband wireless point to multipoint distribution systems.

Sheridan College

Sheridan's **Centre for Advanced Manufacturing and Design Technologies** is an \$8 million venture partnership with over 20 regional private sector manufacturers, the Province of Ontario, the City of Brampton, the Professional Engineers Association of Ontario, and NRC. Private sector partners include Mitutoyo Canada Inc, Siemens Canada Ltd, Rockwell Automation Control Systems, Merlan Scientific Ltd., ABB Inc., Almag Aluminum Inc., Gross Machinery Group, 600 Machine Tools, Inc., Brampton Brick Ltd, Omron Canada Inc., RBH Inc., Polywheels Manufacturing Ltd., SMC Pneumatics (Canada) Ltd., Brampton Board of Trade, Aircraft Appliances and Equipment Ltd, Lab-Volt Ltd., Fluke Networks, Honeywell Canada – Aerospace, Advance Precision Ltd., and Hydra-Fab Fluid Power Inc.

Sheridan Research Visualization Design Institute (VDI) was established in 1998 with public sector funding from CFI, OIT, ORDCF, combined with private sector contributions from Silicon Graphics Inc., Immersion Studios, and Northern Digital Inc. Dedicated to innovation in the field of computer visualization, and specializing in deploying game technologies in 3D environments, VDI has focused on scientific, medical, engineering, educational, and cultural applications. VDI has participated in over 40 industry-driven problem-solving projects for private sector clients totalling \$10 million. One example is the Ottawa Light Rail Transit Visualization project conducted for private sector McCormick Rankin Corporation. Another example involves social networking applications of San Francisco-based iBlocs, Autodesk's Maya, and 3D Studio Max used by approximately 100 civic and industry leaders as a collaborative planning tool at the 2007 Mississauga City Summit. VDI students gain valuable real-world research experience in critical thinking and problem-solving for industry; 2 students from Sheridan's VDI program have won Academy Awards, while 6 have been nominated.

Legislation: With the enactment of the *Colleges of Applied Arts and Technology Act (2003)*, provincial legislation explicitly extended the mandate of Ontario's colleges to grant "applied degrees" and to perform "applied research." The long-standing debate over transferability of college credits was only partially addressed through the recognition of applied, articulated, and cooperative degrees, but this enabling legislation contributed directly to a dramatic increase in applied research activities and collaborations with public and private sector partners.

Operating Grants. While legislation has extended the mandate of Ontario's colleges to include applied research, this mandate has not been accompanied by a corresponding expansion in funding. Operating grants continue to be based primarily on enrolment in approved programs, and do not recognize or explicitly fund applied research. Operating

grants can, however, be allocated as the college sees fit, including support for applied research and innovation projects, and many colleges are now using portions of their provincial operating grants to establish offices and positions of leadership with respect to applied research, as well as to provide internal seed grants and faculty development programs to build research capacity.

Faculty Agreements. The *Framework for a Research Policy for Ontario* (1997) noted that many college faculty have an interest in research, although it is not required under their terms of employment. Fisher's (2007) study found very positive attitudes toward and interest in participation in research by college faculty. However, the current collective agreement is silent on faculty participation in research activities. Appropriate provincial funding allocations and collective agreements that support faculty release time are required to address this issue.

R&D. At this time there are no college-specific provincial programs supporting applied research and innovation at Ontario colleges.

MANITOBA

Red River College

Since the establishment of Red River College's Applied Research & Commercialization (AR&C) in 2004, annual external research funding has grown from \$50,000 to about \$400,000 in 2007/08, with a diversity of partners ranging from SME's to international companies to foundations to governments. Over the same time period, nearly \$4 million in capital funding for research infrastructure has been received. AR&C now has five staff, including a Director, Research Manager, Research Technologist, Westlink Intern, and Administrative Assistant, with a target of 5-10% faculty involvement. RRC is also a founding member of the Great Plains Applied Research Network. RRC is both NSERC and CFI eligible, and received \$550,000 of CFI support (matched by the Manitoba Research and Innovation Fund) to establish the **Centre for Applied Research in Sustainable Infrastructure (CARSI)** a 10,000 sq. ft. dedicated research centre with a "living lab" to develop, test and demonstrate environmentally sustainable, energy efficient, alternate/renewable materials for application in the building, construction and potentially transportation (in partnership with the Composite Innovation Centre) sectors. Collaborative projects and initiatives have involved Manitoba Hydro, NRC, University of Manitoba, Manitoba Highways, ISIS Canada, Winnipeg Construction Association, Misipawistik Cree Nation and numerous SME's like Homenko Builders, Controlled Environments Limited (Convion), NorthAir Tech, Solar Solutions, and SMT Research. NRC-IRAP and RRC recently signed a Network Partnership Agreement to work with CARSI as the foundation for a regional Sustainable Infrastructure Cluster.

RRC's **Leading Advanced Manufacturing Practices (LAMP) Project** was one of the NSERC-6 pilot projects. The LAMP Model Factory has worked with organizations (many SME's) such as Convion, Diametic, Golf Expressions, Motor Coach Industries (with RRC's **Heavy Equipment Transportation Centre or HETC**) and the University of Regina. Further leverage was possible through IRAP, SR&ED, and Western Diversification programs. Through these, and other, RRC applied research initiatives students gain real world experience, contact with industry, opportunities to be challenged, and hands-on experience with leading edge technologies.

Three examples of RRC collaborative innovation projects involving LAMP, HETC, and CARSI are:

- **Manitoba Hydro's Downtown Office Project:** Using CARSI's "living lab" facility, Manitoba Hydro partnered with RRC in a very significant multi-year applied research project to prototype, evaluate, and test a "double curtain wall" that would make Manitoba Hydro's Head Office the most energy efficient commercial building in North America. CARSI was the "prototype" for the innovative double curtain wall system and subsequent evaluation of its thermal, optical, acoustical, infiltration, pressure, and spacing properties; as well as interior finishes (floor coverings and paint) and furnishings. "The CARSI building DTOP mock up has been invaluable in assisting the DTOP (Downtown Office Project) team in making a number of multi million dollar decisions." - Tom Akerstream, Manitoba Hydro.
- **Motor Coach Industries Highway Coach Design Integration:** The 2007 Federal Budget and more recently the Globe and Mail, described an innovative applied research project undertaken by RRC and Motor Coach Industries (MCI) in Winnipeg which has proven to be an overwhelming success. Working on a tight timeline, RRC faculty and students completed the complete design integration of a new heavy-duty diesel engine into a highway coach, assisting MCI in meeting stringent U.S. EPA 2007 reduced emission requirements for their largest export market. Test results have met or exceeded the requirements of both MCI and Cummins (the engine supplier). This project was managed by two RRC instructors working with four students in the College's Mechanical Engineering Technology program and the HETC. The MCI project followed a successful demonstration of a Hydrogen Hybrid Internal Combustion Engine (HHICE) transit bus involving the Province of Manitoba, Government of Canada, Vehicle Technology Centre, ISE Corporation, Kraus Global, New Flyer Industries, City of Winnipeg Transit, Stuart Energy, SunLine Transit, and University of Manitoba Transportation Institute. Extreme cold weather testing and actual "for-fare" service testing of the "Sun Bus" (from San Diego) was the focus. A similar project was carried out on a Hydrogen Fuel Cell Bus and a research agreement to convert a fleet of 10 vehicles to Plug-In Hybrids has just been awarded. The new applied research infrastructure component of HETC was awarded \$2.4M by Western Diversification to address emissions reduction and the integration of alternative, renewable sources of fuels to support innovation in the transportation industry, introduce new vehicle technologies through applied research, and train the next generation of skilled workers to ensure the commercialization of new innovations is successful. Applied research projects will include emissions testing and fuel consumption reduction, adaptation of vehicle usage to alternative renewable fuels such as ethanol, bio-diesel, electricity, and hydrogen, and cold weather testing of vehicles.
- **Red River Raycer:** One of the goals of *Canada's Advantage* is "getting Canadians excited about science and technology." A clear example of the role of colleges in achieving this goal is RRC's Red River Raycer project. This student-run venture produced Manitoba's first solar-powered vehicle that travels up to 100km/hour without using a single drop of gasoline. Developed at RRC's Aviation and Aerospace Training Centre with financial support from the Province of Manitoba and Western Diversification and in-kind sponsorship from firms such as Boeing Aerospace, Standard Aero, and Bristol Aerospace, the car's efficiency is achieved through the use of lightweight composite materials, aerodynamic design, and innovative solar-array technology.

Building this solar-powered car from the ground up, these future engineers and business leaders acquired hands-on experience in large scale multi-disciplinary planning, budgeting, design, manufacturing, product testing, and real-time maintenance using leading edge materials, culminating in their successful completion of the 11-day, 4000 km Texas-to-Calgary North American Solar Challenge. The College is now preparing to “Make History/Drive the Future” with its 2008 vehicle currently under development.



Red River Raycer.

Legislation, Operating Grants, R&D Programs, Faculty Agreements

Manitoba’s legislation governing its three colleges continues to be silent on the role of colleges in performing R&D or helping firms adopt technologies. The rules governing operating grants are also silent in terms of whether these funds can be used to support R&D. The province does not object as long as colleges do not unduly compromise their teaching mandate. The Manitoba Research Innovation fund provides matching contributions to facilitate college access to CFI, but there are no dedicated provincial research funds for colleges, although individual departments may support college research at their discretion. Each of the three colleges has negotiated a separate collective agreement; applied research is now recognized as a Faculty activity.

SASKATCHEWAN

Saskatchewan Institute of Applied Science and Technology (SIAST)

In 1988 Saskatchewan's four existing technical institutes were amalgamated into the Saskatchewan Institute of Applied Science and Technology (SIAT) with four campuses (located in Moose Jaw, Regina, Saskatoon and Prince Albert) currently serving 11,000 students.

In 2006 SIAST established an **Office of Applied Research and Innovation (OARI)** staffed by a Director, Research Project Coordinator, and Administrative Assistant. SIAST's applied research mission is to acquire and apply knowledge at the request of and in partnership with local, regional, and provincial industry, and focuses on four niche areas (urban development, environment and natural resources, health education, and information technology and communication). SIAST's OARI promotes faculty and student participation through its Seed Applied Research Program (SARP): one SARP-initiated project led to integration of the province's emergency response system with the GPS system for rural communities; OARI is sponsoring the principle investigator to present the project at ACCC Institutional Emergency Preparedness Workshop in Vancouver 2008; faculty of the SIAST Nursing Division have conducted many studies on best practices in work and training environments which have been published in refereed journals.

SIAST is engaged in several collaborative research partnerships. SIAST and TRILabs, Inc. are now at an early stage of establishing the first **Prototype Development Center** in Saskatchewan. In another collaborative partnership, SIAST has taken a lead role in responding to requests from representatives of construction and building industries in Saskatchewan to establish a **Building Science Institute (BSI)**; SIAST's OARI convened the initial meeting attended by 23 provincial construction and building industry representatives, leading to the creation of a provincial Task Force and an Advisory Board to move the BSI initiative forward. SIAST also took the lead in creating the Great Plains Applied Research Network. SIAST has established policies in research ethics, integrity, financial accounting, and academic freedom, and is currently in the final stages of obtaining NSERC-eligibility

- **Home Energy Efficiency Project (Share the Warmth).**

Share the Warmth Home Energy Efficiency Project was initiated by a SIAST instructor in the Architectural Building and Interior Technologies as an applied research project on energy efficiency in small buildings. Students analyzed a number of low income houses in Moose Jaw for energy efficiency, collecting data on the state of furnaces, filters, windows (gaps), walls, and lighting (bulbs). Once the needs analysis was completed, students developed an inexpensive (\$150) kit that was used to upgrade each low income house. With the help of the local Salvation Army they identified 100 low income households, and on a predetermined day a group of students and other volunteers entered selected homes and upgraded them using the low-cost energy kits. The provincial energy provider SaskEnergy joined the project to analyze energy savings, which approximated more than \$150 annual savings per home. Based on this successful applied research project, SaskEnergy allocated \$500,000 to a 5-year expansion of this project across the province to retrofit 500 low income homes in 8-12 communities each year, resulting in

multi-million dollar savings in reduced energy loss, and improved living conditions for Saskatchewan residents. SIAST students described their experience and its outcome as “unforgettable.”

- **Integration of GPS and Emergency Response for Rural Communities**

SIAST faculty and students were instrumental in addressing the problem of inadequate fire truck guidance systems in rural communities of Saskatchewan. After a guidance failure that resulted in the loss of life and property, a SIAST GIS instructor proposed a research project in which SIAST students would develop a comprehensive mapping system for rural communities and integrate the system with a database that would facilitate most-direct-routing of emergency personnel to critical locations. In 2007 students in the program were hired to collect the field coordinates of 1400 households in rural communities. Subsequently the emergency offices at Prince Albert acquired GPS equipment and software; faculty and students loaded the coordinate data into the GPS unit and trained the emergency personnel in its use. The GPS technology developed through this project can be introduced in any rural community and has the potential for significant impact in saving lives and property, demonstrating how college faculty and students are playing a significant role in the transfer and application of new technologies.

Legislation, Operating Grants, R&D Programs, Faculty Agreements

The legislation governing SIAST and community colleges continues to be silent in terms of their R&D role. Operating grants do not specifically identify applied research, but SIAST may use their base funding for this purpose. The province does not have any R&D programs targeted at its colleges or technical institute. Collective agreements are silent in terms of recognizing R&D as an appropriate faculty activity.

ALBERTA

At this time Alberta has 12 non-university postsecondary institutions, including 9 colleges, 2 technical institutes, and the Banff Centre. In 2004, with changes to Alberta legislation, applied research became part of the college mandate. The capacity of these institutions to support private sector innovation has been dramatically increased through developments in legislation, infrastructure, and collaborative networks. For example:

- Ministry of Advanced Education and Technology has guaranteed additional research funding to colleges through AACTI at \$2 million per year
- SAIPN (Southern Alberta Intellectual Property Network) is awaiting a provincial decision to approve another 3 years of funding. The theme of SAIPN’s 2008 AGM is Concept to Commercialization
- 7 Alberta Colleges have received NSERC eligibility. .

Alberta Association of Colleges and Technical Institutes (AACTI)

In 2002 AACTI was incorporated to provide a single voice for Alberta’s public colleges and institutes. In 2006 AACTI launched the **Communities of Practice (CoP)** initiative as a strategic action to support the expansion its Applied Research and Innovation agenda. The objective of CoP is to create new pathways for participants to share experiences, explore opportunities of mutual interest, and enable the exchange of knowledge. AACTI

supports four sector-oriented CoPs (Community Development, Energy & Environment, Health, IT & New Media) through the **Olds College School of Innovation (OCSI)**. This initiative is operated through a provincial Innovation Directorate staffed (through AACTI-funded secondments) with a Director of Innovation Development, an Applied Research and Development Consultant, four Development Chairs, and three CoP Advisors. Recent capacity building in applied research and innovation activities at Alberta's colleges and institutes in 2007 are demonstrated as follows:

Southern Alberta Institute of Technology (SAIT)

- opened the RFID Lab with sponsorship from HP, CISCO, and Intermec Corporation, and established an applied research chair in RFID
- launched an applied research module taught in the engineering technology programs
- with its industrial development partner Conematic (furnaces), held a new product launch at SAIT with more than 400 people from around the world
- hosted a seminar called the *Accelerating the Adoption of New Technologies in Apprenticeship Curriculum*
- entered the Sports Engineering Applied Research space by designing a new bobsled used by the Canadian World Cup Team
- *SAIT Centre for Innovative Information Technology Solutions* is a \$10 million collaborative research partnership involving Microsoft, CISCO, WD, Alberta AET and SAIT in providing regional access to knowledge and training on leading edge IT products; to date 24 simulation projects have been completed
- NSERC-eligible
- Other ongoing projects include:
 - *Conematic Prototype Development project*
 - *Implementing radiofrequency identification in healthcare*
 - *Volker Stevin Zero Discharge Desalination project*
 - *Client Management and Project Tracking Database project*
 - *Quantum Key Distribution project*

Northern Alberta Institute of Technology (NAIT)

- launched NAIT Shell Manufacturing Centre, a \$12 million one-stop facility for leading manufacturing technology education and service. Collaboration involved: Microsoft and Matrikon (\$7 million), WD (\$3.1 million), Government of Alberta (\$1.5 million), Shell (\$2.5 million, plus \$500,000 in bursaries and scholarships for students pursuing apprenticeship and technical training). About 400 students a year will use the centre to gain experience in state-of-the-art technologies in manufacturing, mechanical engineering, electronics engineering, and applied information systems
- NSERC-eligible

Mount Royal University College

- hired an Associate VP of Research
- currently working towards shifting 80% of the Faculty to a Teaching/Research Workload over the next 3 years.
- NSERC-eligible

Bow Valley College

- established an Applied Research Office
- approved 5 internal grants projects
- established Researcher in Residence program
- delivered workshops including: Writing a research proposal, Ethics review applications, and Literature review strategies
- received external grants (federal, provincial and industry) in areas including: Health, Practical Nurse, Early Childhood, Essential Skills, and Literacy
- committed to increases in internal grants to build internal capacity for Applied Research among faculty

Grand Prairie Regional College

- established a Centre for Research and Innovation in partnership with Peace Region Economic Development Alliance
- established the Alberta Mountain Pine Beetle (MPB) Training Centre in partnership with Alberta Sustainable Resource Development, and is conducting MPB detection and control training for entry into the FIRS database of ASRD
- created a Palaeontological position at GPRC which is 50% instruction and 50% research, in partnership with the River of Death and Discovery Museum project
- currently engaged in six AACTI-sponsored capacity-building applied research projects
- at present, projects are underway with over 30 clients
- NSERC-eligible

Olds College

- CFI approved \$1.1 million for the completion of the Pilot Plant and Micro-Processing Facility to provide technology development and scale-up services for processing food crops (including nutraceuticals and functional foods), and non-food crops (including bio-lubricants and bio-fuels such as bio-diesel and bio-gas)
- BioFuel Technology Centre™ opened in 2007 and has become the hub for both biodiesel and biogas research, demonstration, and training initiatives
- Olds College Botanical Wetlands project received support from industry totalling \$1.7 million to broaden the environmental research capacity of Olds College and enhance the student learning experience at the College
- Since the commencement of the OCSI Bio-Industry Program, private individuals and College partners have provided significant support and financial contributions. The Bio-Industry Program includes eight individual projects totalling \$9.48 million and to date, a total of \$4.32 million has been procured
- NSERC-eligible; one of the initial NSERC-6 pilot projects

Red Deer College

- \$70 million expansion is 6 months from opening
- \$1.2 million in equipment funding received from Western Diversification for Innovation Centre (Manufacturing Equipment)
- Rural Health Research Chair; final decision pending
- 12 applied research projects currently underway

- Pursuing the development of an Eco-Innovation Park adjacent to RDC property with Zero Carbon Footprint model.
- Pursuing the commercialization of a **Small Scale Portable Bio-Diesel Reactor System**, this joint venture of Red Deer College and Bio-Len Reactors Inc. uses proprietary technology to convert waste from canola oil production into valuable biofuels to blend with diesel fuel or burn 100% biofuel. This mobile, lightweight system, produced by Bio-Len Reactors Inc. and marketed under license by Red Deer College, is particularly well suited to large farms that have their own diesel vehicles and a ready supply of used canola oil. Developed by Red Deer College faculty member, this small scale portable bio-diesel reactor turns a waste stream into a value stream.

NorQuest College

- Print Media Communications Centre is implementing Phase 1 deliverables to establish the hardware and software for a print media test bed environment
- signed MOU with the UofA, Capital Health Region, and Capital Care to create an Institute for Continuing Care Education and Research
- Intercultural Education Centre has established an Associate Director position to lead applied research and business development activities.
- **NorQuest Reader.** English literacy levels of many adult learners who are deaf are often below those of their hearing peers. In response to the need for resources that are appealing to this audience, Norquest College with the support of the National Literacy Secretariat developed two multimedia resources - NorQuest Reader I and II – to support literacy development for deaf and hard of hearing adults. Following the success of the award-winning NorQuest Reader I, developed in 2003-2004, funding was secured to create 25 additional stories including video clips of American Sign language, text, and activities. Approximately 200 copies of NorQuest Reader I have been distributed to literacy programs that serve the deaf across Canada, and NorQuest Reader II will be distributed once the project is completed in 2008.

Lethbridge College

- established a position of Director, Applied Research and Innovation
- launched the Living Home, a three-year project led by 2 Lethbridge faculty members, in partnership with the City of Lethbridge, and Cedar Ridge Homes. The purpose of the project is to design and study an eco-friendly residential home that will enhance the quality of life within the home and in the community and provide documented key findings on its interactive website
- a faculty member in the Multimedia program successfully used open source software to develop a college-based call centre that is used by the Lethbridge College Citizen Society Research Lab to conduct public opinion surveys
- completed the interior of the quarantine facility at the Aquaculture Centre of Excellence, dramatically expanding the capacity for additional research projects
- with AACTI funding, currently supporting six faculty mentored student projects.
- **Aquaculture Centre of Excellence**, in partnership with Alberta Agriculture Food and Rural Development and Alberta Aquaculture has established itself as the sole Canadian source of triploid grass carp, which play a significant role in rural areas

where the sole source of domestic water is from dugouts filled with surface runoff where aquatic vegetation must be controlled. People who use this water usually prefer a biological control to the standard chemical control that has been used in the past. The Aquaculture Centre of Excellence has developed a reliable, environmentally respectful means of spawning and producing triploid Grass carp. This expertise is now being commercialized and production is expanding to keep pace with growing demand.

Lakeland College

- established an Applied Research Office led by a Director of Environment and Applied Research
- currently supporting seven faculty research projects
- established an MOA with Alberta Parks to formalize applied research in the Vermilion Provincial Park, where 2 projects are currently underway
- establishing partnerships with Olds College and SAIT for follow up project on Biodiesel by-products
- Established a project to assess the potential for regional development of wind power
- Multi-stakeholder project on sheep research is in its final year and has been well received by the sheep industry across Canada
- NSERC-eligible

Medicine Hat College

- Research Committee has expanded to include all college divisions
- amended college Mission Statement to include research and scholarly activity
- established policies on Ethics and Copyright Compliance
- establishing policies on research Integrity, Data Storage, Intellectual Property & Revenue sharing, and Financial Accountability
- the Research Committee's activities were added to the College website
- obtained approval for first proposal submitted to AACTI
- submitted plan and budget to establish a Research Office

Grant MacEwan College

- Faculty Research & Scholarly Activity fund has sponsored over 70 projects since 2005, distributed \$100K in \$5K increments
- received funding from SSHRC, CIHR, CCA
- established MacEwan Research Council, policies on research ethics, integrity,
- over 20 projects showcased in 2007 annual showcase of research activities

Banff Centre

- received \$1 million from an industry partner to establish the Centre's first Chair in Aboriginal Leadership and are now seeking other matching funds
- applied research funding increased from \$85,000 in 05/06 to \$870,000 in 06/07
- become member of Westgrid as part of the Compute Canada proposal to CFI, requesting \$150 million for a high performance computing network
- mobile lab project involving mobile telephone and GPS technology has led to a potentially commercializable technology

- successfully recruited a researcher from Carnegie Melon University to manage the Centre’s Advanced Research and Technology Lab

Legislation, Operating Grants, Research Funding. Significant provincial changes since 2002 have created a very college-friendly climate for Alberta colleges. The recently released *Roles and Mandates Policy Framework for Alberta’s Publicly Funded Advance Education System* (2007) has raised applied research to a priority at Alberta’s colleges and institutes, and seeks to “enable an environment that fosters and supports the development of a knowledge economy. Alberta’s future prosperity will depend upon our ability to compete within a global context, and advanced education providers have a key role to play in enhancing our competitiveness.” The new framework “unleashes innovation through world-class research and knowledge transfer.” Specifically with relation to colleges, the framework “recognizes that significant benefits arise from strong linkages between colleges and regional economic drivers, including producing skilled workers in alignment with the needs of the regional labour market, and the importance of applied research in community and economic development.” Future considerations include: “As a key player in the innovation system, there is a clear need to expand research capacity within the system, as well as ensuring that the benefits of research are transferred for the benefit of learners, society, and economy/industry.” The mandate of colleges and polytechnical institutes now states that:

Applied research may be conducted to foster innovation. Applied research is conducted to discover new knowledge with an identifiable and immediate practical application. This form of research tends to be more focused on the identification of practical solutions or applications. In general, applied research lends itself more readily to third-party support, including financing from the private sector, granting councils, and communities.⁷

BRITISH COLUMBIA

British Columbia has 19 publicly funded colleges (including 12 community colleges, 3 university-colleges, and 4 institutes) delivering college and university transfer credits at over 50 campuses and learning centres across every region of the province. Colleges are expected to support the Ministry’s Research and Innovation Branch’s commitment to “an integrated and dynamic approach to research and innovation to improve the social, economic, environmental, and cultural well-being of British Columbians.”⁸ BC colleges are now members in a wide array of provincial and regional networks, including: BC Innovation Council, BC Hub, BCNET, Discovery Parks International, Mid-Island Science, Technology, & Innovation Council, Vancouver Island Advanced Technology Centre, WD, and Westlink Innovation Network. Applied research and innovation activities at BC colleges are illustrated in the following examples.

Camosun College

Camosun has received CFI funding and is NSERC-eligible. The **Innovation Development Corporation (IDC)** is Camosun’s technology transfer service provider, helping faculty and local companies explore commercialization ideas and providing assistance with patenting, business planning, sourcing, and funding opportunities. In

collaboration with the University of Victoria, IDC supports Vancouver Island as an innovation cluster and economic development region and forms alliances with other organizations that provide services and support within the Island's business development continuum.

Camosun's newly formed **Centre for Ocean Technology** exemplifies the role of colleges in creating partnerships to coordinate the transfer of existing knowledge to increase regional competitiveness. Faced with the impending closure of the Esquimalt Shipyard (one of the region's major employers), Camosun's Coordinator of Oriented Research and Innovation took the lead in creating a regional consortium of public and private stakeholders representing: DND, BC Min. of Advanced Education, WD, UVic, Washington Marine Group, and Vancouver Shipyards. This Advisory Panel is conducting an environment scan to identify potential shipyard projects, making them more competitive by transferring and applying knowledge generated at UVic to the public sector, and developing on-site management training programs.

An example of faculty and student engagement in research is found in Camosun's **Pacific Sport Innovation Institute**, where students tackled the problem of variable competition environments by developing a mobile environmentally-adjustable training trailer that simulates a full range of heat, altitude, and humidity conditions for elite athlete training.

Selkirk College

The Occupational Injury Reduction and Performance Enhancement Project at Selkirk College investigates the efficacy of task-specific fitness and dietary programs on workplace productivity, injury rates, and biochemical stress markers among tree-planters (a regional occupation with a high physical demand and a very high injury rate). Faculty and students studied the efficacy of carbohydrate-electrolyte drinks and specialized training regimes to reduce fatigue for tree planters, resulting in higher planting rates and 40% fewer injuries or infections. This research has led to the development of training materials which were produced by students at Selkirk College and which have been distributed by Weyerhaeuser Forestlands Canada, the Western Silviculture Association, BC Safe Silviculture and the Forest Industry Safety Association. The program has also crossed industries and is being utilized by groups of wildland firefighters, timber harvesters, and mountain guides.

University College of the Fraser Valley

UCFV has recently opened a \$21.6 million "low carbon footprint" **Trades and Technology Centre** as part of the new **Canada Education Park**, a collaborative initiative between local, provincial, and international schools developed to train skilled workers, keep BC's economy competitive, and provide direct benefits to the people of BC through the reduction of greenhouse gas emissions.

Justice Institute of BC

Research on violence in the lives of sexually exploited youth and adult sex workers in British Columbia was conducted by three community based researchers and faculty members at the Justice Institute of BC on behalf of the provincial government's Assistant Deputy Minister's Committee on Social Issues. The researchers visited five communities to learn more about the violence in the lives of sex workers residing and working there. Youth and adults were interviewed about their experiences as victims or witnesses of violence as well as front line workers, police, crown counsel, and other criminal justice

system personnel who intervene with those who have been sexually exploited or work in the sex trade. Through an action research approach, the researchers documented emerging issues, identified common themes, described lessons learned at a community level, and presented specific recommendations relevant to rural and remote communities faced with these issues.

Malaspina University College

Malaspina University College is a member of the **Carnegie Academy for the Scholarship of Teaching and Learning (CASTL)**, through which Malaspina is coordinating the **Undergraduate Research Leadership** program, a two-year international study on the impact of undergraduate research. Some facts illustrating recent research capacity-building in 2006-2007 at Malaspina:

- \$234K in funds awarded to students for research awards and salaries
- 53 students hired as research assistants
- 157 students conducted major research projects
- 99 students gave public presentations of their research
- over \$1 million in research funding received in 2006/07
- \$488K invested in building research capacity and infrastructure
- **Applied Environmental Research Laboratories (AERL)** conducts pure and applied research in the environmental sciences and supports the training of highly qualified personnel in environmental chemical analysis. AERL is equipped for air, soil, and water analysis by both traditional and emerging methods. Many AERL projects involve the development and use of **Membrane Introduction Mass Spectrometry (MIMS)** for real-time, ultra trace level analysis of volatile and semi-volatile compounds. AERL specializes in collaborative research projects involving faculty, students, private sector, and community partnerships.
- **Centre for Shellfish Research.** This cross-disciplinary research project involving faculty and students are conducting a holistic investigation of the shellfish industry, including production, health and environmental interactions, as well as social and economical aspects related to governance issues, traditional uses, and community impacts. Collaboration includes partnerships with the Pacific shellfish industry, small local entrepreneurs, Vancouver Aquarium, Oregon State University, University of British Columbia, and University of Victoria, with funding through OCAD, ASI, CFI, and BCKDF.

British Columbia Institute of Technology (BCIT)

Research conducted at BCIT focuses on activities with industrial and commercial relevance, where partnerships lead to benefits for the institution, business and industry, and students. Since its inception in 1989, the **Technology Centre** has been a hub of multi-disciplinary research and development at BCIT. The centre employs a team of more than 30 full-time researchers working in fields ranging from human factors and medical device development to cyber security and alternative energy. Some of BCIT's many successful technology transfer and commercialization projects include:

- **GT Automation Inc.**, under license from BCIT, is now manufacturing the Heavy Tool Support Arm. This technology, specifically designed for the construction and related industries, helps to reduce back, shoulder, and neck injuries suffered when

workers hold heavy tools such as demolition hammers, drills, or saws, in raised positions for long periods of time.

- **F.A.S.T.1™** BCIT Technology Centre helped Pyng Medical Corp. transform a basic prototype of the intraosseous infusion system into a marketable medical product. The F.A.S.T.1™ delivers life-saving fluids, such as drugs and medication, through bone marrow rather than through a vein. This innovative, award-winning alternative to conventional IV infusion, specifically designed for demanding emergency environments, allows EMTs and Doctors to achieve faster, safer, and more reliable vascular access for fluid resuscitation in shock and trauma victims. Today, Pyng Medical Corp. is successfully selling this device.
- **BCIT's Internet Engineering Lab (IEL)** This \$2.2M facility is Canada's only public test and measurement facility open to both academia and industry. The IEL contains complex and sophisticated network components capable of being configured to resemble different topologies and architectures, and offers much needed testing services for web application developers and network equipment and application vendors who need to expose their products to a variety of network anomalies, and to validate and qualify the resilience, performance, and scalability of their applications and devices against issues prevalent in the core and edges of the network.
- **Maximum Power Point Tracking (MPPT).** In partnership with Analytic Systems Ware Ltd., BCIT developed a unique controller designed for industrial, stand-alone photovoltaic applications. The high efficiency (97% efficient) unit maximizes the output from a solar array using a patented BCIT technology, and will be offered commercially through Analytic Systems alternative energy dealerships.

Legislation The Ministry of Advanced Education's *College and Institute Act* covers university colleges, community colleges, and Aboriginal institutes. Through the Ministry of Advanced Education's Research and Innovation Branch, BC has made a commitment to "an integrated and dynamic approach to research and innovation to improve the social, economic, environmental, and cultural well-being of British Columbians."

Operating Grants As of 2002/03 BC's colleges, university colleges, and institutes receive core operating grants as block funding, of which they may allocate some core funding to support research. This information is not collected by the province.

Research Funding Since 2002 BC colleges have gained access to a range of provincial and regional funding sources; research grants have been obtained from: British Columbia Knowledge Development Fund (BCKDF), Leading Edge Endowment Fund (LEEF), Natural Resources and Applied Sciences Research Endowment, Research and Innovation Strategy, Technology Action Plan, Life Sciences Action Plan, Federal/Provincial/Territorial Innovation Agenda, World Centre for Digital Media Education, Centre for Drug Research and Development

Faculty Agreements The majority of the university colleges, colleges and institutes have faculty collective agreements that are a combination of provisions of a common agreement, shared across all of the member institutions, and local provisions, unique to each institution. Research activities are negotiated as a local provision. University colleges and institutes have included language regarding research activities in their local collective agreements.

YUKON

Yukon College

Yukon College, the only college in the Yukon, places a heavy emphasis on applied research, innovation, and technology transfer and commercialization activities through a number of enterprises. The **Northern Research Institute (NRI)**, opened at Ayamdigut campus of Yukon College in 1992, allowing Yukon College to formalize its institutional commitment to research, and now promotes and stimulates innovative technology applications for the benefit of Yukon society and economy through a number of programs. These include:

- Northern Research Institute Research Endowment - Research Fellowships.
- Administrative and logistical support for research.
- **Yukon Technology Innovation Centre (YTIC)**. Established in 2000, YTIC encourages the development of innovative technology applications and technology-based employment in the Yukon. YTIC has sponsored 37 projects to date, with 5 projects resulting in commercial distribution. Private and public partners include: Dana Naye Ventures, NorthwesTel, Government of Yukon, NRC, CANARIE, Whitehorse Chamber of Commerce, and Yukon Information Technology Industry Society. Commercialized YTIC projects include:
 - **IceField Tools Corporation**. YTIC assisted with the development of instrumentation for use in mining, oil and gas, and geotechnical industries operating in the north. GyroShot MEMS gyroscope-based survey tools.
 - **Lister Clutch Weights**. Used on different brands of snowmobiles and produced by a local manufacturer.
 - **Yukon Technology Innovation Network (YTIN)**. Oversees the operations of the **CA*net4** network in the Yukon, Canada's \$110 million "customer-empowered network" that places network resources in the hands of end users and permits users to innovate in the development of network-based applications. YTIC manages the YTIN Development Fund with a view to supporting Yukoners and other interested parties in the development of innovative hardware and software applications that add value to the Yukon's CA*net4 connectivity and to the value of CA*net4 as a whole.
- **Northern Climate ExChange (NCE)**. NCE was created in 2000 in response to growing concern over the impacts of climate change on the land, life, and communities of northern Canada. While the focus of NCE is on activities within the Yukon, it has undertaken projects that are relevant across northern Canada through funding provided by Yukon College, the Yukon government, and the Government of Canada.
- **Social Economy Research Network of Northern Canada (SERNNNoCa)**. Funded by the Social Sciences and Humanities Research Council of Canada in 2006, the northern network of the national research program on the Social Economy is built around the three Northern Territorial Colleges and their respective research institutions and links researchers working in the North with Northern students, community organizations, and educational institutions. Social economy research will include seeking to conceptualize and inventory the social economy in the North, investigate the particular

- relationships that exist between social economy and indigenous cultures, resource regimes, and the state.
- **Innovators in the Schools.** Science and technology education, providing Yukon teachers (K-12) with science & technology experts who visit their classroom or lead a field trip. Students are exposed to the real lives and work of biologists, engineers, geologists, health technologists, chemists, computer programmers and others.
 - **International Polar Year (IPY) (2007-2008).** The Northern Research Institute and Yukon College are involved in a number of IPY funded projects, which include Instructor led research, program involvement and administration and coordination. Research partner Don Russell is leading an international network of scientists, managers, and community representatives monitoring the impacts of global change on caribou and wild reindeer and their link to human communities in the circum-arctic world. This project is one of the IPY projects sponsored by the Government of Canada to help advance our understanding of cultural, social, economic and health dimensions, as well as geophysical, climate and biological processes in our polar regions.
 - **Researcher in Residence.** Recently appointed as Scholar-in-Residence at Yukon College in Whitehorse, and a Research Affiliate at the Yale School of Forestry & Environmental Studies, Dr. Clark received his Ph.D. at Wilfrid Laurier University in 2007 and is currently a postdoctoral fellow in the University of Alberta's Department of Renewable Resources. Dr. Clark's research interests include policy processes and governance for wildlife and protected areas.
 - **Aboriginal Health.** The Northern Research Institute and Yukon College are partners with the Network Environments for Aboriginal Health Research British Columbia-Western Arctic-Yukon and the Arctic Health Research Network. Both research networks strive to develop a foundation of excellence in Aboriginal health research by using a community based approach.
 - New initiatives include business development, the **Yukon Cold Climate Innovation Centre and a Climate Change Centre of Excellence.**

Faculty Agreements. The collective agreement explicitly supports college R&D. A provision in the collective agreement states that: “an instructor may apply to have up to a 12.5% reduction in his/her annual instructional workload once every two years for the purpose of undertaking an appropriate activity related to research or workplace renewal, subject to operational requirements.” Promotions and bonuses are not linked to faculties’ research activities.

NORTHWEST TERRITORIES

Aurora College/Aurora Research Institute (ARI)

Aurora College serves the Northwest Territories through 3 regional campuses (Yellowknife, Fort Smith, Inuvik) and Community Learning Centres in all but the smallest communities. The **Aurora Research Institute (ARI)**, a division of Aurora College, is responsible for licensing and coordinating research, promoting communication between researchers and the people of the land in which they work, and increasing public awareness of the importance of science, technology, and indigenous knowledge. ARI houses two research centres (at Inuvik and Fort Smith) that have become primary research hubs in the north. **Inuvik Research Centre (IRC)**, the largest facility, provides logistical support and services to researchers in the northern area. Since 2001-2002, when approximately 50 researchers used their facilities, IRC reports that more than 2000 research projects involving more than 1500 researchers have been conducted using the IRC facility. The smaller Fort Smith research facility (formerly South Slave Research Centre) provides office space to researchers, a shared laboratory, new GIS capabilities, and access to Thebacha Campus Library and its newly developed Internet resources. Current and ongoing projects in which Aurora Research Institute is involved include:

- **Illisarvik Bibliography** was northern Canada's longest-running field experiment, conceived in the 1960s as a research program on the behaviour of aggrading permafrost. The Illisarvik (an Inuvialuit word meaning “a place of learning”) project was supported by: ARI, NSERC, the Polar Continental Shelf Project; and Geological Survey of Canada..
- **Neutron Monitor program.** Bartol Research Institute (of the University of Delaware) currently operates 11 neutron monitors worldwide to measure the impact of high-energy particles from space on the Earth; two of these are located at ARI-monitored stations at Inuvik and Fort Smith.
- **Polar Continental Shelf Project (PCSP).** ARI provided assistance in the form of equipment, radio schedules, and air support to PCSP researchers in Tuktoyaktuk and Resolute Bay.
- **Portal to Online Licensing Applications for Research (POLAR).** ARI's POLAR website registry provides licensing services to community and aboriginal organizations, to researchers who wish to apply for northern research licences, and for internal management of the licensing process.
- **Field Stations.** In addition to its Research Centres, ARI supports access to numerous field stations, cabins, and shelters that are maintained by various territorial, federal, and independent agencies such as Arctic Institute of North America, Canadian Circumpolar Institute, Northern Scientific Training Grants Program
- **NWTRResearchWiki.** In 2008 ARI will begin creation of a wiki encompassing over 30 years of research data in the Northwest Territories, including dynamic graphs based upon actual current and historical northern research activities.
- **Mallik gas hydrate production research program.** The 2006-08 Mallik gas hydrate production research program is a \$75 million study to evaluate the natural properties of gas hydrates, and for the first time to measure and monitor their long-term production behaviour. The Japan Oil, Gas, and Metals National Corporation (JOGMEC) and Natural Resources Canada (NRCan) are funding the program and

leading the research and development studies. Aurora College/Aurora Research Institute is acting as the operator for the field program with support from Inuvialuit Oilfield Services who will be the project managers.

Legislation Operating Grants, R&D Programs, or Faculty Agreement

Through the *Public Colleges Act*, Aurora College's Board of Governors established a Science Advisory Council that maintains responsibility for the ARI and recommends research and development programmes to address social and economic challenges. ARI is responsible for administering the *NWT Scientist Act* and ensuring that licensed research information is communicated to northerners. ARI's Portal to Online Licensing Applications for Research (POLAR) website registry supports this mandate. Since 2002, when ARI issued 73 scientific licences, over 900 licences have been issued, including 203 in 2007. Since 2002 R&D allocations have increased from \$983K to \$1.3 million. A "conducive atmosphere" was reported regarding territorial government support for research at ARI.

NUNAVUT

Nunavut Arctic College/Nunavut Research Institute (NRI)

Nunavut Arctic College is Nunavut's only post-secondary institute, operating through 4 campuses, and 24 Community Learning Centres. Nunavut College's Nunavut Research Institute (NRI) provides advisory services, acts as a development partner in science and technology education, and provides scientific licenses according to the *Nunavut Scientist Act*. NRI operates out of two research centres located in Iqaluit and Igloolik.

Iqaluit Research Centre: The Iqaluit Centre's services include science and technology development, logistical co-ordination, research liaison, and public education. The Centre facilitates a variety of initiatives, undertakes contracts, and participates in long-term scientific research, data collection, and monitoring programs. The facility operates year-round. Facilities and services include two laboratories with a variety of basic scientific equipment, accommodations in the Nunavut Arctic College student residence, a cold-storage warehouse, and field equipment. The Centre also has a resource library with considerable research related holdings including reports, periodicals and a northern book collection. The resource library is networked by a database to collections held locally by the Nunavut Wildlife Management Board, the Government of Nunavut's Departments of Environment and Economic Development & Transportation, federal Department of Fisheries & Oceans, and Environment Canada. College students and the public are welcome to use the Resource Library.

Igloolik Research Centre. Services at this Centre are primarily focused on documenting Inuit Qaujimagatuqangit, which includes Inuit knowledge, social and cultural values, practices, beliefs, language and world-view. The facility operates year-round, is equipped with a reference library, and has limited office space available for researchers.

Nunavut Research Institute engages faculty and students in activities related to environmental contaminants research and monitoring, educational programming, IYP, and renewable energy, including:

- **Scientific Research Licences.** Under the *Nunavut Scientist Act* NRI is responsible for administering scientific research licences, and provides a web-based Online Scientific Research Licence Application Service to fulfil this mandate.
- **Student Bursaries:** NRI provides bursaries to assist students from Nunavut to obtain education in the sciences, technology, engineering or application of traditional knowledge in science which will then be applied to future work in Nunavut.
- **Canadian Climate Impacts and Adaptation Research Network (C-CIARN)**
C-CIARN was established in 2001 as a national network to facilitate the generation of new climate change knowledge by bringing researchers together with decision-makers from industry, governments, and non-government organizations to address key issues. Since 2002, NRI has hosted C-CIARN Nunavut which has supported more than 40 impacts and adaptation research projects and upwards of 200 stakeholders (community members, resource and environmental managers, etc.) engaged in climate impacts and adaptation research and decision making in Nunavut.
- **Biogeographic examination of climate driven impacts to Arctic aquatic systems.** This faculty/student project was conducted in 2007 in the vicinity of Iqaluit, Rankin Inlet, Arviat, and Baker Lake
- **Biomonitoring of Arctic Streams.** Beginning in 2007, this investigation is examining the benthic invertebrate community composition in Airport Creek and the Apex River in Iqaluit.
- **Geospatial examination of Arctic Vegetation.** This 2007 project used GIS to develop representative samples from Nunavut in Iqaluit, Rankin Inlet, Arviat, and Baker Lake; the project is now being expanded across the proposed route of the Mackenzie oil and gas pipeline to identify potential impacts from invasive species migrations.
- **Niqiit Avatitinni Committee (NAC).** The NRI is an active member of NAC, established in 2003 to serve as the territorial advisory committee to Canada's Northern Contaminants Program (NCP). Current members include Nunavut Tunngavik Incorporated, Indian Affairs, Inuit Tapiriit Kanatami, University of Northern British Columbia, Nunavut Departments of Environment, Health, and Social Services.
- **Katigsuiniq Project.** In 2005 NRI received \$48K in project funding under the Northern Contaminants Program to undertake the Katigsuiniq project: to identify, catalogue, and compile existing sources of contaminants terminology and make these resources more available to Nunavut interpreter translators; to review the accuracy and consistency of translations for key terms and highlight sources of translation error; and to provide tips for contaminants scientists and Nunavut interpreter translators to help them improve the accuracy and consistency of contaminants translation work done as part of the Northern contaminants program.
- **Research Relationships Guide.** Over the course of 2005 and 2006, NRI faculty and students partnered with University of Toronto to develop *Negotiating Research Relationships with Inuit Communities: A Guide for Researchers*.
- **PLANTWATCH North.** NRI is coordinating PlantWatch North, a volunteer monitoring effort that engages citizens across the NWT, Yukon, northern Manitoba, Labrador, and Nunavut in tracking the phenology (flowering time) of a suite of tundra

plants in order to better understand how Arctic tundra ecosystems might be responding to changing climate conditions.

- **Nunavut International Year of the Polar Bear (IYP).** The interim IYP Node for Nunavut is currently hosted by NRI to provide a point of contact in Nunavut for information dissemination, networking, and dialogue related to IYP, to develop information materials for specific target audiences in Nunavut; to raise awareness of, and encourage engagement in, activities planned for Nunavut; to help Nunavut agencies and communities to develop their own IYP project proposals; to establish a Nunavut-based review committee and coordinate a process to evaluate the social and cultural merit of IYP proposals; to consult broadly with Nunavut agencies and communities to develop a plan for the permanent Phase 2 Nunavut IYP node; and to provide IYP research proponents with information on research permitting

No changes were reported regarding **Legislation, Operating Grants, R&D Programs, or Faculty Agreement.**

3. Associations and Networks

Association of Canadian Community Colleges (ACCC)

ACCC is the official voice of Canada's college system, representing over 150 colleges, institutes, cégeps, university-colleges, and polytechnics in approximately 1000 communities in every region of Canada. Recognition of the role of colleges and institutes in innovation, applied research, and commercialization is a key advocacy priority for ACCC. Over the past seven years ACCC has worked to increase the understanding of the role of applied research at Canadian colleges and to voice the need for new federal research funding policies and programs to enable colleges to make a greater contribution to innovation in Canada.⁹ Some of the major advocacy measures included:

- A national **ACCC Task Group** was created in 2001 to undertake advocacy activities to explore funding options for colleges and institute applied research. In 2004, a **National Research Advisory Committee** comprised of experts in college applied research was created to move forward with the work of the Task Group and provide strategic advice to ACCC in the areas of advocacy and capacity building.
- In 2002, ACCC conducted, with support from the Industry Canada Policy Branch, an inventory of college innovation activities, resulting in *Colleges and the National Innovation Agenda* and *Provincial and Territorial Profiles* (Corkery 2002). A second survey conducted in 2006 resulted in *Applied Research at Canadian Colleges and Institutes*.
- In 2005, Jim Madder (on release time from Fleming College) produced on behalf of ACCC a report entitled *Innovation at Colleges and Institutes*, providing an overview of policies, programs, practices, and administrative structures that existed at that time to support innovation at colleges.
- ACCC mobilized colleges and institutes to respond to the Social Sciences and Humanities Research Council (SSHRC) consultation on the transformation of SSHRC from a Granting Council to a Knowledge Council.
- Created a marketing tool brochure: *Role of Colleges and Institutes in Applied Research, Development and Technology Diffusion*.
- Working with the Canadian Education Association, ACCC produced a series of articles within *New Knowledge for a New Economy*, one of which focused on the return on investment from research and development in colleges.
- In addition, advertisements highlighting specific capabilities of colleges and institutes were placed in *20/20* magazine (Canadian Manufacturers and Exporters), the *Hill Times*, and *Re\$earch Money*.
- ACCC's publication *College Canada* has been featuring applied research editions since 1999. The most recent edition (2007) provides an extensive overview of some of the applied research activities within the college system.
- Since 2001, the Association has held annual **Applied Research Symposia** to facilitate networking and dialogue between federal government officials, granting councils, colleges, and industry. The recent 2008 *College and Institute Applied Research Symposium: Building Momentum* reflected the growing and dynamic niche that Canada's colleges are carving in applied research and innovation.

- Submissions to the pre-budget consultations of the Standing Committee on Finance for support of college applied research.
- In 2007 ACCC produced *Colleges and Institutes and Canada's SME's: A Partnership for Innovation*, highlighting the need for recognition of the importance of SMEs to Canada's prosperity and the role of colleges in helping SMEs become more innovative.
- *Conceptual Framework: College/Institute Technology Transfer Initiative* (2007) was prepared as a position paper and submitted to Industry Canada in response to the federal government's release of *Advantage Canada* and its commitment to help businesses become more innovative.
- Niagara College, Centennial College, and VISTA S&T produced a report on *Developing a College-Based, Evidence Informed R&D Assessment Framework: Literature Review and Research Proposal*
- ACCC's electronically-linked network **Applied Research Affinity Group** currently includes 85 member colleges who share ideas, best practices, and advocacy concerns related to promoting, improving, and further developing applied research capacity at Canadian colleges.

Atlantic Provinces Community College Consortium (APCCC)

APCCC is a regional organization formally established in 1998 to provide an intergovernmental mechanism for coordination, collaboration, and resource sharing among the public providers of community college education and training. The goal of the Consortium is to enhance the quality and cost-effectiveness of the community college systems of the four Atlantic Provinces through the pursuit of cooperative and collaborative initiatives, and to ensure a collective voice for Atlantic colleges at the regional level.

APCCC represents a model for regional collaboration. The Consortium and its member colleges have a long history of regional partnerships that include local industry, government departments, universities, and federal agencies such as the Atlantic Canada Opportunities Agency (ACOA). APCCC provides a framework for regional collaboration that includes public colleges, provincial departments of education, and the Council of Atlantic Premiers (CAP) and the Council of Atlantic Ministers of Education and Training (CAMET). The standing committees of the Consortium include an **Applied Research Network** which has sponsored a *Roundtable on Improving Competitiveness and Productivity in Atlantic Canada* (2005), and has produced an *Inventory of Applied Research Projects* (2007) at member colleges.¹⁰ This survey indicates that:

- Since 1999 Atlantic colleges have been involved in Applied Research projects totalling more than \$50 million
- Resources are committed by all colleges to the growth of applied research
- All colleges are either NSERC-eligible or preparing for eligibility
- NSCC was a member of the original NSERC 6 – a three-year pilot project for College-level research in Canada
- Atlantic Colleges have received research grants from NSERC, CFI, AIF, SSHRC, CIHR, NRC, NLS, and HRDC

Springboard Atlantic

Established in 2004, Springboard Atlantic Inc., a network that supports the commercialization of university research in Atlantic Canada, has recently admitted Atlantic Canada's public community colleges into its membership. This network is funded through ACOA's Atlantic Innovation Fund (AIF), NSERC/CIHR/SSHRC Intellectual Property Mobilization (IPM) Program, and the Nova Scotia Office of Economic Development. Through its networking and commercialization programs Springboard:

- supports the establishment of Technology Transfer/Industrial Liaison Offices
- delivers educational programs relative to intellectual property
- runs networking events to bring together researchers and business representatives
- liaises with industry and facilitates industry-sponsored research
- develops and manages proof-of-concept projects
- markets and licenses technologies to industry and entrepreneurs
- supports the creation of new companies based on platform technologies.

Reseau Trans-tech (see Quebec)

ARC (see Quebec)

Colleges Ontario/Heads of Applied Research (see Ontario)

Colleges Ontario Network for Industry Innovation (CONII) (see Ontario)

AACTI (see Alberta)

Westlink Innovation Network

Established in 1999 with \$25 million in WTSIF funding, Westlink is a not-for profit organization facilitating communication, collaboration, and technology development and commercialization in Western Canada. Westlink's mission is to accelerate the rate of successful commercialization of scientific inventions created by its Member organizations through collaboration, skill building, and targeted, "gap-filling" programs and services. College members include Assiniboine College, Banff Centre, Lakeland College, Mount Royal College, NAIT, Olds College, Red Deer College, Red River College, SAIT, and SIAST. Sponsors include Western Economic Diversification Canada, NSERC, CIHR, SSHRC, and the governments of Manitoba, Saskatchewan, Alberta, and British Columbia. Westlink is a catalyst for technology transfer and training through its \$2.2 million Technology Commercialization Internship Program and \$800K Federal Networked Training Initiative, which also includes five Atlantic internships (out of 20).

Great Plains Applied Research Network

This recently-formed cross-provincial western network brings together SIAST, Red River College, Assiniboine College, University-College of the North, and NSERC-Prairies for the purpose of raising awareness, sharing best practices, building research capacity, and promoting applied research and research partnerships among the members. NSERC-Prairies is currently working with the Great Plains AR Network to develop a research communicators workshop to address their specific needs related to NSERC reporting requirements.

BC and Alberta Colleges and Technical Institutes Network (in formation)

This network of colleges and technical institutes in British Columbia and Alberta is in the process of formation with the purpose of establishing strategies and processes to enhance innovation in their respective jurisdictions, including the establishment of transfer protocols between Alberta and British Columbia.

Polytechnics Canada

• **Polytechnics Canada** is a consortium of seven colleges and institutes whose members share an extensive track record in applied research, in fostering research partnerships with industry, and in conducting applied research based on industry needs aimed at specific commercial objectives. With the exception of BCIT, all members of Polytechnics Canada are also members of ACCC. To date, four members have received CFI funding exceeding \$3.2 million; all have established policies concerning research ethics, integrity, and financial accountability, and all are either NSERC-eligible (4) or in the process of obtaining NSERC-eligibility. (Profiles of these institutions are found in this Report within their respective provincial profiles.) The seven current members of Polytechnics Canada include: British Columbia Institute of Technology (BCIT), Conestoga College Institute of Technology and Advanced Learning, George Brown College, Humber Institute of Technology and Advanced Learning, Southern Alberta Institute of Technology (SAIT), Seneca College, and Sheridan Institute of Technology and Advanced Learning.

Polytechnics Canada has developed a valuable instrument in their *Applied Research Activity Metrics Guide* (2008) with a Metrics Matrix identifying six classes of benefits, with subsets of types and measures of activity (see Measures of Impact). Other advocacy documents developed by Polytechnics Canada include:

- *Submission to the Competition Policy Review Panel* (2008)
- *Building Canada's Competitive Strength: The Role of Canada's Polytechnics* (2007)
- *Polytechnics Canada's Canadian Environmental Solutions* (2007)
- *Submission to the Standing Committee on Industry, Science and Technology* (2006)
- *Submission to the HRSDC Post-Secondary Education Consultation* (2006)
- *Submission to the Standing Committee on Finance's Pre-Budget Consultation* (2006)
- *Submission to the Minister of Industry's Expert Panel on Commercialization* (2005)
- *Bridging The Productivity Gap* (2005)

Advocating for expanded federal funding to support applied research is one of Polytechnics Canada's priorities, and to this end they are currently requesting an annual federal investment of \$150 million into polytechnic institutions.

4. Funding Agencies

Canada Foundation for Innovation (CFI)

CFI was established in 1997 to strengthen Canada's capacity for world-class research. CFI provided 40% matching funds for infrastructure development, with contributions expected from provinces (40%) and other sources (20%). Colleges had access through CFI's **Innovation Fund** and **College Research Development Fund (CRDF)** and to date 30 colleges have completed 68 projects with \$29 million in CFI funding. This represents *less than 1%* of total CFI funding to date. However, changes in subsequent rounds of funding, and cancellation of CRDF have resulted in limited access to CFI funding for colleges. While college projects previously supported through CRDF can apply for extension of prior funding through the newly created Leading Edge Fund, there are currently no CFI college-specific programs to replace CRDF.

NSERC

Currently there are 27 NSERC-eligible colleges, with another 19 formally engaged in the application process. Current NSERC-eligible colleges, by province, are:

British Columbia
Camosun College
Alberta
Grande Prairie Regional College
Lakeland College
Mount Royal College
Northern Alberta Institute of Technology
Olds College
Red Deer College
Southern Alberta Institute of Technology
Manitoba
Red River College of Applied Arts, Science and Technology
Ontario
Algonquin College
Conestoga College Institute of Technology and Advanced Learning
Fanshawe College of Applied Arts and Technology
Humber College Institute of Technology and Advanced Learning
Lambton College of Applied Arts and Technology
Niagara College
St. Lawrence College
Quebec
Cégep de l'Abitibi-Témiscamingue

Cégep de La Pocatière
Cégep de Lévis-Lauzon
Cégep de Rimouski
Cégep de Saint-Hyacinthe
Cégep de Saint-Jérôme (Campus de Saint-Jérôme)
Collège de Maisonneuve
Institut de technologie agroalimentaire
New Brunswick
Collège communautaire du Nouveau-Brunswick, Campus de Bathurst
Nova Scotia
Nova Scotia Community College, Annapolis Valley Campus
Newfoundland and Labrador
College of the North Atlantic

The number of colleges currently applying for NSERC-eligibility, by province, include:

British Columbia: 2	Ontario: 9
Manitoba: 2	Prince Edward Island: 1
Saskatchewan: 1	Quebec: 4

NSERC/Idea to Innovation (I2I)

NSERC’s I2I program has expanded its eligibility criteria for colleges, but this program inhibits college access and participation through its constraint on the use of I2I funds for release time or replacement costs to support reduced teaching loads. I2I states specifically that:

NSERC funds may **not** be used for any part of the salary, or consulting fee ... to support release from teaching (replacement personnel) for the grantee. *NSERC recognizes that college faculty have heavy teaching loads; however as many colleges now have research as part of their mandate from the province where they are located, it is therefore not appropriate that NSERC cover any part of the faculty salaries.*¹¹

To date, no colleges have obtained funding through NSERC’s I2I.

NSERC/College and Community Innovation Pilot (CCIP) program

In 2002 NSERC Senior Management visited 19 colleges to gain an understanding of the role colleges were playing in the overall innovation spectrum, and concluded that colleges had a role to play in building the innovative capacities of communities by helping firms commercialize new discoveries and adopt new technologies. This led to the launch in 2004 of NSERC’s **College and Community Innovation Pilot (CCIP)** program to increase the capacity of colleges to support local innovation. Six pilot projects, informally named the “NSERC-Six”, were selected through competition; base grants of \$100K/year for three years were awarded; in years two and three an additional \$100K was available based on each college’s ability to leverage equivalent funds. The initial funded NSERC-Six projects included:

- British Columbia Institute of Technology (BCIT): *Centre for the Advancement of Green Roof Technology*
- Olds College, Alberta: *Agri-Health Innovation Centre*
- Red River College, Manitoba: *Leading Advanced Manufacturing Practices*
- Niagara College, Ontario: *Use of Virtual Reality Technologies in Land Use Decision-Making*
- CEGEP Levis-Lauzon, Quebec: *Identification of Molecular Markers in the Field*
- Nova Scotia Community College: *Integrating Environmental and Geomatics Technologies for Landscape Monitoring, Assessment, and Restoration.*

An NSERC review of this program subsequently concluded that:

- colleges were well positioned to work with local industry on applied R&D
- capacity of the institutions funded to conduct applied R&D and work with local industry was enhanced by the CCIP program
- short term benefits to local industry and the potential for longer term economic benefit were demonstrated
- stable financial support is required for colleges to carry out applied R&D projects with local industry, in particular SMEs.¹²

NSERC/College and Community Innovation (CCI) program

Based on the success of the CCI Pilot program, NSERC established a permanent college-specific **College and Community Innovation (CCI)** program with an initial budget of \$48 million over 5 years. Funding in years 1-3 will be up to \$500K/year, with \$400K/year in Years 4 and 5. Project funding duration is 5 years, covering direct costs as well as indirect costs (up to 20%) and operating and equipment costs (up to 20%).

Selection criteria include:

- NSERC-eligibility
- portfolio of applied research projects, technology and knowledge transfer, outreach activities
- industry participation
- faculty and student participation

Anticipated impacts of this program:

- enhanced college and industry partnerships to increase local/regional economic sector
- professors and students participating in applied R&D activities on real industry problems
- increased applied research capacity and technology transfer activities in colleges as well as in local firms, including SMEs
- local companies adopting new technologies, launching new and improved products and processes.

NSERC's CCI program appears to be the most accessible and "college-friendly" research funding program currently available to Canadian colleges. Especially notable aspects of CCI include: flexibility of measures used to demonstrate impact; eligibility of course load reduction costs for faculty; and salary/internship costs for students.

Atlantic Canada Opportunities Agency (ACOA)

ACOA is a Government of Canada department that works in partnership with Atlantic region colleges to develop an innovative economy, to enhance regional economic and community development, to train a productive and skilled workforce that meets industry standards, and to support applied research and/or product/process testing that assists private sector implementation of innovative technologies. ACOA's President and Vice-President meet regularly with the Executives of APCCC and Springboard Atlantic to discuss initiatives and potential opportunities for collaboration. Through its **Atlantic Innovation Fund** (AIF), ACOA has funded numerous Atlantic college R&D projects, including:

- CNA: *Geospatial Research Facility; Petroleum Applications of Wireless Systems; Wave-Powered Pumping of Seawater for On-Shore Applications*
- Holland College: *Justice Knowledge Network*
- NSCC: *Coastal Zone Decision Support System for Disaster Preparedness.*

Recently announced 2008 AIF-funded college research projects include:

- Nova Scotia Agricultural College (Truro) Project (\$1.9 million): *Revitalization of Fruit Tree Industry*
- NSCC (\$3 million): *Environmental Assessment: Geomatics Technology and Science Integration*

FedNor

FedNor Canada is a federal department that supports sustainable development in Northern and rural Ontario communities, works with colleges to create effective partnerships, networks, and linkages, and to support applied research and enhanced commercialization capacity in those communities. Since 2001 FedNor has provided over \$13 million in support of 70 projects at northern Ontario colleges. Some examples of FedNor-supported college R&D partnerships include:

- Cambrian College: *NORCAT; Sustainable Energy Centre and Internship Program; E-Dome Project*
- Confederation College: *Aviation Centre of Excellence; Forest Biomass Recovery Cost Analysis Trail*
- College Boreal: *Rural Knowledge Cluster*
- Canadore College: *Aviation Campus*
- Sault College: *Wind Energy Training Centre*

Western Economic Diversification Canada (WD)

WD was established in 1987 to help broaden the economic base of the four western provinces, with a focus on Innovation, Entrepreneurship, and Community Economic Development. Some examples of WD collaborations with western colleges include:

- **NAIT Fuel Cell and Interpretive Centre** (WD Investment: \$950,000)
In 2003, Canada's first high-voltage operational fuel cell was installed at the NAIT. The cell is used for research and educational purposes, and as part of an interpretative centre that educates the public about fuel cell technology and environmental impacts. It will also be compared against alternative sources of energy, including traditional forms of power production, other fuel cells, and hybrid systems.
- **SAIT Centre for Innovative Information Technology Solutions** (WD investment: \$2.5 million).

- **Red River Raycer** (WD Investment: \$30,000)
WD supported the development of the Red River College Raycer, a solar powered vehicle that competed in the biennial solar race from Austin, Texas, to Calgary, Alberta. RRC was the only Canadian college to compete against teams from across North America. The solar-powered Raycer survived the 4,000 kilometre race and a new version is expected to return to the race in two years' time. This project provides an international platform to develop and operate energy efficient designs and technology, while engaging students in state of the art innovative technology development.
- **WestLink Innovation Network Ltd.** (WD Investment: \$2.25 million)
Established and operated with WD funding, Westlink accelerates the commercialization of its members' scientific inventions through collaboration, skill building, and targeted programs and services. Ten Western colleges (out of 25 members) benefit from participation in Westlink.

5. MEASURES OF IMPACT

Enhancing accountability by demonstrating to taxpayers that public expenditures are achieving intended results is one of the four core principles guiding *Canada's Advantage*. Since 2002, significant strides have been taken by Canada's colleges to enhance accountability by developing appropriate measures and indicators of performance that can be used in the future to gauge the impact of their applied research and innovation activities. The following list illustrates the ongoing development of indicators and instruments:

1. **Madder** (2005)¹³, in *Innovation at Canadian Colleges and Institutes*, suggested that measures of success should evolve as college innovation capacity and activities develop through three stages. Initial quantitative measures could include:
 - number of faculty and students directly involved
 - learning objectives met through increased project based delivery
 - number of graduates in the workforce using research related skills
 - industry problems addressed and resolved
 - private/public sector support (venture capital, in-kind support)
 - inventions (product/process) disclosed.

As innovation activities develop further, measures could include:

- patents filed
- license agreements executed
- number of successful spin-off companies formed.

Mature or global measures of success could include:

- number of products successfully introduced to the market
- employment associated with the sales, production, and maintenance of new products and services
- fiscal return to licensee/investor (college, government, private sector)
- growth in regional economic activity
- qualitative improvement of individual lives associated with new processes and products.

2. In 2006 **Polytechnics Canada** undertook the development of a set of metrics to be used as Key Performance Indicators (KPIs) for each institution and for their association. Their resultant *Applied Research Activity Metrics Guide* (2008)¹⁴ identifies six classes of benefits with subsets of types and indicators of benefits, as summarized in the following table:

Metrics Matrix (used with permission of Polytechnics Canada)

Class of benefit	Type	Metric
Economic and Commercial Value: assesses the value brought by AR activity to clients, the host institution, or a community.	Economic Improvement	dollar value
	Number of Prototypes Developed	Count
	Patents	Count
	IP	# of disclosures
	Revenue sharing	dollar value
Internal Research Capacity Building: assesses the contribution of AR activity to the host institution in terms of creating and building additional human resource capacity.	New Faculty Engaged	Count
	Workshops	Count
	Seminars	Count
	Consultations	Count
	Publications	Count
	Conference Presentations	Count
External Knowledge Transfer: quantifies the activity of knowledge transfer outside the institution.	Student Projects	Count
	Workshops	Count
	Seminars	Count
	Consultations New / Existing	Count
	Publications	Count
	Conference Presentations	Count
Industry: measures client satisfaction.	Client Satisfaction	surveys
Institutional: measures the impact of by AR activity on the overall operation of the institution	Financial contribution to the institution	dollar value
	External Revenues	dollar value
	Institutional capacity - HR and facilities	FTE's, sq ft
	Recognition / Awards	# of projects, staff and students
	Collective - collaborative efforts	# of institutions and dollar value
Learner: measures the involvement of students in AR activity; reflects the integration of AR into curriculum and the contribution of the institution to providing graduates with AR skills.	Integrated projects into curriculum	# of projects
	Highly relevant, skilled personnel	# of students

3. Similar measures of the impact of college research are articulated in **NSERC's** recently expanded **College and Community Innovation (CCI)** program. The program's stated objective is to increase the capacity of colleges to contribute to economic development and to create new quality jobs based on know-how and technological innovation. Consequently the impact of AR activity conducted by participants in the CCI program will be demonstrated by:

- increased awareness by local industry of the capacity of the colleges to assist with applied research projects
- involvement of the colleges with key industry and other relevant stakeholders in the community
- increased involvement of faculty in applied research
- increased applied research capacity at colleges
- college students acquiring applied research knowledge and experience, and exposure to business work environments
- new technologies and processes adopted by local industries and other organizations
- increased applied research collaborations between colleges, local industries and other organizations
- increased R&D investment by local industries and other organizations
- increased productivity and competitiveness of local industries and other organizations
- enhanced reputation of colleges as applied research partners, for local industries and other organizations
- other specific impacts identified by the college.

4. **Colleges Ontario Network for Industry Innovation (CONII)** has developed similar measures of capacity building in two categories. Institutional-focused measures included:

- number of CONII offices
- number of faculty involved with office
- number of students working with office
- number of hours training in research
- college investment in research infrastructure (HR, facilities, etc)
- leveraged support for research infrastructure
- number of new educational resources

Industry-focused measures included:

- number of approaches from industry
- number of faculty working with industry on AR projects
- number of students working with industry on AR projects
- number of AR projects resulting in positive impact as defined by industry partner
- number of new/improved products/process as result of collaborative research with college
- number of prototypes, simulations, product tests with college

5. **CCTTs** in Quebec are accountable to two ministries on an annual basis. Ministry evaluative criteria include the following general categories:

- client demand for the products and services offered
- added value to the Québec province

- development of a critical mass for growth in research services (personnel, equipment, and infrastructure)
- portrait of the activity, products, and the services
- client satisfaction with the transfer practices
- linkages, partnerships, and collaborations with other stakeholders
- implications for the other financial partners (the lever effect)
- increased innovation capacity and activity of the SME client
- social and economics repercussions on Québec province

6. A recent study commissioned by **Niagara College** and **Centennial College** (*Developing a College-Based, Evidence Informed R&D Impact Assessment Framework*, Vista Science & Technology, 2007)¹⁵ provided an extensive literature review of models, typologies, frameworks, ideologies, and methodologies for assessing the impacts and outcomes of applied research and innovation activities at Canadian colleges. Salter & Martin's six benefits appeared particularly relevant measures in terms of college innovation activities, such as:

- increasing the stock of useful knowledge
- training skilled graduates
- creating new scientific instrumentation and methodologies
- forming networks
- increasing capacity for scientific and technological problem solving
- creating new firms

Since 2002, colleges and college-related organizations have made significant progress in enhancing accountability by purposefully examining and developing appropriate metrics, models, and measures of performance that can be used in the future to gauge the impact of their applied research and innovation activities. Indicators of performance have included inputs, outputs, and impacts of research activity. Two recurrent categories include increased capacity for ongoing innovation tailored to the needs of the local and regional economy, and increased skills training of college graduates (highly qualified personnel) who, as industry employees, would further support local and regional innovation.

Appropriate indicators can provide important insights, but there is no single set of metrics that is entirely satisfactory in all cases of college/private sector innovation activities. Further collaboration on the development of local, regional, provincial, and pan-Canadian measures of impact could prove fruitful in enhancing accountability as colleges expand their collaborative activities in applied research and innovation.

6. CONCLUSION: The College Advantage

The applied research landscape at Canadian colleges has changed dramatically since 2002. Several studies over the past six years have tracked the growth and evolution of applied research capacity at colleges across Canada, prior to this report.

- In 2004 the Colleges of Ontario Network for Education and Training studied the capacity of Ontario's colleges to conduct applied research, innovation, and commercialization. This study found that applied research was specifically mandated in 93% of respondents' strategic and operational plans, while commercialization was mandated in 80% of operational plans; additionally, 73% of respondents had IP disclosure policies and research-specific accounting policies in place.¹⁶
- Madder (2005), on behalf of ACCC, surveyed college administrators to provide a state of the field overview of policies, programs, practices, and administrative structures supporting college innovation practices at that time. Madder's report, *Innovation at Canadian Colleges and Institutes*, described how college participation in applied research not only directly supported private sector innovation, but also provided employers with highly qualified workers. Madder described a four-fold typology of generic models of development that demonstrated the stages of capacity building, and highlighted critical challenges to further growth, of which the lack of funding for faculty release time was identified as "the primary limiting factor for innovation activities" at Canadian colleges.¹⁷
- In a further effort to measure the level and scope of college research activity, the ACCC, through their National Research Action Committee (NRAC), conducted an on-line survey that received responses from administrators at 59 institutions representing 42% of the 140 ACCC members at that time. The resulting document, *Applied Research at Canadian Colleges and Institutes*, substantiated the conclusions of previous studies: development of applied research capacity was characterized in terms of internal and external policy environments, faculty participation rates, and the challenges faced in building applied research capacity. This report also identified the lack of release time for faculty participation and limited access to government support as the barriers that were most inhibiting expansion of research and innovation activities at Canadian colleges.¹⁸
- Fisher (2007) conducted the first large-scale pan-Canadian survey of college faculty to gauge their levels and areas of interest in research activities. With responses from over 2400 faculty representing 90 colleges in every region of the country, this study found that 79% of faculty were interested or strongly interested in participating in research at their college. More than half (57%) were specifically interested or strongly interested in participating in "Applied Research", suggesting strong receptor capacity for growth of faculty participation in this area. These findings were consistent across all seven demographic variables employed in the survey, including: respondents' age, gender, employment status, years of experience, credentials, subject area, and home province. Lack of release time was identified by faculty as their primary barrier to participation.¹⁹

The College Advantage

This report provides compelling evidence of the value and contribution of colleges in achieving the goals articulated in *Canada's Advantage*, and documents the dramatic growth in research interest, infrastructure, capacity, and performance since the initial Industry Canada studies in 2002. Great strides have occurred in a relatively short timeframe for putting in place mission statements, policies and strategies, infrastructure, research offices, and networks. Applied research activities have been integrated with program curriculum, led by faculty, and performed by students. Based on the findings presented in this Report, the *College Advantage*, in supporting private sector innovation and developing highly qualified workers, can be characterized as follows:

- **Pan-Canadian presence**

Colleges provide a huge advantage through their presence in approximately 1000 communities in every region of Canada. With their mandate to support regional economic development, colleges focus on serving regional priorities. Examples range from CNA and Marine Institute activities in oceanographic research, to Niagara College's support of their region's wine industry, to SIAST's Share the Warmth program, to Camosun College's leadership in finding alternative uses for BC's shipbuilding facilities, to neutron monitoring across the North, colleges are capitalizing on their pan-Canadian presence and close ties to communities in responding to and finding solutions for regional, national, and international challenges.

- **SME Partnerships**

Canadian colleges are playing an increasingly important role in augmenting the innovative capacity and competitiveness of Canada's SMEs, and providing key transformational changes for business, industry, and individuals alike.²⁰ In response to "market pull", colleges are increasingly focused on solving problems for local businesses and helping them to survive and thrive by adopting new technologies and by launching new and improved products and processes. The following summary, drawn from the myriad examples contained in this Report, highlights the extent to which private sector businesses and industries are recognizing the importance of, and actively participating in, a wide spectrum of college/SME applied research collaborations:

Newfoundland's Marine Institute works with hundreds of international maritime companies, while Nova Scotia Community College is solving problems local businesses such as blueberry farmers, internet providers, and gravel operators. Holland College is exploring new products and markets with PEI farmers, while New Brunswick Community College works with international food producer McCains to find environmentally-sound uses for potato waste. Quebec's unique CCTTs produce a 3-to-1 Return on Investment while assisting hundreds of provincial businesses compete in new economy sectors such as geo-textiles, biotechnology, micro-electronics, and zero-emission vehicles. Ontario's community colleges are solving a wide range of SME problems related to permeable pavements, flour silo inventory controls, waterproof coaxial connectors, telehealth homecare networks, frost- and virus- prevention for wineries, catastrophic loss reduction for insurers, new product testing for Sobeys, car safety testing for Magna, process control for international petrochemical companies, and visualization design solutions for clients ranging from Ottawa transit to Hollywood film

studios. Manitoba's Red River College is working with North America's largest bus producer to apply hydrogen hybrid engine technology, while Saskatchewan's SIAST has helped SaskEnergy reduce costs by millions of dollars each year. Alberta's colleges and institutes are engaging in a range of private sector collaborations ranging from NAIT's multi-million dollar Shell Oil tar-sands project to Red Deer College's small scale portable bio-diesel reactors, to NorQuest's commercialization of a multi-media reader for hearing impaired. British Columbia's colleges and institutes are working with shipping companies to find new uses for ship repair-yards, to reduce occupational injury among Weyerhaeuser's forest workers, to find holistic production processes for the Pacific shellfish industry, and to commercialize blood infusion systems with medical product developers. Across the North, college research institutes are developing marketable cold weather tools, gas hydrate production technology, and arctic internet connectivity. From sea to sea to sea, private sector companies are partnering with colleges to solve problems and increase competitiveness.

- **Highly Qualified Personnel**

Canada's colleges are frontline players in addressing the changing technological and skills requirements of the 21st century Canadian marketplace.²¹ Applied research activities extend and enhance the college mandate to produce current, well prepared workers by providing rich learning activities for today's students to experience real world challenges, hands-on training with leading edge technologies, contact with industry, and advanced skills training in all sectors of the economy. Through the college research activities faculty increase their currency while students learn advanced "new economy" research skills in oceanography, geomatics, bio-receptors, "intelligent" textiles, disaster/emergency preparedness, wind power, advanced visualization, tribology, energy efficient materials prototyping, low-cost fuel reduction, integrated GPS emergency response, desalinization, nutraceuticals, weather-controlled sport training, membrane spectrometry, solar-photovoltaic applications, cold weather inter-connectivity, neutron monitoring, and arctic geo-spatial transformations, to name a few. Also, not only are colleges training the next generation of Canada's researchers and innovators, they are *getting students excited* about science and technology, as dramatically demonstrated by the Red River Raycer project.

- **Networks**

Colleges are active participants in a wide array of networks, associations, and consortia that have been established in every region of the country, with further expansion underway. Organizations like ACCC, APCCC, Springboard Atlantic, Reseau Trans-tech, ARC, Colleges Ontario HAR, CONII, Westlink, Great Plains Applied Research Network, AACTI, and Polytechnics Canada provide shared platforms for raising awareness, sharing best practices, building shared capacity, exploring opportunities, collaborating, and advocating on behalf of member colleges.

- **Funding agencies**

Ongoing financial support through successful stand-alone and matching grants adds capacity as well as credibility to college research activities. Canadian colleges have successfully obtained research funding from national and regional funding agencies such as CFI, NSERC, ACOA/AIF, FedNor, WD, and Westlink, as well as from various provincial funding sources. Colleges have consistently demonstrated both short term

benefits and the potential for longer term economic benefits when opportunities were provided to build capacity in order to help SMEs survive and thrive in the highly competitive local, national, and international marketplace. Government investment in colleges is well positioned to support initiatives that are demonstrably important to industry.

- **Metrics**

Enhancing accountability by demonstrating to taxpayers that public expenditures are achieving intended results is one of the four core principles guiding *Canada's Advantage*. Since 2002, significant strides have been taken by Canada's colleges to enhance accountability by developing appropriate measures and indicators of performance that can be used in the future to gauge the impact of their applied research and innovation activities. This report provided seven examples of indicators and instruments for consideration in designing a pan-Canadian template for ongoing reporting and accountability of research activities at Canadian colleges.

- **Sectors**

Canada's Advantage focuses strategically on research in areas that are in the national interest from a social and economic perspective. This Report contains a wealth of examples of college research activities in all of the targeted areas, including environmental science and technologies, natural resources and energy, health and related life sciences and technologies, information and communications technologies, and other critical areas such as manufacturing technologies.

With respect to applied research and innovation, *colleges are currently operating at their full capacity, based on their available resources*. With the dramatic growth of research activity illustrated in this report, it is clear that colleges have turned a corner and that their momentum has reached the point at which they are poised to dramatically expand their applied research and innovation activities. However, further progress at this critical juncture is severely constrained by several inhibiting factors.

Challenges

Several factors are currently inhibiting the capacity of colleges to expand their applied research and innovation strategies and activities.

- **University-centric funding models**

Nationally, regionally, and provincially, Canada's colleges are constrained in their applied research and innovation activities by systemic bias in favour of universities. This is evident in the composition of funding agency panels, selection criteria, restrictions on eligible expenses (such as faculty release time), outcomes and expectations, etc. While colleges are ostensibly able to apply for funding competitions, the university-centric nature of these competitions precludes fair access for colleges, or requires that they participate as "junior partners" with universities. This lack of college-sector specific funding opportunities is a significant inhibitor of future growth. To date, *less than 1% of CFI* research grants, and *less than one-half of 1% of NSERC* research grants have been awarded to colleges. The discontinuation of CFI's College Research Development Fund has only aggravated the situation. While the recent expansion of NSERC's college-

specific CCI program is a welcome exception, even this expanded opportunity represents less than 1% of NSERC's annual research funding programs.

- **Release time for college faculty**

The lack of recognition or accommodation for research-related faculty release time in provincial operating funds, R&D programs, and federal/provincial granting competitions has been consistently identified as the primary barrier inhibiting further growth of college capacity (Corkery, 2002; Madder, 2005; ACCC, 2006; Fisher, 2007). Again reflecting the prevalent university-centric funding model, this lack of accommodation stems primarily from the unacknowledged disparity between the roles of university and college teachers. While research is an expectation included in collective agreements and hiring processes for university professors, college teachers are expected to teach full time, with no allocation for research-related release time in provincial operating grants, collective agreements, or funding agency competitions. Unlike university professors, college teachers are expected to conduct research on their own time, over and above full teaching loads. The lack of adequate funding for release time for college faculty to engage in research activities is the single greatest inhibitor to further expansion of research at Canadian colleges. NSERC's CCI program is the only funding opportunity that recognizes faculty release time as an eligible expense, although even this college-friendly program includes constraining limits.

- **Alignment of policies**

Recognizing the great diversity of regional priorities, provincial R&D policies, collective agreements, and variance in regional economies, support programs for colleges cannot follow a 1-size-fits-all model, but must recognize and accommodate provincial and regional diversity, and allow for flexibility in structuring future support mechanisms.

- **Focus on world-beating new knowledge and applications**

While "promoting world-class excellence" is one of the four core principles guiding *Canada's Advantage*, the reality of college/industry collaborations occurs primarily on a smaller scale. Most partnerships involve SMEs, and in particular, "small" enterprises, usually with fewer than 10 employees. These small local companies often approach colleges with issues related to economic survival, where adoption of new technologies helps companies compete more effectively to stay in business, and to grow their business, but where world-beating applications are not priorities.

- **Terminology**

To some extent, the range of terminology involved in this enterprise is itself at times an inhibitor. Terms like innovation, applied research, R&D, technology transfer, and commercialization, while clear to policy makers, are often used in different contexts and with different intentions across the diverse range of activities described in this report. Fisher's (2007) pan-Canadian survey of college faculty found that 30% of respondents were "uncertain" about their attitudes toward "applied research"; this finding was partially a result of confusion over terminology used within the survey questionnaire itself, but may also reflect widespread uncertainty with respect to the various uses and contexts in which these terms appear. While this is a minor inhibitor, attention to and clarification of relevant terminology may contribute to greater understanding and participation of stakeholders.

Over the past six years, the unprecedented momentum in building applied research capacity, partnering with private sector businesses, and training highly qualified personnel for the knowledge economy has brought Canada's colleges to the point where they are *currently using their available capacity to their full extent, based on limited available resources*.

Colleges are therefore at a critical juncture. In order to more fully exploit their considerable advantages, additional resources from both the public and private sector are essential to support further expansion.

With additional resources in the form of growth capital, colleges can reach the point of critical mass where momentum becomes self-sustaining and fuels further growth. At this time, a combination of government investment (in the form of stable, long-term financial support and equitable access to funding opportunities) coupled with increased private sector participation (through expanded college/SME collaborative partnerships) can provide the leverage to maximize return on investment, to increase value, and to unleash the full potential of Canada's *College Advantage*.

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