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ACAATO DOCUMENT

Applied Research and Innovation Ontario Colleges - An Underutilized Resource

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SEPTEMBER 2004

About Ontario Colleges

Ontario Colleges of Applied Arts and Technology (CAATs), hereafter referred to as *colleges*, were established in 1967 by the Government of Ontario. Ontario's Colleges of Applied Arts and Technology and Institutes of Technology and Advanced Learning are regulated by the Ontario Colleges of Applied Arts and Technology Act, 2002, ONTARIO REGULATION 34/03. The mandate of Ontario's colleges is to provide accessible, quality career-oriented education and training that foster leadership and citizenship in students, and strengthen the workforce as well as the economy. Ontario's colleges also undertake applied research and innovation to enhance social and economic development throughout Ontario and to meet local, regional and global marketplace demands.

There are 24 colleges in Ontario with campuses in over 200 communities. Shared leadership of economic development is an overarching goal of the Ontario college system. Ontario colleges accomplish this through strategic alliances with education, labour and corporations.

In addition to a range of diploma, certificate, workplace training, and apprenticeship programs, Ontario colleges offer concurrent diploma and degree studies, post-diploma and post-degree programs, collaborative degree programs and, since 2002, bachelor's degrees in applied studies. The authority to confer bachelor's degrees in applied studies was granted to Ontario colleges to better enable them to respond to the increasing demands for highly qualified personnel and to facilitate the colleges' contributions to economic development, job creation and the national innovation strategy, which seeks to move Canada from 14th to 5th place in the OECD rankings of research intensity.

Ontario colleges enroll approximately 150,000 full-time and 350,000 part-time learners per year. The college student body comprises over 70 cultural and ethnic groups. College academic staff number 16,000, of nearly 30,000 employees.

As crown agencies, Ontario colleges are governed by community-based boards involving more than 400 volunteers. In addition, Ontario colleges have over 1,000 program advisory committees comprising employers and alumni. These advisors represent 10,000 points of direct contact with Ontario's business, industry and community leaders.

The Association of Colleges of Applied Arts and Technology of Ontario (ACAATO) represents the collective interests of Ontario colleges provincially. The Association of Canadian Community Colleges (ACCC) is the national body representing colleges in Canada.

Preface

This report, representing the views of Ontario's 24 colleges, highlights a systemic dearth of applied research and innovation funding opportunities for colleges at the federal level. Applied research and innovation at Ontario colleges are undertaken in collaboration with private and public sector partners. College applied research and innovation regularly lead to innovations and the commercialization of knowledge that result in new products and services benefiting the Canadian economy.

*Prepared by the Association of Colleges of Applied Arts and Technology of Ontario (ACAATO), this report suggests **specific strategies to enhance the contribution of colleges to economic development and national prosperity**. The recommendations provided herein are relevant, in the broadest sense, to all Canadian colleges with the capacity to contribute to innovation, commercialization and the development of new products and services through applied research and innovation.*

About ACAATO

The Association of Colleges of Applied Arts and Technology of Ontario (ACAATO) is the advocacy and marketing association of the 24 Colleges of Applied Arts and Technology of Ontario. The Association presents the collective views and interests of college Boards, Chairs and Presidents. Its mandate is to advance a strong college system for Ontario.ⁱ

About ACCC

The Association of Canadian Community Colleges (ACCC) is a voluntary membership organization created in 1972 to represent colleges and institutes to government, business and industry — nationally and internationally. Canadian colleges, institutes of technology and the collèges d'enseignement général et professionnel (cégeps) are collectively represented by ACCC on issues that impact Canadian colleges, including college access to federal research and development funding opportunities.

About ACPPI

The recently established Association of Canadian Public Polytechnic Institutes (ACPPI) advocates specifically on behalf of national polytechnic education. ACPPI focuses its efforts on strengthening credit transfer, promoting polytechnic partnerships and advocating at the federal level for increased access to funding for applied research.

ⁱ Federated and affiliated colleges associated with an Ontario university are members of the university community. These institutions are represented by the Council of Ontario Universities provincially, and the Association of Universities and Colleges of Canada nationally. University-based federated and affiliated colleges are not part of the college community represented by ACAATO and ACCC.

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Executive Summary and Highlights

In March 2004, a sweeping agenda was unveiled by the Federal government to stimulate the development of “a Canada of success.” The underlying strategy has two fundamental components:

- Support learning by providing young Canadians with tools to success, while encouraging lifelong learning for all; and
- Support innovative Canadian industries and enhance productivity.

Ontario’s 24 Colleges of Applied Arts and Technology have a long-standing track record of successful collaboration with the private sector, the public sector, local communities and regional economic clusters in providing state-of-the-art education and training that fosters leadership, enhances workforce productivity and strengthens the economy.

In recent years, Ontario colleges have also been increasingly encouraged to engage in applied research activities by private- and public-sector partners. These partnerships, of which more than 80 examples are provided in this paper, are frequently initiated by small and medium-sized organizations seeking innovation and commercialization opportunities essential to sustaining their operations. Lacking the capacity to do their own applied research and development, these organizations turn to Ontario colleges, with whom they often have long-standing education and training relationships, to provide the applied research, commercialization expertise and facilities necessary to stay ahead of their competition.

Applied research and innovation initiatives undertaken by Ontario colleges to date demonstrate that:

- Ontario colleges have the ability to generate significant support for applied research from industry and public sector partners;
- Applied research undertaken by Ontario colleges yields a high rate of commercializable intellectual property;
- Ontario colleges understand and respond readily to the innovation and commercialization challenges facing industry;
- Ontario colleges readily undertake applied research in ways consistent with industry’s culture and timeframes.

Although colleges are emerging as strategically important partners for small and medium-sized enterprises that need applied research to sustain productivity through innovation, current federal research funding policies and programs limit college access to funds to support an expansion of their applied research activities. Ontario colleges' applied research capacity is an underutilized resource that, with improved access to federal research funds, will contribute significantly to the future competitiveness of Canadian companies and the prosperity of Canadian society.

Highlights

- Between 2000 and 2003, the Government of Canada invested \$3.5 billion in Tri-council research and \$2.1 billion in research infrastructure, of which only \$18 million or 0.3% went to Canadian colleges. There are barriers to college success in existing federal research funding programs.
- Ontario colleges engage in applied research, development, innovation and commercialization activities with strategic relevance and importance to small and medium-sized enterprises (SMEs), and to Canada's future competitiveness in a range of public and private sectors of society.
- College research typically involves the development and prototyping of new products and processes, enhancing existing products and services, and working closely with industry to ensure innovation that supports regional economic development.
- Ontario colleges undertake applied research, with private and public sector partners, that has potential for global impact.
- Ontario colleges undertake applied research relevant to a range of sectors including alternative energy, bioproducts technology, biotechnology, pharmaceuticals, health and life sciences, information/communication and learning technologies, sustainable development and environmental protection.
- College applied research and innovation is a good investment strategy for Canadians to achieve national innovation targets due to the colleges' already close working relationship with industry in the local community and the rapidity with which college research results are translated into social and economic benefits.
- With campuses in 200 Ontario communities, touching 500,000 learners annually, Ontario colleges provide a strategic link between applied research and the marketplace that can help Canadian SMEs remain at the forefront of innovation.
- An estimated 2% of Ontario's 6,388 full-time college faculty engage in applied re-

search, development and commercialization activities and about 20% of college faculty hold research-based master's or doctoral degrees.

- Ontario colleges project that within a decade, with adequate funding, 10% or approximately 700 full-time faculty will be involved in applied research and development activities at any given time.
- Colleges contribute to the development of highly-qualified personnel/human resources by training the next generation of Canadians who will strengthen the knowledge-based economy by using applied research and development skills to enable innovation. College applied research and innovation activities also contribute to the professional development of faculty and enable faculty to remain at the leading edge in both teaching and training.
- College applied research and innovation expertise is underutilized in large part due to limited research funding available to the college sector. With the exception of a recently announced NSERC pilot program targeted at college applicants, federal research granting council funding program expenditure guidelines limit college faculty participation because, for example, they do not recognize the need for teaching release support for college faculty or the fact that college faculty do not have access to graduate student research assistants.
- Ontario colleges recommend the establishment of a **new federal funding envelope dedicated to college research** beginning in 2005 and increasing annually to a target value of \$100 million per year by 2010, to support applied research at Canadian colleges undertaken in collaboration with private and public sector partners.
- In addition, dedicated **“college competition” envelopes** within federal granting councils are recommended. They would provide incentives for universities to partner with colleges in research teams, enable colleges to play a more extensive role in linking research to the needs of the marketplace, fill a gap in Canada's innovation “tool-box” for the promotion of commercialization of knowledge, and better enable the collective achievement of Canada's innovation targets for research intensity. **Modified adjudication criteria and processes are required.**
- Ontario supports proposals from the Association of Canadian Community Colleges (ACCC) and the Association of Canadian Public Polytechnic Institutes' (ACPPI) for **new funding mechanisms** at the national level that would enable colleges and institutes to make a greater contribution to innovation in Canada, and for **existing funding mechanisms to include colleges**, recognizing their unique capabilities and experience.

Consolidated Recommendations

ACAATO recommends that the Federal Government:

- 1) Establish a new national funding envelope dedicated to college research (excluding major infrastructure) beginning in 2005 and increasing annually to a target value of \$100 million per year by 2010, to support applied research at Canadian colleges undertaken in collaboration with private and public sector partners.¹ \$100 million per year represents less than 10%² of the total amount of funds allocated to federal granting councils to support research across Canada in 2003. This dedicated funding for college research would enable colleges to play a more extensive role in undertaking research linked to the needs of the marketplace and would fill a gap in Canada's innovation "tool-box."
- 2) Dedicate "college competition" envelopes within federal granting council and research infrastructure program budgets that take into account the unique funding needs of college researchers, the capacity of colleges to engage in research partnerships with small and medium-sized enterprises (SMEs), and the need for incentives for colleges and universities to undertake collaborative research.
- 3) Support commercialization at colleges by ensuring that colleges have access to the \$100 million that government announced in the Federal budget 2004 for investment over the next five years to improve capacity for commercialization at universities, hospitals and other research facilities.³
- 4) Facilitate college access to existing federal research funds by adapting federal research funding agencies' criteria for college applicants so that the criteria:
 - a. ensure adjudicators consider the unique context of college research proposals and the unique strengths and experiences of college faculty;
 - b. take into account the potential for college research impact (commercialization, innovation);
 - c. provide funding for college faculty release time from teaching; and
 - d. involve college faculty and representatives of SMEs in the peer review and/or selection committee processes.

1.0 Applied Research and Innovation: Ontario Colleges — An Underutilized Resource

This proposal calls on federal decision-makers to introduce new policies, programs and adjudication processes that enhance college access to federal research and research infrastructure funding. This can be accomplished by establishing new, college-only research funding programs and envelopes, and by reducing barriers to college success in existing research granting council and research infrastructure funding competitions.

Applied research undertaken at Ontario colleges includes innovation- and commercialization-related activities such as developing new and enhanced products and processes; bringing new knowledge to market to expand market opportunities for small and medium-sized enterprises and global corporations; building and testing prototypes, demonstrating proof-of-principle; and carrying out non-routine laboratory testing or field studies that have application potential.

What is Innovation?

A process through which economic or social value is extracted from knowledge ...through the generation, development and implementation of ideas...to produce new or significantly improved products or processes.

— Conference Board of Canada, 2004

To date, Ontario colleges have received funding from a range of federal and provincial programs, and public and private partners in support of research and development activities. Public sector partners include:

- Canadian International Development Agency (CIDA);
- Industry Canada;
- Canada Foundation for Innovation (CFI);
- Ontario Innovation Trust (OIT);
- Ontario Research and Development Challenge Fund (ORDCF);
- Ontario Centres of Excellence, Inc.
 - Communications Information Technology Ontario (CITO) Network;
 - CRESTech
 - Materials and Manufacturing Ontario (MMO)
 - Photonics Research Ontario (PRO)

- Ontario Ministry of Economic Development and Trade;
- Ontario Ministry of the Environment; and
- a selection of municipalities and regions.

During the brief time that Ontario colleges have had applied research as part of their mandate, they have demonstrated that their research outcomes have much to offer in terms of economic development and commercialization impact, innovation, job creation and the development of highly-skilled personnel. For example, college applied research and innovation projects funded in 2003 by the Communications Information Technology Ontario (CITO) Network, a member of Ontario Centres of Excellence, Inc., (OCE) demonstrated that Ontario college applied research and innovation initiatives:

- generate higher than average support and investment from industry partners
- *(the 2:1 ratio of industry to CITO investment exceeded expectations);*
- yield a high rate of commercializable intellectual property
- *(four of the five funded projects [80%] are actively pursuing commercialization of results);*
- provide OCEs with an applied research and innovation investment strategy that is highly responsive to industry needs
- *(The core functions of Ontario colleges are inextricably linked to the needs and challenges of Ontario industry - longstanding local, regional and provincial linkages between colleges and industry are already in place);* and
- provide OCEs with a vehicle for investment where applied research can be readily undertaken within industry timeframes and where researchers share with industry an emphasis on applicability, cost-control and sustaining industry competitiveness
- *(Ontario colleges have facilities, expertise and a culture that is already aligned with industry priorities).*

Ontario colleges plan to progressively increase their capacity to undertake applied research and innovation. This includes increasing the amount of applied research undertaken as well as strengthening their internal capacity to manage research programs, including administrative and financial research management, partnership agreements, intellectual property protection, and the commercialization of research outcomes.

However, a range of barriers limits college access to existing federal programs that support research. Many of these barriers are rooted in the criteria for eligibility and the processes of, and participants in, the adjudication processes used.

For example, the majority of granting council research programs are designed with universities in mind, and as a result, research publication records are extremely important; whereas in colleges the research focus is on application. Granting council programs also assume that applicants operate in a university funding context where operating grants support teaching and research activities, and where research funding is needed primarily for the direct costs of research.

Ontario college operating grants do not cover the release time from teaching that college

What is commercialization?

It is the process of taking new products or services from development to market. It generally includes production launch and ramp-up, financing, marketing materials and program development, supply chain development, sales channel development, training development, training, and service and support development.

It includes programs or activities that increase the value or decrease the cost of integrating new products or services into the marketplace.

faculty need to undertake research. This barrier was recognized and addressed in the terms and conditions of funding for the CITO college funding program in 2003 and the Natural Sciences and Engineering Research Council's (NSERC) recently announced *College and Community Innovation Pilot Program* – a program restricted to community colleges, institutes of technology and cégeps. This pilot program provides funding for release time from teaching for college faculty members. This enables college

faculty to allocate time for innovative research programs and projects without reducing the teaching capacity of their college.

The Conference Board of Canada's recent briefing note, *Will We Rise to the Challenge? Eight Mega Issues Facing Canada* (Charles Barrett and Anne Golden, February 2004), observes that Canada's science and technology community has an admirable record of expanding knowledge, but its success in turning scientific advances into products that reach the market is mediocre. It further noted that Canada has a preponderance of small and medium-sized companies that lack the capacity to do effective research and development. The Conference Board recommended that Canadians produce more goods and services that employ new and expanding technologies in order to catch up and keep up with their global competitors. It also warns that worldwide shortages of skilled labour will become more acute after 2010, which places additional importance on the innovative capacity of the workforce. The Conference Board brief concluded that Canada has to nurture an environment that not only encourages research for its own sake, but also leverages creativity, promotes international connections that facilitate global marketing, and builds the new knowledge industries of tomorrow.

Ontario's colleges, even with limited access to research and research infrastructure funding, have already demonstrated that they have the people, the partners and the place to undertake applied research that readily contributes to the competitiveness of small and medium enterprises (SMEs), enhances the performance of the public sector, creates jobs and helps to move new products and services to market in a timely fashion.

The strength of college research is its relevance and applicability to innovation and competitiveness.

2.0 A Strategy to Enhance College Contributions to the Innovation Agenda

It is estimated that 2% of Ontario's 6,388 full time college faculty are currently engaged in research, development and commercialization activities. Roughly 20% of college faculty currently hold research-based master's or doctoral degrees in addition to possessing industry experience relevant to the program in which they teach. Research credentials are increasingly common among newly-hired faculty. Ontario colleges recruit only masters- and PhD-prepared individuals to teach in college baccalaureate degree programs in applied studies. The number of college faculty with research expertise and experience will continue to increase to meet Ontario colleges' needs for advanced teaching and research qualifications.

While education and training will continue to represent the majority of Ontario colleges' mandate, over the next decade, Ontario's colleges envision that, with adequate funding, 10%, or approximately 700, of its full-time faculty will be involved in applied research and development activities at any given time. This projected gradual increase in research and development activities at Ontario colleges by 2010 will enable the college system to more effectively respond to local and regional demands for research and development expertise. It will also provide college students with related applied research and innovation experience, which is essential to the development of an innovative economy.

Canada's colleges are emerging as important players in the country's innovation system. [The new NSERC] pilot program will increase their capacity to work with local industry and businesses and to advance innovation at the community and regional level.

The Honourable Mauril Bélanger NSERC
Press Release
February 12, 2004

To optimize the contribution of colleges to the achievement of national innovation goals, an explicit federal strategy is required to expand the volume of applied research and innovation undertaken by Canadian colleges. Ideally, such a strategy would not reduce the level of existing research funds available to universities, but rather would arise from the identification of new funds for college-only competitions.

Working collaboratively, NSERC and the ACCC have taken some important first steps toward establishing dedicated research funds for college-only funding rounds. The *College and Community Innovation Pilot Program* (2004) provides Canadian colleges with an opportunity to demonstrate their relevance and contribution to product and process

innovations and commercialization for the benefit of local and regional firms. While recognizing the important role that colleges play in the national innovation system, the limited funding afforded to the program (\$3.6 million) means that a maximum of six projects can be supported from among the Canadian colleges that apply.

ACAATO is asking the federal government to work in partnership with colleges over the next five years to expand college access to federal research funds.

Both new and existing funding programs are needed that recognize the limitations of college research overhead support for the direct and indirect costs of research and that create incentives for college-university research collaborations.

To effectively leverage the colleges' capacity for applied research and innovation and their potential contributions to national economic competitiveness, **it is recommended, in priority order, that the federal government:**

1. Establish a new national funding envelope dedicated to college research (excluding major infrastructure) beginning in 2005 and increasing annually to a target value of \$100 million per year by 2010, to support applied research at Canadian colleges undertaken in collaboration with private and public sector partners..⁴ **\$100 million per year represents less than 10%⁵ of the total amount of funds allocated to federal granting councils to support research across Canada in 2003. This dedicated funding for college research would enable colleges to play a more extensive role in performing research linked to the needs of the marketplace and would fill a gap in Canada's innovation "tool-box."**
2. Dedicate "college competition" envelopes within federal granting council and research infrastructure program budgets that take into account the unique funding needs of college researchers, the capacity of colleges to engage in research partnerships with small and medium-sized enterprises (SMEs), and the need for incentives for colleges and universities to undertake collaborative research.
3. Support commercialization at colleges by ensuring that colleges have access to the \$100 million that government announced in the federal budget 2004 for investment over the next five years in improving capacity for commercialization at universities, hospitals and other research facilities.⁶

3.0 College Applied Research and Innovation Contributes to the National Innovation Strategy

In 2001, the Government of Canada issued a national two-part Innovation Strategy.

Part 1: *Achieving Excellence: Investing in People, Knowledge and Opportunity* recognized the need to treat knowledge as a strategic national asset and to focus on ways to strengthen research capacity, as well as to ensure that knowledge contributes to building an innovative economy that benefits all Canadians.

Part 2: *Knowledge Matters: Skills and Learning for Canadians*, recognized that a country's greatest resource in the knowledge society is its people, and focused on strengthening learning, developing talent and creating new opportunities for Canadians to contribute to the economy in the future.

Ontario's colleges have long been recognized for the relevance and quality of their skills development programs in response to industry's needs. College campuses are located in over 200 Ontario communities. Including full-time, part-time and contract training, Ontario colleges serve 500,000 learners per year.

What is less well known, but of equal importance to the achievement of Canada's national innovation strategy goals, are Ontario colleges' contributions in the area of applied research and innovation. Ontario colleges have well-developed and long-term relationships with a wide range of local and regional industries and community groups. In addition, Ontario colleges have experience providing leadership to private-public partnerships (PPP) that support local and regional innovation agendas in a wide range of areas. Brief examples of recent college applied research and innovation partnerships include:

ALTERNATIVE ENERGY:

- Solar Energy - *St. Lawrence College, in partnership with Conserva Engineering, Toronto, ON*

BIOPRODUCTS TECHNOLOGY:

- Bioproducts Applied Research and Innovation – *Lambton College, in partnership with Acrolab Ltd., Windsor, ON; Municipality of Chatham-Kent; Sarnia-Lambton Economic Partnership; Auto21 Network of Centres of Excellence, Windsor, ON; St. Clair College and the University of Windsor, Windsor, ON; University of Western*

Ontario, London, ON; and Ontario Biotechnology Innovation Cluster Program (BCIP)

BIOTECHNOLOGY / BIOPHARMACEUTICALS:

- Enhancing the Purity of Natural Ingredients Extracted from Plants – *Loyalist College, in partnership with Bioniche Life Sciences, Belleville, ON; the University of Ottawa; and the Canadian College of Naturopathic Medicine, Toronto, ON.*
- Respiratory Virus Vaccines – *Seneca College, in partnership with Cangene Corporation, Toronto, ON; Fisher Scientific, Ottawa, ON; Applied Biosystems, Streetsville, ON; and Carsen Group, Markham, ON.*

HEALTH AND LIFE SCIENCES:

- Haptic Surgical Training Tools — *Algonquin College, in partnership with Handshake Interactive Technologies Inc., Kitchener, ON; MPB Technologies, Montreal, PQ; and National Capital Institute of Telecommunications*
- Impact of Urban and Rural Air Quality Variations on Human Health – *Fanshawe College, in partnership with Trudell Medical, London, ON; London Health Sciences Centre; St. Joseph's Health Centre, London, ON; Ontario Ministry of the Environment; and the Delaware Observatory, University of Western Ontario, London, ON*

INFORMATION, COMMUNICATION AND LEARNING TECHNOLOGIES:

- Interactive Digital Television – *Sheridan College, in partnership with E-tv Interactive Technologies, Brampton, ON; Ontario Media Development Corporation; and Pebblehut Productions, Toronto, ON*
- Virtual Reality Technology for Land Use Planning – *Niagara College, in partnership with Delcan Engineering, Toronto, ON; Fusepoint Inc., Mississauga, ON; Iron Fusion, Hamilton, ON; NiteVision 2000, London, ON; Walker Industries, Niagara Falls, ON; City of Burlington; City of Welland; and Parsons Engineering International, USA*
- Technologies to Improve Group Decision-making – *Mohawk College, in partnership with the Industry-Education Council of Hamilton-Wentworth; Stelco, Hamilton, ON; Sheridan College, Oakville, ON; and GroupSystems, Tucson, AZ*
- Wireless Tracking for Long-Term Care Patients, Staff and Equipment – *Fleming College, in partnership with WIMCare, Toronto, ON*
- Wireless Internet Access Strategies for Rural and Remote Communities – *Algonquin College, in partnership with the Canadian International Development Agency*

(CIDA); Industry Canada; National Capital Institute of Telecommunications; and Network Planning Systems Inc., Ottawa, ON

- *Wireless File Sharing Systems – St. Lawrence College, in partnership with Kingston Software Factory, Kingston, ON*
- *Internet-based Curricula for Secondary School Teacher In-service Education – Seneca College, in partnership with York University, IBM Canada, and TV Ontario*

SUSTAINABLE DEVELOPMENT / ENVIRONMENTAL PROTECTION:

- *Alternative Wastewater Treatment – Fleming College, in partnership with SGS/ Lakefield Research, Lakefield, ON; Siemens/Milltronics, Peterborough, ON; Varian Canada Inc., Mississauga, ON, and the Kawartha Innovation Centre, Lindsay, ON.*

Details related to the examples summarized above are provided in Appendix A.

With campuses in 200 Ontario communities, touching 500,000 learners annually, Ontario colleges provide a strategic link between applied research and the marketplace that can help Canadian SMEs remain at the forefront of innovation.

Ontario colleges are ideally positioned to expand their leadership role in community-based innovation and development by building on existing facilities, state-of-the-art equipment, partnerships and best practices that have been developed through community-based skills development, training, and applied research and innovation initiatives. Yet, colleges and their SME partners find it difficult to fund the volume of applied research needed by such companies to stay at the frontier of innovation in their sectors. Enhanced access to federal research funds would increase the volume and scope of research that colleges can undertake. *However, the general funding policies and adjudication practices within the federal research funding programs currently limit college access to federal research and research infrastructure funds.*

While Ontario colleges have an applied research mandate, the provincial operating grant funds only teaching. University operating grants cover both the teaching and research activities of faculty. Existing funding processes of the federal research granting councils were developed with universities in mind. Consequently, the need of college faculty for teaching release time typically goes unrecognized in the funding eligibility rules of federal

programs. In the case of federal research funding criteria, one size does not fit all. Eligible objects of expenditure within existing federal research funding programs should take into account the colleges' need for faculty release time from teaching and include teaching release support as an eligible expenditure for proposals from college researchers.

Finally, expanding the membership of federal research granting council adjudication committees by adding college faculty members and typical SME "users" of college research results would help to increase the awareness among peer review committees of the context in which college research is undertaken, and the potential significance of the impact of college research proposals.

To facilitate college access to existing Federal research funds, it is recommended that research funding agencies adapt their funding criteria for college applicants so as to:

- a) ensure adjudicators consider the unique context of college research proposals and the unique strengths and experiences of college research faculty;
- b) take into account the potential for college research impact (commercialization, innovation);
- c) provide funding for college faculty release time from teaching; and
- d) involve college faculty and representatives of SMEs in the peer review and/or selection committee processes.

The changes to the research granting council adjudication process would substantially increase the opportunity for college research proposals to compete successfully for federal research funds and help Canada to become one of the most research intensive countries in the world.

The Ontario college system is currently an underutilized resource within the national innovation strategy. Colleges can contribute more to the achievement of national innovation goals with enhanced access to federal research funds.

4.0 The Value and Impact of College Research

In March 2004, a broad agenda for “a Canada of success” was outlined by the government that included:

- supporting learning by providing young Canadians with tools to succeed, while encouraging lifelong learning for all; and
- supporting innovative Canadian industries and enhanced productivity.

Ontario colleges are key partners with federal and provincial governments in achieving this vision for Canada’s success. Ontario colleges continuously adapt their programs, services and activities to provide young Canadians with the skills and training that enable them to immediately add value to Canada’s SMEs. In this way, Ontario colleges ensure local and regional industries remain innovative and prosperous within the fiercely competitive global economy.

Colleges have emerged as strategically important partners for SMEs that need applied research to sustain productivity through innovation. Of particular relevance to companies for which applied research and innovation is essential to their economic survival, are colleges’ specialized research facilities, product development expertise and ability to deliver applied research results that are timely and readily commercializable. Ontario colleges work closely with SMEs to develop, prototype, test and produce new goods and services in fields ranging from sustainable development to virtual reality technology. See **Appendix A** for examples of the **outcomes and impacts** of research undertaken at Ontario colleges.

Commercialization is important to realizing the benefits of our investment in research because it opens new markets, helps create new jobs and improves the well-being of Canadians through better products and services. Moreover, by stimulating wealth creation and economic growth, commercialization helps provide additional resources that can be used to finance other important priorities. However, there is evidence that Canada is not doing as well as other nations in bringing new research discoveries to the market, preventing us from capitalizing fully on our research investment. Improving our commercialization performance must therefore become a priority.

Federal Budget 2004, Budget Plan
Commercialization of Research

Given widespread recognition that research and innovation are crucial to Canada’s long-term economic prosperity, enhanced funding opportunities for colleges to increase their capacity to undertake research in partnership with Canadian SMEs directly contributes to the achievement of Canada’s national prosperity goals.

If a greater proportion of new and/or existing federal research funding were devoted to funding programs supporting college research, colleges would rapidly expand their existing research capacity and more effectively bridge the gap between knowledge and its application to meet the needs of Canada's SMEs.

Ontario colleges, their corporate partners and the local business and community leaders represented by the 1,000 college program advisory committees, are calling on federal decision-makers to increase the number and value of research funding programs that support and expand college research activities relevant to the innovation agenda.

5.0 College Applied Research and Innovation Enhances the Development of HQP⁷ /Human Resources

Ontario colleges' primary focus has been and will remain education and training linked to the needs of industry. However, as the needs of industry evolve, business leaders are looking to colleges to prepare more graduates adept in technology adoption and the application of knowledge to the development of new products, processes and services. Employers demand more graduates who can rapidly integrate into the workforce and who have studied technologies, worked on state-of-the-art equipment, and can maintain corporate competitiveness through innovation.

In response to SMEs' demands for the "upskilling" of college graduates to include applied research and innovation experience, colleges have enhanced their training and learning programs by involving students as applied research and innovation trainees wherever possible. This better prepares graduates to meet the needs of employers when they join the workforce. By virtue of the fact that college applied research is typically conducted by teams, students also obtain valuable experience in teamwork, which is highly valued in the workplace.

The involvement of college faculty in research partnerships with industry also enhances their knowledge and skills. Faculty, in turn, introduce advanced learning opportunities into the classroom.

College graduates with applied research and innovation experience are currently being produced in small numbers. With additional funding opportunities to support college-based

Improving Canada's Innovative Performance Requires:

- *More creators*
- *More entrepreneurs and financial risk takers willing to invest*
- *Managers skilful at managing the innovation process*
- *A workforce that can better adapt to change, work in diverse teams, implement new or improved processes, and produce new or improved products or services.*

The Conference Board of Canada, 2002

Who "innovates"?

- *Individuals*
- *Work Groups; Project Teams*
- *Organizations*
- *Clusters; Sectors; Partnerships*
- *Provinces; Countries*

Conference Board of Canada, 2004

research activities, Ontario colleges have the capacity to play a much greater role in preparing the next generation of:

- Proto-type developers;
- Technical experts;
- New product developers;
- Commercializers; and
- Entrepreneurs.

The demand from SMEs for college graduates possessing research-related innovation skills continues to increase. By increasing the number of students exposed to applied research and innovation in the context of a college education, colleges can expand their capacity to provide young Canadians with experience in developing new ideas, translating them into marketable products and services, and realizing commercial potential for economic benefit to Canada.

6.0 College Applied Research and Innovation Complements University R&D

Canadian universities, government and private industry undertake most of Canada's long-term programs of research involving exploration and discovery to learn things "that are not currently known." These activities consume wealth, involve high levels of scientific risk, and generate a continuous flow of future research opportunities.

Universities play a major role in performing curiosity-driven research that tests and extends the boundaries of what is known. University research results are typically published and consumed in the international "marketplace" of ideas. Universities also produce highly-educated knowledge workers who are prepared for research and innovation careers, some of whom will become the next generation of university faculty, engaging in teaching, discovery research and publication. "Receptor capacity" outside of academe for university research is sometimes a challenge because the applications for discoveries have yet to be identified. As noted by the Conference Board of Canada, there is an inadequate demand from industry leaders in Canada for the "building blocks of innovation" to take new ideas and turn them into new products and services that generate real economic activity.⁸

Development, on the other hand, is an activity that leads to innovations and wealth creation through the sales of new goods or services. It often requires basic and applied research to solve problems that cannot be solved with existing knowledge.

Innovation is the link between research and economic activity. It is the application of knowledge to the development of new products, processes and services. Innovations in many products and services on the market are incremental and involve more development

College research is typically undertaken for or with "research receptors" and serves to train the next generation of entrepreneurs and innovators to meet the future applied research and innovation needs of industry.

than research. Innovations based on new research results tend to be radical and create entirely new products and markets.

Colleges bring a unique set of strengths and opportunities to bear in the context of research, innovation and commercialization

that complement the research functions of universities. Ontario's colleges undertake both applied research and innovation, and do so usually in collaboration with the SMEs located within their local community or region. Colleges enjoy strong reputations with

industry as local and regional “centres of expertise” responsive to the business development needs of the community.

In the same way that universities primarily undertake research and development at the

The colleges are well positioned to enhance innovation and economic revitalization within the communities where they are located and to play a critical role in building an innovative productive economy.

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Announcement

Natural Sciences and Engineering Research Council
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frontiers of knowledge, colleges primarily undertake research and development-related activities with innovation as their goal by creating and applying new knowledge in novel ways. By partnering with colleges, SMEs address challenges requiring applied research and development rapidly and efficiently. SMEs and the economy, reap an immediate benefit.

Both colleges and universities are strategic instruments of achieving Canada’s innovation goals. Both contribute to the achievement of the national innovation strategy. Both need to ensure that the learning experiences they offer explicitly link creative processes and novel learning experiences. In preparing their graduates, both encourage and support teamwork, and workplace and community collaboration.

Like university research, college applied research and innovation activities are responsive to societal needs. However, unlike universities, colleges rarely publish their research results in academic journals. College applied research and innovation results are disseminated primarily through reports to program advisory committees and at regional, national and international conferences, in trade journals, on college web-sites and in college publications.

College research results are deemed successful if they are rapidly put to use in a partner organization or an industry sector. Typically, college research results are readily incorporated into new products, services or spin-off companies because “receptor capacity” for the research outcomes is built into the research partnership from the outset.⁹ Tight private sector linkages, and the SME community’s appreciation of the colleges’ commercialization record, applied research expertise and emphasis on the development aspect of applied research and innovation, often make colleges the research partner of choice for SMEs.

With additional funding for applied research, colleges will be able to do more to address the innovation gap by inventing new solutions to real problems and transforming new ideas and information into commercializable products and services.

Colleges place priority on value, application and impact of their research results to business and industry.

7.0 College Applied Research and Innovation: A Sound Investment Strategy

Canada's small and medium-sized businesses remain key engines of Canadian growth by taking risks, seizing opportunities, creating jobs.¹⁰ A range of federal programs are attempting to buttress Canada's existing efforts to bring research discoveries to the marketplace through the process of commercialization because commercialization of knowledge has the potential to open new markets, create new jobs and improve the well being of Canadians through new and better products and services.

Yet, an "innovation and commercialization gap" persists between new knowledge arising from Canada's research efforts and the needs of the market. Colleges and universities are both important sources of research because the innovation and commercialization gap in Canada is so large. Colleges, which are currently underutilized resources for applied research and innovation, are poised to increase their contribution to the translation of knowledge into commercializable products and services.

"Canada is developing an environment in which ideas flowing from scientific discovery are being generated at an unprecedented rate. Now we must focus on bringing these ideas to market; to realizing their commercial potential. That is what will drive our economy forward, increasing investment and employment."

Federal Budget 2004

Investments in college applied research and innovation are an important component of a national strategy to achieve Canada's innovation targets due to Ontario colleges':

- Connections to industry;
- Regional proximity to industry clusters;
- Unique value-added in the research "market-place";
- Experience in applying new knowledge to solve industry problems and achieve industry goals;
- Array of faculty and expertise related to programs in a range of fields and at a variety of levels: diplomas, bachelor's degrees in applied studies and joint diploma-degree programs;
- Capacity to move industry rapidly through the early stages of product development and commercialization;

- State-of-the-art facilities, equipment and space to support the development of new products and applications; and their
- Sustained commitment to a culture of innovation.

Ontario colleges have the place, the space, the people and the partnerships that allow innovation to flourish.

8.0 Conclusions

If the federal government's focus on knowledge and innovation is to be in the 21st century what the construction of the transcontinental railway was in the 19th century — a “new National Dream” — then the dream should include all institutions of higher education and learning that are capable of and willing to contribute.

Since balancing the budget in 1997-98, the Government of Canada has vigorously pursued new funding strategies to bolster research and innovation. Funding dedicated to research and innovation has increased each year since that time — a cumulative increase of \$13 billion to 2004-05. However, the innovation and commercialization gaps targeted by the national innovation strategy in 2001 have yet to be adequately addressed.

Colleges have a long and accomplished history of working in partnership with small and medium-sized enterprises in the areas of skills development, training and innovation. SMEs constitute the economic backbone of the nation's economy and keep our communities and our nation economically innovative and prosperous. Colleges work hand in hand with these companies on a regular basis, ensuring that they retain their competitive edge in the global economy. Yet, colleges all across Canada face challenges related to accessing federal research funding. Targeted investments in college-based applied research and innovation would provide the Government of Canada with a significant opportunity to reach directly into local and regional communities to promote the development of applied research and innovation-based products and services that rapidly impact the economy.

In response to global competition, the education and training needs of industry have permanently shifted to include college graduates with exposure to applied research and innovation teams because it is central to their corporate survival. As underlined by ACCC in recent communications to the federal government, a partnership between the Government of Canada and colleges that ensures the impediments to college-based applied research and innovation are removed from federal research, innovation and commercialization programs is urgently needed if our national goals for economic growth are to be achieved.¹¹

Ontario colleges, through ACAATO, ACCC and ACPPI, are committed to working in partnership with the federal government to enable colleges to optimize their contribution to making Canada's economy among the strongest in the world. Enhanced access to federal research funding is central to ensuring that the public's investment in colleges can

be leveraged for the benefit of the Canadian economy.

Canada's realization of its goal of being the fifth most research intensive jurisdiction in the world will require increased research activity from colleges as well as from the private, public, and university sectors. More effectively utilizing colleges' applied research and innovation capacity will further Canada's goals of closing the commercialization gap, spurring innovation, enhancing productivity and stimulating economic growth.

Endnotes

- 1 Ontario colleges' anticipated needs by 2010 represent approximately 35% of the total national fund proposed. The types of applied research envisioned for support range from short-term projects to multi-year, multi-institutional "mega-projects."
- 2 \$100 million currently represents approximately 7% of the \$1,410,000,000ⁱ in federal tri-council funding, 2003. (ⁱ Source: Federal Budget 2004.)
- 3 Budget Plan, 2004, Chapter 4, The Importance of Knowledge and Commercialization, *Highlights*. <http://www.fin.gc.ca/budget04/bp/bpc4ce.htm#commercialization>
- 4 Ontario colleges' anticipated needs by 2010 represent approximately 35% of the total national fund proposed. The types of applied research envisioned for support range from short-term projects to multi-year, multi-institutional "mega-projects."
- 5 \$100 million currently represents approximately 7% of the \$1,410,000,000ⁱ in federal tri-council funding, 2003. (ⁱ Source: Federal Budget 2004.)
- 6 Budget Plan, 2004, Chapter 4, The Importance of Knowledge and Commercialization, *Highlights*. <http://www.fin.gc.ca/budget04/bp/bpc4ce.htm#commercialization>
- 7 HQP = Highly Qualified Personnel
- 8 Conference Board of Canada, *Solving Canada's Innovation Conundrum: How Public Education Can Help*, July 2003, citing Roger L. Martin, *The Demand for Innovation in Canada*, Toronto: Rotman School of Management, University of Toronto, August 12, 2002, p. 2.
- 9 Colleges typically enter into IP ownership agreements where industry partners, funding partners and the college have equal opportunity to exploit the IP arising from jointly conducted research, and where licensing fees are also shared among the three parties.
- 10 Federal Budget, 2004. In June 2002, The Honourable Pierre Pettigrew, C.I.T.P., and Minister of International Trade, in a presentation to the Forum for International Trade Training (FITT) conference in Ottawa, underscored the importance of small and medium sized enterprises (SME) to Canada's current and future prosperity, stating "In 2001, SMEs were responsible for 43% of Canada's GDP and every \$1 billion in exports was associated with 10,000 jobs in Canada." See: <http://www.fitt.ca/english/News&Events/Pettigrew%2006-02.pdf>
- 11 Letter from Mr. Gerald Brown, President, ACCC to The Honourable Ralph Goodale, Minister of Finance, March 29, 2004, pp. 1-2.

Appendix A:

**Examples of Ontario College Applied Research and
Innovation Outcomes and Impacts**

Appendix A: Examples of Ontario College Applied Research and Innovation Outcomes and Impacts

Project	College	Partners / Total Contributions (Cash and In-kind)	Outcomes	Impacts/Sector
ALTERNATIVE ENERGY				
Solar Energy Research Applied research and innovation to improve the energy efficiency of photovoltaic panels by pairing them with solar wall panel-generated cooling systems.	St. Lawrence College, Kingston, ON	Conserval Engineering, Toronto, ON - \$8,000 St. Lawrence College - \$10,000	<ul style="list-style-type: none"> • Improved efficiency and performance of photovoltaic panels by creating optimum conditions for photovoltaic panel energy generation by combining this technology with solar wall panels which provide cooling necessary for photovoltaic panel peak performance. • Invention of photovoltaic panel mounting system compatible with solar wall panelling. • Design and development of temperature sensor conditioning circuitry. 	Alternative Energy /Energy Conservation / Manufacturing – Product Development / Building and Construction / Environmental Protection: <ul style="list-style-type: none"> • Temperature profiles created from the research are linked to performance of the solar wall. This data will inform future product development. • Laboratory facilities now exist at the College capable of evaluating solar energy technology performance around the clock, on a minute-by-minute basis. Performance data can be linked to weather system information, providing valuable feedback for further product development. • Generation of additional research projects building upon the findings of this project, including partnerships with Conserval (solar wall) and Spheral Solar Power (solar electricity cell manufacturer) for research on photovoltaic roof shingles; and with Direct Energy for research on hot-water heaters toward the development of new applications for solar energy technology. HQP: <ul style="list-style-type: none"> • Students in the Engineering Technologist and Technician programs were directly involved in research and development activities related to this project. • Research findings and processes were directly linked to curricula.

Project	College	Partners / Total Contributions (Cash and In-kind)	Outcomes	Impacts/Sector
BIOPRODUCTS TECHNOLOGY				
<p>Transforming Agriculturally Based Commodities into Environmentally Friendly and Cost-competitive Bio-products and Bio-materials</p> <p>The Southwestern Ontario Bioproducts Innovation Network (SOBIN) focuses on research that will:</p> <ul style="list-style-type: none"> • accelerate natural and agricultural resources innovations • build new markets for bio-products and bio-materials <p>SOBIN goals include: Strengthening the region's agricultural cluster</p> <p>Enhancing the region's chemical industry cluster</p> <p>Advancing the region's automotive cluster</p> <p>Building an emerging bio-products cluster</p> <p>Improving the sustainability of regional economic development</p>	<p>Lambton College, Sarnia, ON</p>	<p>Acrolab Limited, Windsor, ON</p> <p>Municipality of Chatham-Kent</p> <p>Sarnia-Lambton Economic Partnership</p> <p>Auto 21 Network of Centres of Excellence, Windsor, ON</p> <p>University of Windsor, Windsor, ON</p> <p>St. Clair College, Windsor, ON</p> <p>University of Western Ontario, London, ON</p> <p>Ridgetown College – University of Guelph, Ridgetown, ON</p> <p>(Associated with the Ontario Biotechnology Innovation Cluster program (BCIP)) - \$200,000</p>	<ul style="list-style-type: none"> • This applied research and innovation Network is currently in start-up phase. <p>The Network will:</p> <ul style="list-style-type: none"> • accelerate innovation by assembling research teams composed of college, university and industry researchers • proto-type, test and evaluate new bio-products and their applicability to industrial markets • foster adoption of new bio-products in the energy, chemical and materials sectors • identify and collaborate with partners from across Ontario - including distinctive feedstock sources of bio-diesel and users of cellulose-based materials • screen and assemble biomass, process and test bio-products, and • develop new engineering applications of bio-fuels and materials to expand economic activity in the region and nationally 	<p>Network will create collaborative opportunities for the Agriculture, Chemicals/Plastics, and Automotive sectors that will:</p> <ul style="list-style-type: none"> • Enhance the use of natural and agricultural resources in existing manufacturing and processing sectors • Revitalize the agricultural sector of the economy • Strengthen existing bio-product firms' ability to bring products to markets • Create new bio-products business opportunities • Assist with financing and marketing of product development and distribution strategies • Attract related new industries to the region • Reduce dependence on hydrocarbon based energy sources

Project	College	Partners / Total Contributions (Cash and In-kind)	Outcomes	Impacts/Sector
BIOTECHNOLOGY / BIOPHARMACEUTICALS:				
<p>Enhancing the Purity of Natural Ingredients Extracted from Plants for use in Health Products</p> <p>Applied bioscience research using state-of-the-art supercritical carbon dioxide extraction technologies to increase the purity of active ingredients selectively extracted from plants for use in natural source health products.</p>	Loyalist College, Bellville, ON	<p>OIT - \$184,000</p> <p>Bioniche Life Sciences, Inc., Bellville ON - \$92,000</p> <p>Loyalist College - \$184,000</p> <p>University of Ottawa – in-kind</p> <p>Canadian College of Naturopathic Medicine, Toronto, ON – in-kind</p>	<ul style="list-style-type: none"> A specialized research facility has been constructed at Loyalist College, equipped with Supercritical Carbon Dioxide (CO₂) Extractors, to support a wide ranging applied research program related to plant ingredient extraction, purification, and process optimization. Supercritical CO₂ technology will be used to extract active ingredients from plants including, but not limited to Evening Primrose and Palmetto, with the goal of reducing significantly the amount of toxins and residues common in current petrochemical-based extraction processes. Research partnerships have been developed with the University of Ottawa. A clinical trials partnership is in place with the Canadian College of Naturopathic Medicine. Findings with potential for patent protection and commercialization will be exploited in collaboration with a range of commercial research partners. <p>This research is in start-up phase.</p>	<p>Consumer Protection:</p> <ul style="list-style-type: none"> Applied research using supercritical CO₂ extraction technologies to select and remove specific ingredients from plants has the potential to make natural source-based health products, including topical medications and vitamins, more standardized, safe, and effective. <p>Biotechnology and Pharmaceutical Processing and Production:</p> <ul style="list-style-type: none"> This program of applied research will contribute to the optimization of processes by which specific ingredients are extracted from plants. New natural source health products are expected to arise which will strengthen the competitiveness of Ontario's natural health care and personal products companies. <p>Agriculture:</p> <ul style="list-style-type: none"> Increased demand for the sources of botanical extracts has the potential to increase demand for new and existing agricultural products grown in Ontario. <p>HQP:</p> <ul style="list-style-type: none"> Students enrolled in the School of Applied Science and Computing, Biosciences Cluster programs at Loyalist College will be directly involved in the applied research process during their final year of study, providing them with hands-on applied research experience valuable to a range of local and regional health product manufacturers.

Project	College	Partners / Total Contributions (Cash and In-kind)	Outcomes	Impacts/Sector
<p>Combating Respiratory Viruses</p> <p>The Biotechnology Centre for Applied Research and Training enables Seneca Faculty to undertake genomics, proteomics, bioinformatics and microbiology research.</p> <p>Among the several collaborative activities with research laboratories from universities and biotech companies that are currently underway, research in the area of combating existing and emerging respiratory viruses offers hope for greater control of infectious pathogens such as the human metapneumovirus (hMPV) which is responsible for 10% of all respiratory diseases.</p>	<p>Seneca College, Toronto, ON</p>	<p><u>EXISTING FUNDING:</u> Instrument Manufacturers - \$800,000</p> <ul style="list-style-type: none"> • Agilent Technologies, Toronto, ON • Silicon Graphics, Inc., Mountain View, CA, USA • Beckman Coulter, Fullerton, CA, USA <p>CFI - \$600,000</p> <p>OIT - \$600,000</p> <p>Research Team Collaborators:</p> <ul style="list-style-type: none"> • University of Toronto • St. Michael's Hospital • York University <p><u>FUNDING REQUESTED / APPROVAL PENDING:</u></p> <ul style="list-style-type: none"> • Cangene Corporation, Mississauga, ON - \$150,000 • Seneca College - \$1,650,000 (operations); \$152,800 (infrastructure) <p>Instrument Manufacturers - \$214,000</p> <ul style="list-style-type: none"> • Fischer Scientific, 	<ul style="list-style-type: none"> • The goal of this research project is to develop prophylactic, diagnostic and therapeutic vaccines to protect populations from the Human metapneumovirus (hMPV), which is responsible for 10% of all respiratory diseases. • The Human metapneumovirus is a respiratory viral pathogen that causes a spectrum of illnesses, ranging from asymptomatic infection to severe pneumonia. • This research would protect the very young and the elderly, who are hardest hit by the metapneumovirus. <p>This research is in start-up phase.</p>	<p>Biotechnology / biopharmaceuticals:</p> <ul style="list-style-type: none"> • Development of effective prevention, treatment and control of metapneumovirus, which is currently untreatable, would reduce morbidity and ease the burden on the health care system. <p>HQP:</p> <ul style="list-style-type: none"> • Seneca is an important training centre for technologists requiring modern microbiology techniques critical to the workforce of diagnostic labs in hospitals and the private sector. • Co-op students receive hands-on training on state-of-the-art research instruments and research methodologies. • Faculty provide emergency pathogen search capacity for the Province.

Project	College	Partners / Total Contributions (Cash and In-kind)	Outcomes	Impacts/Sector
		<p>Ottawa, ON</p> <ul style="list-style-type: none"> • Carsen Group, Markham, ON • Applied Biosystems, Streetsville, ON <p>OIT – \$344,000</p> <p>Research Team Collaborators:</p> <ul style="list-style-type: none"> • University of Toronto & The Hospital for Sick Children Toronto, ON • St. Michael's Hospital, Toronto, ON • Baylor College of Medicine, Texas, USA • Human Genome Sciences Inc. (Rockland, Maryland, USA) 		

Project	College	Partners / Total Contributions (Cash and In-kind)	Outcomes	Impacts/Sector
HEALTH AND LIFE SCIENCES:				
<p>Surgical Teaching Tools that allow “Touch and Feel” Sharing over the Internet</p> <p>Applied research and development to create networked, simulated surgical environments using haptics and 3-D stereographic technologies that simulate the look, touch, and feel of real surgical intervention, and allow learners to experience the real-time sensations resulting from an instructor's demonstration of surgical interventions where learners and instructors are in different locations.</p>	<p>Algonquin College, Ottawa, ON</p>	<p>Handshake Interactive Technologies Inc., Kitchener, ON - \$180,000</p> <p>MPB Technologies, Montreal, PQ</p> <p>National Capital Institute of Telecommunications (NCIT) / Ontario Research and Development Challenge Fund (ORDCF) - \$100,000 (capacity building)</p> <p>CITO - \$162,000</p> <p>Algonquin College – 50,000</p> <p>Carleton University - Department of Systems and Computer Engineering and Canada Research Chair in Interactive Network Computing and Teleoperation</p>	<ul style="list-style-type: none"> Research, development and design of a haptic surgical simulation training workstation prototype where the Internet shares haptic feedback that allows one surgeon's movements to be felt by the teacher leading the learner or vice versa in a remote location. A new application was created that allowed workstations connected via the Internet to simultaneously share surgical movements and pressure over the Internet. Algorithms that reduce and manage time delays over networks were improved upon. Resulting IP is being licensed to the commercial partner, Handshake Technologies, for further development. 	<p>Information and Communication and Technology Sector (ICT)</p> <ul style="list-style-type: none"> The haptic virtual reality surgery simulation training workstation application will be further developed by industry with a goal to commercialize new products for the medical education and training market. <p>Medical Education and Professional Development</p> <ul style="list-style-type: none"> Teaching hospitals can deliver remote surgical training and education to surgeons via telementoring, keeping surgeons on-site at local hospitals. Surgeons separated by distance can work together in a teaching environment to learn new surgical procedures and changes to existing procedures. Applications for dental training are being explored. <p>Military / Defense:</p> <ul style="list-style-type: none"> Internet-mediated haptics technology has potential applications to weaponry training. <p>Mining:</p> <ul style="list-style-type: none"> Applications to training in the use of mining equipment are being explored. <p>HQP:</p> <ul style="list-style-type: none"> Students in the Photonics Engineering, Mechanical Engineering and Computer Science programs collaborated on this research project. A number of these students were subsequently hired by industry in fields directly related to this project.

Project	College	Partners / Total Contributions (Cash and In-kind)	Outcomes	Impacts/Sector
<p>Impact of Urban and Rural Air Quality Variations on Human Health</p> <p>Studying the correlation between air quality as defined by short-term variations in ozone and particulate matter, and distress in patients with upper respiratory disorders and Chronic Obstructive Pulmonary Disease (COPD).</p>	<p>Fanshawe College, London, ON</p>	<p>Highbury Air Quality Monitoring Station, Ontario Ministry of the Environment, Southwestern Ontario Regional Office, London, ON</p> <p>London Health Sciences Centre, London, ON</p> <p>St. Joseph's Health Centre, London, ON</p> <p>Delaware Observatory, University of Western Ontario, London, ON</p> <p>Trudell Medical International, London, ON</p> <p>EJLB Foundation, Montreal, Q.C.</p> <p>TD Friends of the Environment, London, ON</p> <p>Lehder Environmental Services, Point Edward, ON</p> <p>C.D. Nova, Markham, ON</p> <p>Avensys Inc., Mississauga, ON</p> <p>CRESTech - \$140,000</p> <p>CFI - \$240,000 OIT - \$240,000 Fanshawe - \$24,000</p>	<ul style="list-style-type: none"> • Unique database of round-the-clock, minute-by-minute ozone levels in the region. • Unique database of round the clock, minute-by-minute particulate matter levels by size. • Survey results documenting peak distress periods of COPD patients. • Analysis is ongoing of the relationships between COPD patient stress/distress and short-term variations in the level of ozone and particulates in the regional atmosphere. 	<p>Health Status and Quality of Life:</p> <ul style="list-style-type: none"> • Research findings will assist Respiriologists in the London Regional Chronic Obstructive Lung Disease Program to better predict and manage peak periods of patient distress possibly triggered by spikes in ozone and particulate matter levels. • Research findings will assist in the development of new compounds for use in aspirators that help patients manage through peak periods of respiratory distress. <p>Environmental Protection / Improved Air Quality Management:</p> <ul style="list-style-type: none"> • Research findings have the potential to help improve air quality monitoring in Southwestern Ontario, which suffers from some of the poorest air quality in Ontario due to transboundary migration of pollutants emitted throughout the Ohio Valley as well as Southwestern Ontario. • State-of-the-art technology able to monitor and identify particulate matter will enable researchers to track down sources of unacceptable emissions and facilitate air quality enforcement and compliance, thereby improving the quality of life for all citizens. <p>HQP:</p> <ul style="list-style-type: none"> • Seven students from the Environmental Technology and Science Laboratory Technology programs were involved with this project for periods of between four and eight months each. • Students developed expertise in

Project	College	Partners / Total Contributions (Cash and In-kind)	Outcomes	Impacts/Sector
				<p>calibrating and operating state-of-the-art instrumentation; developed presentations; collected, organized and analyzed data from equipment; and conducted face-to-face surveys with COPD patients, developed in collaboration with respirologists.</p> <ul style="list-style-type: none"> All Environmental Technology and Science Laboratory Technology students are exposed to research methods, process and outcomes.

Project	College	Partners / Total Contributions (Cash and In-kind)	Outcomes	Impacts/Sector
INFORMATION, COMMUNICATION AND LEARNING TECHNOLOGIES				
Real Time Interactive “Live-to-Air” Digital Television Research on the development and delivery of real-time interactive “live-to-air” animated game content compatible with the technological and commercial constraints of digital broadcast television.	Sheridan College, Oakville, ON	E-tv Interactive Technologies, Brampton, ON - \$125,000 Ontario Media Development Corporation - \$70,000 Pebblehut Productions, Toronto, ON – in-kind consulting CITO - \$250,000	<ul style="list-style-type: none"> • A prototype real-time interactive “live-to-air” animated game compatible with the technological and commercial constraints of digital broadcast television. • Documentation of the technological viability of the system developed. • A spin-off company has been created and additional funding of over \$200,000 has been secured to bring the technology to the digital cable television market. • Ongoing collaborative research relationships developed with a software development lab in Japan, the Psychology Department at Queen’s University in the field of communications, and with E-tv Interactive Technologies. • Linkages with university researchers at Toronto and Guelph universities. 	Information and Communication Technologies (ICTs): <ul style="list-style-type: none"> • Digital cable television company E-tv working with the research team to bring the new product to market. • This innovation spawns a new industry and related jobs in content creation (game concepts, artwork and animation), technology development, training, support and service and software development. • Makes Ontario and Canada more competitive with animated television produced in the Far East. Entertainment Industry: <ul style="list-style-type: none"> • This unique technology has the potential to revolutionize digital cable TV by enabling real-time interaction of participants from their home. Education: <ul style="list-style-type: none"> • Educational opportunities for interactive learning remain to be exploited. HQP: <ul style="list-style-type: none"> • All 12 employees began as students or staff at Sheridan College.

Project	College	Partners / Total Contributions (Cash and In-kind)	Outcomes	Impacts/Sector
<p>Virtual Reality Technologies to Communicate Land Use Planning and Development Options</p> <p>The Niagara Centre for Advanced Visualization undertakes research to develop and improve virtual reality technology applied to land use planning modelling and scenario development in interactive, real-time 3-D.</p> <p>The objective of this research is to create 3-D virtual reality models of complex land use planning and development options that illustrate the implications of different choices in order to facilitate decision-making.</p>	<p>Niagara College, Niagara-on-the-Lake, ON</p>	<p>Delcan Engineering, Toronto, ON Fusepoint Inc., Mississauga, ON Iron Fusion Inc., Hamilton, ON Matrix Engineering, Florida, USA NiteVision 2000, London, ON Parsons Engineering International, USA Synetics, South Africa Walker Industries, <u>Niagara Falls, ON</u> <i>Total Private: \$1.1M</i></p> <p>City of Burlington, ON City of Welland, ON</p> <p>Algonquin College, Ottawa, ON Mohawk College, Hamilton, ON</p> <p>University of Buffalo, Buffalo, N.Y. McMaster University, Hamilton, ON Lakehead University, Thunder Bay, ON Queen's University, Kingston, ON University of Toronto, <u>Toronto, ON</u> <i>Total Other Partner Contributions: \$356,000</i></p> <p>CFI/OIT - \$1.6 M CITO - \$99,935</p>	<ul style="list-style-type: none"> Transforming existing 3-D IP into new and innovative products. Increased realism in 3-D visualization. Ability to create detailed visualizations of development areas and “virtual 3-D helicopter” tours of development sites. Web-based 3-D model delivery database for use in face-to-face public consultation and review meetings and/or in an on-line “net-meeting” context. Software Modularization to adapt large 3-D program files for use in laptop PC-based presentations. Completion of over 30 highly detailed models used by planners, engineers and municipalities, including: <ul style="list-style-type: none"> Peace Bridge Expansion, Can/USA Spencer Smith Park, Burlington Digital Welland, Welland Columbia Turnpike, USA Enhanced technology transfer and uptake to industry through collaborative research partnerships. <p>New teaching tools related to manufacturing processes, engineering and medical education, design, nano-ceramics, photonics.</p>	<p>Information and Communication Technologies:</p> <ul style="list-style-type: none"> Positioning Ontario and Canada at the forefront of 3-D visualization innovation. Better, faster and more cost-effective decision-making for land use planners and developers. Easy adoption of “Smart Growth” strategies for land use planning and development. <p>Engineering, Architecture and Land Use Planning:</p> <ul style="list-style-type: none"> More efficient and effective project planning and execution. Increased adoption of 3-D technology by engineering, architecture and land use planning firms. <p>HQP:</p> <ul style="list-style-type: none"> Students hired to work on projects are in high demand from companies around the world.

Project	College	Partners / Total Contributions (Cash and In-kind)	Outcomes	Impacts/Sector
<p>Technologies to Improve Group Decision-Making</p> <p>At the Mohawk College Procor Decision Support Centre, electronically facilitated meetings and brainstorming sessions are studied to identify the conditions where such technology provides a significant opportunity to improve the efficiency and effectiveness of group decision-making processes, as well as to develop training strategies for electronic meeting facilitators.</p>	<p>Mohawk College, Hamilton, ON</p>	<p>Mohawk College and Partners: \$368,117</p> <ul style="list-style-type: none"> • Industry-Education Council of Hamilton-Wentworth, Hamilton, ON • Stelco, Hamilton, ON • Sheridan College, Oakville, ON <p>OIT - \$112,345</p> <p>GroupSystems, Tuscon, Arizona, USA - \$88,275</p> <p>Bell Canada Community Development Fund - \$21,000</p>	<ul style="list-style-type: none"> • New strategies to enhance group decision-making processes using information and communication technologies (ICTs) in corporate, non-profit and governmental organizations. • Capacity building strategies for facilitators of group decision-making in educational, corporate and non-profit communities. • Ongoing partnerships in future research related to “repeatable processes” and sustainability of the use of technology in group decision-making. 	<p>Across Sectors (Business, Government and Community Organizations):</p> <ul style="list-style-type: none"> • Research process has forged strong educational partnerships among business, government and community organizations that facilitate linkages between sectors such as economic development and educational programming. • Reduced time and cost for group decision-making processes. • Catalyzed the creation of a self-sustaining community of practice among “groupware” users. • Augmented the skill-set and “tool-kit” available to facilitators across sectors.

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<p>Wireless Tags Track Patients, Staff and Equipment in Long-term Care Settings</p> <p>Research and development leading to the creation of wearable tag locators to monitor the location of patients, staff and equipment in long-term care facilities</p>	<p>Fleming College, Peterborough, ON</p>	<p>WIMCare (Wireless Interactive Medicine Care), Toronto, ON - \$462,000</p> <p>CITO - \$97,440</p> <p>CFI - \$389,733</p> <p>OIT - \$389,733</p> <p>Fleming College - \$106,239</p> <p>DapaNet, Markham, ON - \$9,545</p> <p>MicroAge, Tempe, AZ - \$5,000</p> <p>Mitel, Kanata, ON - \$34,497</p>	<ul style="list-style-type: none"> Research and development of wireless technology platforms and wearable tag locators resulted in proof-of-concept for a personal locator system that monitors the location of patients, staff and equipment in long-term care facilities. Prototype wearable tag that provides a reference design for subsequent miniaturization. Creation of a licensed algorithm (program rules) and software engine (code that can be incorporated into other software) that tracks patient movements. Locator tags can seamlessly transfer information between wireless data and cell-phone-based networks. Locator tags can transmit indoor and outdoor locations. Locator tags can issue an alert message triggered by patients or staff requiring assistance. 	<p>Information and Communication Technologies:</p> <ul style="list-style-type: none"> Prototype for this cost-effective, broadly deployable device was readily commercialized to track indoor and outdoor location of patients, staff and equipment in long-term care and other healthcare settings. WIMCare has completed the miniaturization, manufacturing, and marketing of the product. <p>Health Care:</p> <ul style="list-style-type: none"> Product provides long-term care patients with greater freedom of movement within their facilities. Reduces the number of medical devices needed in facilities (e.g. intervenus infusers, patient lifts) by providing instant access to the location of available equipment. <p>HQP:</p> <ul style="list-style-type: none"> Students in the Applied Computing and Engineering program gained hands-on experience in setting up experiments, software testing, analysing data, programming, and hardware development.

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<p>Low Cost Internet Access Strategies for Rural and Remote Communities Using Wireless Technologies</p> <p>Applied research to develop two low cost, robust rural/remote area wireless broadband network configuration prototypes that provide reliable, locally supported internet access for rural and remote communities in Canada and developing countries.</p>	<p>Algonquin College, Ottawa, ON</p>	<p>Canadian International Development Agency (CIDA) – Science and Technology Group - \$25,000</p> <p>Industry Canada (Broadband for Rural and Northern Development initiative) - \$25,000</p> <p>National Capital Institute of Telecommunications (NCIT) - \$25,000</p> <p>Network Planning Systems Inc., Ottawa, ON [industrial partner]</p> <p>Algonquin College - \$25,000</p>	<ul style="list-style-type: none"> • Feasibility demonstrated: Wireless broadband network prototypes were successfully configured for First Nations Communities in Canada and rural and remote communities in Asia Pacific suitable for unique conditions of climate, power supply, terrain and maintenance, using “off-the-shelf” low cost technologies (under \$5,000). • Compatibility of system with solar and wind generated sources of energy was demonstrated. • Rural and remote “test” communities obtained access to the Internet, e-mail, and voice-over IP and multi-media communications. • Simple instruction manual produced suitable for users with minimal technical skill to support wireless (WiFi) local area network (LAN) system assembly and maintenance. • Configured hardware and software system is licensed. • Instruction manual is copyrighted. • A publication is being developed for submission to the Institute for Electrical and Electronic Engineers. 	<p>Telecommunications:</p> <ul style="list-style-type: none"> • Identified cost-effective, locally maintainable wireless Internet configurations that can increase use of the Internet in previously unserviceable rural and remote areas of the world. <p>Regional and International Social and Economic Development Agencies:</p> <ul style="list-style-type: none"> • The simple manual for set-up and maintenance of a wireless LAN system can be globally distributed by Regional and Industrial Development Offices of Federal/ Provincial / Territorial (FPT), Local and Municipal governments as well as international aid and development agencies. • Individual communities can easily adapt existing resources to use these research findings to connect to the Internet. <p>HQP:</p> <ul style="list-style-type: none"> • Students in the Telecommunications Engineering Technology program were key team members and gained valuable exposure to government officials, applied research and testing, and applied field research. • Some students involved in this project were subsequently hired by the Communications Research Centre Canada, an agency of Industry Canada.

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<p>Wireless File Sharing</p> <p>Develop wireless software applications to support automatic multi-directional file sharing and data streaming among multiple users with minimal pre-configuration requirements and appropriate data security</p>	<p>St. Lawrence College, Kingston, ON</p>	<p>Communications Information Technology Ontario Network (CITO) - \$100,000</p> <p>Kingston Software Factory, Kingston, ON - \$50,000</p> <p>St. Lawrence College - \$12,500</p>	<ul style="list-style-type: none"> • Development of proof-of-principal software application framework demonstrating exchange of secure and non-secure static file sharing and dynamic streamed data exchange among predetermined group of wireless device users using existing technologies. • New software written to manage connections, exchanges and interfaces between user machines that automatically adjusts for recipient capacity, battery life, speed of transmission and content over time. • Proof-of-principal re: intelligent relay capacity among wireless devices within the user group. • Software “tool-kit” for file sharing, data streaming and security control for teams / workgroups. 	<p>Information Technology/Software:</p> <ul style="list-style-type: none"> • Kingston Software Factory applying research outcomes to a range of new applications including healthcare team data-sharing at the bedside. • New product ready for market expected by early 2005. • Contributes to development of the “high tech” economy in Kingston. <p>Education:</p> <ul style="list-style-type: none"> • St. Lawrence College developing applications for the classroom setting. <p>HQP:</p> <ul style="list-style-type: none"> • St. Lawrence Computer Engineering Technology students gained in-depth knowledge about wireless communications and invaluable new team-based research and development experience. • St. Lawrence now has a technology lab that can be used to undertake additional research.

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<p>Internet-based Curricula for Secondary School Teacher In-service Education</p> <p>Develop, apply and evaluate on-line learning programs to meet the professional development needs of Ontario secondary school teachers of “broad based” technological subjects, arising from Ministry of Education curricular innovations.</p>	<p>Seneca College, Toronto, ON</p>	<p>York University, Institute for Research on Learning Technologies – in-kind</p> <p>TV Ontario – in-kind</p> <p>IBM Canada & Global Furniture - \$13,891</p> <p>CFI - \$76,035</p> <p>OIT - \$76,035</p>	<ul style="list-style-type: none"> • Seven learning modules related to Ontario secondary schools’ “broad based technology” curricula. • Creation of copyrighted templates for the development of a range of on-line professional development training courses for teachers. • Identification of best practices and processes in developing and delivering on-line, in-service teacher education. 	<p>Education:</p> <ul style="list-style-type: none"> • 14 Professional Learning Credits were granted by the Ontario College of Teachers for the seven learning modules created for professional development of secondary school teachers of “broad based” technological subjects. • Licensing arrangements are being developed for school boards that will enable them to adapt and tailor the templates to local needs. • The research project catalyzed the establishment of a jointly led Seneca College – York University Technology Enhanced Learning Institute (TELi) to foster and coordinate leading edge research, development, implementation and evaluation of new technologies and applications that enables educators to enhance K-12 and post-secondary education and life-long learning. • Templates are being used by the Seneca – York <i>Technology Enhanced Learning Institute</i> (TELi) in research and development for an additional 20 on-line Additional Qualification courses to be offered by York University's Faculty of Education. <p>HQP:</p> <ul style="list-style-type: none"> • Four students, drawn from the Graphic Design and the Communication Arts programs were involved in the research. • One student was hired on a permanent basis by Seneca College to work on related future projects.

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SUSTAINABLE DEVELOPMENT / ENVIRONMENTAL PROTECTION				
<p>Centre for Alternative Wastewater Treatment</p> <p>The unique research facilities of the Centre for Alternative Wastewater Treatment will enable research on and development of a wide range of constructed wetland wastewater management approaches.</p> <p>Multi-seasonal research focuses on applied research, design, testing and development of constructed wetlands and other sustainable methods of water and wastewater management suitable for cold climates.</p>	<p>Fleming College, Lindsay, ON</p>	<p>SGS/Lakefield Research, Lakefield, ON (global environmental testing and consulting organization) – \$21,000</p> <p>Siemens/Milltronics, Peterborough, ON (electrical engineering and electronics components corporation)</p> <p>Kawartha Innovation Centre, Lindsay, ON</p> <p>Dionex Canada, Oakville, ON - \$10,000</p> <p>Varian Canada, Mississauga, ON - \$110,000</p> <p>Trent University – Watershed Sciences Centre and DNA Cluster teams</p> <p>Ontario Ministry of Natural Resources</p> <p>CFI and OIT - \$1.7 million</p> <p>Fleming College - \$195,000</p>	<p>The research undertaken at the Centre for Alternative Wastewater Treatment will:</p> <ul style="list-style-type: none"> Identify affordable, sustainable biological wastewater treatment options tailored to homes, municipalities, and industries operating in the Canadian climate. Provide proof of the sustainability and safety of constructed wetland wastewater treatment systems in the Canadian climate. Develop a modularized wetlands management system that can be scaled to meet different needs. <p>This project is in start-up mode.</p>	<p>Pharmaceutical and Aquaculture Sectors:</p> <ul style="list-style-type: none"> Commercial and industrial use of constructed wetlands wastewater management systems can remove organic compounds such as polycyclic aromatic hydrocarbons (PAHs), metals and other contaminants from waste water. <p>Sustainable Development:</p> <ul style="list-style-type: none"> Constructed wetlands wastewater management systems can enable installation of municipal and residential small scale wastewater treatment systems that: <ul style="list-style-type: none"> Provide “green” solutions to waste management Reduce energy use Purify water returned to the water table Remove contaminants not treated by conventional systems Protect groundwater and surface water quality. <p>Public Education:</p> <ul style="list-style-type: none"> The Centre acts as a clearinghouse for dissemination of information to the public about constructed wetland wastewater management strategies and how to build and maintain them. The Centre has provided educational tours of its research facilities to schools, community groups and the general public. <p>HQP:</p> <ul style="list-style-type: none"> Students in the Environmental Technology program involved in all aspects of the research and public education undertaken at the Centre.